Bazian

# Appendix F: Evidence tables

Contents

## List of Abbreviations

| Abbreviation | Full |
|---|---|
| AS | Artificial sweetener |
| BMI | Body mass index |
| CASP | Critical Appraisal Skills Programme |
| CHD | Coronary heart disease |
| CI | Confidence interval |
| CKD | Chronic kidney disease |
| CVD | Cardiovascular disease |
| D | Study design |
| d | day |
| DARE | Database of Abstracts of Reviews of Effects |
| DEXA | Dual-energy X-ray absorptiometry |
| DQI | Dietary Quality Index |
| FO | Food only |
| FFQ | Food frequency questionnaire |
| FD | Food and drink |
| GRADE | Grading of Recommendations Assessment, Development and Evaluation |
| HFCS | High fructose corn syrup |
| HR | Hazard ratio |
| kg | kilograms |
| lb | Pound (weight) |
| LDL | Low-density lipoprotein |
| MD | Mean difference |
| MDS | Mediterranean Diet Score |
| MDP | Mediterranean Diet pattern |
| MED | Mediterranean Diet |
| MJ | Megajoule |
| MPA | Moderate physical activity |
| MVPA | Moderate to vigorous physical activity |
| n | number |
| NNT | Number needed to treat |

| Abbreviation | Full |
|---|---|
| NR | Not reported |
| NS | Not significant |
| O | Outcome |
| OR | Odds Ratio |
| OECD | Organisation for Economic Co-operation and Development |
| oz | Fluid ounce |
| P | Population |
| PA | Physical activity |
| PAF | Population attributable fraction |
| PAL | Physical activity level |
| PRISMA | Preferred Reporting Items for Systematic Reviews and Meta-Analyses |
| RCT | Randomised controlled trial |
| Q | quintile |
| RFS | Recommended Foods Score |
| RR | Relative risk |
| SD | Standard deviation |
| SE or SEM | Standard error or Standard error of the mean |
| Set | Setting |
| SFT | Skinfold thickness |
| SMD | Standardised mean difference |
| SR | Systematic review |
| T2D | Type 2 diabetes |
| TEI | Total energy intake |
| USDA | US Department of Agriculture |
| VPA | Vigorous physical activity |
| WC | Waist circumference |
| WCRF | World Cancer Research Fund |
| WHR | Waist to hip ratio |
| WMD | Weighted mean difference |
| y | year |
| zBMI | BMI z score |

## List of prioritised reviews for each behaviour/factor

| Behaviour/factor | Prioritised reviews |
|---|---|
| **4.1 Physical activity and exercise** | |
| 4.1.1Active leisure or recreation | Summerbell et al. 2009 [++]<br>te Velde et al. 2012 [+] |
| 4.1.2 Sport participation | Nelson et al. 2011 [+] |
| 4.1.3 Active travel or commuting | Saunders et al. 2013 [+]<br>Schoeppe et al. 2013 [++] |
| 4.1.4 Walking | Murphy et al. 2007 [++] |
| 4.1.5 Cycling | Oja et al. 2011 [+] |
| 4.1.6 Activities of daily living | WCRF 2006 [++] |
| 4.1.7 Incidental physical activity | Summerbell et al. 2009 [++] |
| 4.1.8 Strength training | Benson et al. 2008 [+]<br>Ismail at al. 2012 [++] |
| 4.1.9 Aerobic exercise | Kelley and Kelley 2006 [++]<br>Laframboise and Degraauw 2011 [+]<br>te Velde et al. 2012 [+]<br>Ismail at al. 2012 [++] |
| 4.1.10 Physical activity intensity, frequency and duration | Murphy et al. 2009 [-]<br>Summerbell et al. 2009 [++]<br>Janssen and Leblanc 2010 [+]<br>Ekelund et al. 2012 [+] |
| **4.2 Sedentary behaviour** | |
| 4.2.1 Amount of sedentary time | Summerbell et al. 2009 [++]<br>van Uffelen et al. 2010 [+] |
| 4.2.2 Screen time | US Department of Agriculture (USDA) 2010 [++]<br>Costigan et al. 2013 [++]<br>Leblanc et al. 2012 [++]<br>Tremblay et al. 2011 [++] |

| | |
|---|---|
| 4.2.3 More active screen time | Leblanc et al. 2013 [+] |
| **4.3 Food and drinks** | |
| 4.3.1 Sugar sweetened beverage consumption | Malik et al. 2013 [++]<br>Kaiser et al. 2013 [++] & Mattes et al. 2011 [++]<br>Te Morenga et al. 2013 [++]<br>USDA 2010u [++] |
| 4.3.2 Fruit juice consumption | Summerbell et al. 2009 [++]<br>USDA 2010s [++] |
| 4.3.3 Water consumption | Muckelbauer et al. 2013 [++]<br>Summerbell et al. 2009 [++] |
| 4.3.4 Tea and coffee consumption | Summerbell et al. 2009 [++] |
| 4.3.5 Alcohol consumption | Bendsen et al. 2013 [+]<br>Sayon-Orea et al. 2011 [+]<br>Summerbell et al. 2009 [++]<br>USDA 2010x [++] |
| 4.3.6 Milk and other dairy food consumption | Abargouei et al. 2012 [++]<br>Louie et al. 2011 [++]<br>USDA 2010r [+] |
| 4.3.7 Whole grain consumption | Bautista-Castano and Serra-Majem 2012 [++]<br>Pol et al. 2013 [++]<br>WCRF 2006 [++] |
| 4.3.8 Refined grain consumption | Bautista-Castano and Serra-Majem 2012 [++]<br>Fogelholm et al. 2012 [+]<br>Summerbell et al. 2009 [++] |
| 4.3.9 Fruit and vegetable consumption | Summerbell et al. 2009 [++]<br>USDA 2010e [+]<br>USDA 2010t [++] |
| 4.3.10 Meat consumption | Fogelholm et al. 2012 [+]<br>Summerbell et al. 2009 [++]<br>USDA 2010n [+] |
| 4.3.11 Fish consumption | Summerbell et al. 2009 [++] |

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|---|---|
| 4.3.12 Legume consumption | Summerbell et al. 2009 [++]<br>USDA 2010o [+] |
| 4.3.13 Nut consumption | Flores-Mateo et al. 2013 [+]<br>Fogelholm et al. 2012 [+]<br>Summerbell et al. 2009 [++] |
| 4.3.14 Specific dietary patterns | Fogelholm et al. 2012 [+]<br>Kastorini et al. 2011 [+]<br>Vadiveloo et al. 2013 [+]<br>Smithers et al. 2011 [+]<br>Kuhl et al. 2012 [-] |
| 4.3.15 Vegetarian or vegan diet consumption | USDA 2010v [+] |
| **4.4 Energy and nutrients** | |
| 4.4.1 Total fat consumption | Hooper et al. 2012 [++]<br>Summerbell et al. 2009 [++]<br>USDA 2010y [++] |
| 4.4.2 Total protein consumption | Santesso et al. 2012 [++]<br>Schwingshackl and Hoffmann 2013 [++]<br>Summerbell et al. 2009 [++] |
| 4.4.3 Total carbohydrate consumption | Summerbell et al. 2009 [++] |
| 4.4.4 Glycaemic index/load of the diet | USDA 2010j [+] |
| 4.4.5 Fibre consumption | Summerbell et al. 2009 [++]<br>Wanders et al. 2011 [+]<br>Ye et al. 2012 [+]<br>USDA 2010w [++] |
| 4.4.6 Energy density of the diet | Fogelholm et al. 2012 [+]<br>Johnson et al. 2009 [+] |
| 4.4.7 Non-nutritive sweetener consumption | Wiebe et al. 2011 [++]<br>Summerbell et al. 2009 [++]<br>USDA 2010c [+]<br>Brown et al. 2010 [-] |
| 4.4.8 Dietary sugar consumption (sucrose, glucose, fructose, high fructose corn syrup) | Te Morenga et al. 2013 [++] *(dietary sugars)*<br>Sievenpiper et al. 2012 [++] *(fructose)*<br>Wiebe et al. 2011 [++] *(fructose, glucose, sucrose)* |

| | |
|---|---|
| 4.4.9 Catechins consumption | Phung et al. 2010 [++] |
| 4.4.10 Caffeine consumption | Summerbell et al. 2009 [++] |
| **4.5 Eating patterns** | |
| 4.5.1 Eating meals prepared outside of home (eating out/take away meal/fast food) | Bezerra et al. 2012 [++]<br>*(eating out of home)*<br>Mesas et al. 2012 [+]<br>*(eating out of home, fast food intake, takeaway food intake)*<br>Rosenheck 2008 [+]<br>*(fast food consumption)*<br>Summerbell et al. 2009 [++]<br>*(fast food consumption)*<br>USDA 2010i [+]<br>*(eating out of home)* |
| 4.5.2 Eating occasions (eating frequency) | Mesas et al. 2012 [+] |
| 4.5.3 Eating patterns (e.g. timing of eating, consistency across the week) | Summerbell et al. 2009 [++] |
| 4.5.4 Family meals | Hammons and Fiese 2011 [+] |
| 4.5.5 Breakfast consumption | Mesas et al. 2012 [+]<br>USDA 2010f [+] |
| 4.5.6 Snack consumption | Mesas et al. 2012 [+]<br>USDA 2010m [+]<br>Larson and Story 2013 [+]<br>Summerbell et al. 2009 [++] |
| **4.6 Other factors** | |
| 4.6.1 Sleep | Chen et al. 2008 [+]<br>Magee and Hale 2012 [+] |
| 4.6.2 Monitoring | Bravata et al. 2007 [+] |
| 4.6.3 Support | Cunningham et al. 2012 [+] |
| **4.7 Primary studies and other evidence** | |
| 4.7.1 Meal setting or distractions | Robinson 2013 [+] |
| 4.7.2 Drinks with meals | Daniels and Popkin 2010 [+] |

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|---|---|
| 4.7.3 Holiday weight gain | Yanovski et al. 2000 [+]<br>Cook et al. 2012 [+]<br>Wagner et al. 2012 [-]<br>Moreno et al. 2013 [+] |
| 4.7.4 Stress minimising activities | Wardle et al. 2011 [++] |

# Full data extractions

Data extraction tables for each behaviour /factor are presented within each of the 6 sections alphabetically by behaviour /factor name.

## Physical activity and exercise

**Active leisure / recreation**

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 25 (17, n=265,337 adults/8, n=1,956 children)<br>Other: 1 (case cohort)<br><br>**Intervention/exposure description:**<br>Adults<br>Types of physical activity assessed varied across the studies and included: total LTPA; high, moderate or low intensity LTPA; PA Index (intensity x duration x monthly frequency); leisure time activity index (not further described); 'time on activity' (not otherwise specified); sport and leisure activity; mean level of sport/exercise; recreational PA (operationalized as MET hours per week, mean blocks walked/day, mean hours of vigorous PA/day, mean stairs climbed/day); recreational activities (including jogging/running, | **Result(s):**<br>Adults<br>Follow-up ranged from 1 to 11 years. The majority of studies had a follow-up period of 1 to 3 years.<br><br>Participant age at baseline ranged from 19 to 88 years. Four studies included women only, four included men only, and eight were in mixed sex samples.<br><br>In the four studies that included only female participants, one study (n=9, 357) found a significant inverse relationship between LTPA level and change in BMI over 11 years (mean difference between high and low LTPA: -0.18, 95% CI -0.32 to -0.05). One study (n=3,604) reported a significant inverse association between mean sport/exercise level and 3-year weight gain and WC increase (Regression coefficient -2.76 [units NR] (95% CI -3.47 to -2.05, p< 0.0001), regression coefficient -0.32 [units NR] (95% CI -0.48 to -0.16, p<0.0001). One study in post-menopausal women (n=18,583) found that high recreational PA (>18 | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: P<br>Partial: D<br>Unclear: Set<br><br>**Authors' limitations:**<br>No factor specific limitations were reported. Across physical activity studies, reported limitations inlcuded:<br>Inprecise exposure measurement (majority of studies used self-report measures) and difficulty capturing the complexity of PA using these instruments.<br><br>Use of change in PA as a measure of the exposure (measured at baseline and follow-up) in some studies renders analysis of the association between PA and weight cross-sectional and retrospective, regardless of the prospective cohort design.<br><br>Included studies adjusted for a wide variety of potential confounding variables; it is, however, not possible to account for all |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| | aerobics/callisthenics, gardening/mowing/planting, walking, tennis/racquetball); regular walking.<br><br>Assessment of active leisure and recreation included Baecke PA scale questionnaire, and self-report questionnaire (not further specified, and used in the majority of studies).<br><br>Children<br>Types of physical activity assessed varied across the studies and included: sport participation, active leisure time index (not further described), leisure sport activities, sport, aerobic activity, outside play, exercising, and LTPA levels (not otherwise specified).<br><br>Methods of exposure assessment varied across the studies and included: questionnaire, parent report of child's structured activities compared with other children of the same age and sex.<br><br>**Outcome(s):**<br>Adults<br>Outcomes included: BMI, obesity, WC, skinfold, WHR, % body fat, BMI>=26, weight gain of 10lb or more over 10 years, and weight gain of 5kg or more over 10 years.<br><br>Outcome measurement varied across studies and included: objectively assessed height | METhrs/wk.) was associated with significantly reduced likelihood of a 10lbs or greater 7-year weight gain compared to low recreational PA (>0 to <4 METhrs/wk.) (OR 0.88, 95% PI 0.77 to 0.99). One study in premenopausal women (n=353) reported no significant association between recreational PA and weight gain of 10 pounds or more over 10 years (data not reported).<br><br>In the four studies that included only male participants, one study (n=6,749) reported no difference in change in BMI over 11 years between high and low LTPAL groups; any LPTA at baseline had a significant inverse associations with BMI (versus no LTPA; regression coefficient -0.116 (95% CI -0.195 to -0.037). Moderate LTPA at baseline had a significant inverse association with BMI (versus low LTPAL; regression coefficient -0.13 (95% CI -0.213 to -0.046). No significant association was seen between high LTPAL at baseline and BMI at follow-up, compared to low baseline LTPAL. When assessing baseline LTPA intensity, a significant positive association was seen with BMI at follow-up amongst participants with low compared to high baseline LTPA intensity (regression coefficient 0.146, 95% CI 0.038 to 0.254). One study reported an inverse association between baseline LTPA and WHR (r=-0.06) and WC (r=-0.79) and % body fat (r=-0.4) at five year follow-up (p-value NR for all outcomes). | confounders, especially given the complex relationship between PA and weight gain. Imprecise measurement of included covariates can result in residual confounding.<br><br>More recent studies (published after 2000) tend to find the expected inverse assocation between PA and weight; this may be due to a tendency towards larger sample sizes and resultant higher statistical power, better adjustment for confounders, better measurement of exposure, or high potential for publication bias.<br><br>**Review team limitations:**<br>Sample size of included cohort studies ranged from n=132 to n=184,448 in adults, but was consistently small (n<300) in child studies.<br><br>The review did not report which confounders were adjusted for in the individual studies, therefore this could not be taken into account in the interpretation of their results. One study was a case cohort and is not summarised in the results. The setting of the majority of the studies in unclear. The majority of participants in one study were former elite athletes, and a high proportion of the cohort were physically active. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| | and weight (infrequent across studies); interview; self-administered questionnaire; survey; self-reported weight, height and weight gain.<br><br>Children<br>Outcome measurement varied across studies and included: weight, BMI, % body fat, WC, WHR, skinfold ratio, subscapular skinfold thickness.<br><br>Methods of outcome assessment in children were not reported. | One study reported a significant inverse association between high intensity LTPA and five year change in BMI (r=-0.103 (yes vs. no high intensity LTPA), 95% CI -0.174 to -0.032), but no significant association between moderate or low LTPA and change in BMI (data NR). One study in middle-aged and old men (most of whom were who were former elite athletes) (n=1,143) reported a significant association between increase LTPA and weight loss over 10 years (regression coefficient -1.27, 95% CI -2.35 to -0.19, p=0.02).<br><br>In the eight studies with mixed sex samples, one study (n=12, 669) reported a significant increased risk for substantial weight gain over median 5.7 years in the rare vs. frequent leisure PA groups (men: RR 1.9, 95% CI 1.5 to 2.3; women: RR 1.6, 95% CI 1.2 to 2.2).<br>One study (n=184,448) reported significant associations between a variety recreational activities and 10 year change in BMI and weight at the waist. In men, significant decreases in BMI were seen for recreational activities including jogging/running, aerobics/callisthenics, gardening/mowing/planting, and walking 4hr/week or more (change in BMI ranged from -0.08 to -0.34 kg/m2). No significant association was found for tennis/racquetball and BMI (data NR). Significant decreases in odds of waist weight gain were found in men | |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| | | for jogging/running, aerobics/callisthenics and walking 4hr/week or more (OR ranged from 0.57 to 0.89), but not for gardening/mowing/planting or tennis/racquetball (data NR). In women, significant associations were found for aerobics/callisthenics, gardening/mowing/planting, and walking 4hr/week or more (change in BMI ranged from -0.14 to -0.27 kg/m2). No significant association was found for jogging/running or tennis/racquetball and BMI (data NR). Significant decreases in odds of waist weight gain were found in women for aerobics/callisthenics and walking 4hr/week or more (OR ranged from 0.28 to 0.84), but not for jogging/running, gardening/mowing/planting or tennis/racquetball (data NR).<br>Another study (n=3,897) reported a significantly higher mean weight gain over 10 years in men but not women who were physical inactive vs. those who were physically active (1.2kg (whether between or within group NR), 95% CI 0.4 to 2.0; p=0.001). Odds of a weight increase of 5kg or more BMI greater than or equal to 26kg/m2 at follow-up was not associated with LTPA energy expenditure at baseline (low vs. high LTPAEE). In women but not men, the odds of this outcome were higher for those with no regular weekly activity at baseline vs. vigorous activity twice a week or more (OR 1.63, 95% CI 1.02 o 2.59). | |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| | | One study (n=287) reported significant associations between baseline leisure activity and 3-year weight loss in women but not men (regression coefficient -6.181, 95% CI -9.41 to -2.95, p=0.0003). Baseline sport activity was not significantly associated with weight change in men or women.<br>Another study (n=121) reported no significant association between baseline sports in leisure activity and 2 year change in waist circumference.<br>One study (n=602) reported no significant association between baseline activity time and 7 year change in body composition.<br>One study (n=9,325) reported no significant association between recreational activity at baseline and odds of 10 year weight gain.<br>One study (n=5,846) reported that LTPA was significantly associated with odds of developing obesity over 10 years in men but not women (OR [high vs. low baseline LTPA*] 1.98, 95% CI 1.03 to 3.6).<br>* reported as high vs. low, unclear if this is the correct formula (i.e. high LTPA association with 98% increased odds of obesity at 10 years) or if OR was actually calculated as low vs. high LTPA).<br><br>Children<br>Eight studies (n=1,956) assessed the association with various types of leisure and recreational PA and weight related outcomes). Baseline age varied between 4 to 16 years, and follow-up time ranged from 1 | |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| | | to 37 years.<br><br>One study (n=166) reported that sports participation in childhood was not significantly associated with weight related outcomes in adulthood (data NR).<br>One study (n=278) found that participations in two or more leisure sport activities during adolescence was not significantly associated with elevated BMI (>= 27kg/m2) or WHR (>=0.95 in men or >=0.85 in women) in adulthood (data NR).<br>One study (n=168) found that aerobic activity during pre-school was significantly associated with a 2 year decrease in BMI (regression coefficient -0.316, p=0.03).<br>One study (n=314) found that no sports participation outside of school was associated with significantly increased odds of BMI change >=90th percentile change in boys but not girls (OR 2.14, 95% CI 0.96 to 4.77).<br>One study (n=198) found that outside play was significantly inversely associated with subscapular skinfold thickness at 2 years in boys but not girls (r=-0.26, p<0.05). Community sports involvement was associated with the outcome in girls but not boys (r=0.21, p< 0.05), and summer sports activities were associated with the outcome in both sexes (girls r=0.21, p<0.05; boys r=0.32, p<0.01).<br>One study (n=41) reported no significant association between PA and 1-year change in | |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| | | BMI z-score (data NR).<br>One study (n=355) found that recreational PA was inversely associated with 4 year change in BMI (regression coefficient -0.08, p<0.05). The number of hours/week spent in sport or exercising was not significantly associated with follow-up BMI, however.<br>The final study (n=436) found that high LTPAL (vs. low LTPAL) was significantly positively associated with BMI at two year follow-up (high: 19.7 kg/m2 vs. low: 19.4kg/m2, p-value for difference=0.04). No significant associations were seen for % body fat, skinfolds or WC.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The review concluded that physical activity, in general, is not associated with excess weight gain or obesity over time, with studies reporting total PA resulting in no effect or a small inverse association with excess weight gain. Conflicting results were reported in studies in both children and adults. No factor specific conclusions were drawn regarding active leisure/recreational PA. | |
| **te Velde et al. 2012**<br><br>**Quality:** +<br><br>**Search date:** Jun 2010 | **Study participant inclusion criteria:**<br>Children aged 4 to 6 years.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0 | **Result(s):**<br>Children<br>Three studies were identified, with the mean baseline age of participants ranging from 4.4 years to 6, and study follow-up between 3 | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| **Review design:**<br>Systematic review of prospective cohort and intervention studies.<br><br>**Review aim:**<br>To identify dietary, physical activity and sedentary behaviours in preschool children (aged 4 to 6 years) that are prospectively related to overweight and obesity in later childhood.<br><br>**Review funding:**<br>Seventh Framework Programme of the European Commission<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | Cohort: 3 (3, n=529)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Exposures included: PA of child's structured leisure time, leisure activity compared to other children; Hours spent outdoors during warmer/cooler months (week- and weekend-day); average hours of the past year of sports or recreational PA.<br><br>Assessed via parental report<br><br>**Outcome(s):**<br>BMI, BMI z-scores, body composition<br><br>Objectively measured (DEXA only reported method) | and 5 years.<br><br>One study (n=203) (Klesges 1995) reported that increases in children's leisure activity was associated with decreases in subsequent weight gain (t=-1.727, p=0.08). (This study was also included in Summerbell et al. 2009 [++], which reported on the results from this study on aerobic activity as part of its "recreational physical activity" section and reported n=168)<br><br>One study (n=188) found "very little evidence of an association between time spent outdoors and BMI z-scores" (data NR).<br><br>One study (n=138) found that the number of recreational activities at baseline was inversely correlated with % body fat and weight at follow-up (data NR).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Insufficient evidence was found to draw conclusions regarding the association between leisure activity and overweight. | Unclear: P, Set<br><br>**Authors' limitations:**<br>Only a few studies (from the total review) were of high methodological quality and used valid and reliable measures for energy balance related behaviours.<br><br>**Review team limitations:**<br>Parental report of child leisure/recreational activity was used for exposure measurement in all relevant studies.<br><br>Unclear whether relevant studies included participants based on their weight status. Unclear whether PA was assessed in school settings.<br><br>Review did not consistently report adjustment for confounders in the individual studies. |

Activities of daily living

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| **WCRF 2006**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2005<br><br>**Review design:**<br>Systematic review of prospective cohorts of more than 1 year, RCTs of any length and systematic reviews for the area of TV viewing.<br><br>**Review aim:**<br>What are the food, nutrition and physical activity related causes of weight gain, overweight and obesity in humans?<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>Funding is reported for some but not all included studies e.g. international governmental bodies, charities, industry, pharmaceutical companies.<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 3 (3, n=54,169 adults)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Household activities, including household and caregiving physical activity, walking or standing in the home, or household activity.<br><br>Exposure was assessed with self-report questionnaires where reported.<br><br>**Outcome(s):**<br>Weight, WC, obesity, obesity over 3 to 6 years.<br><br>Weight was self reported in 1 study, and assessment method NR in other studies. | **Result(s):**<br>Adults:<br>One study (n=3,604) reported a non-significant positive relationship between household and caregiving physical activity and weight (regression coefficient: 0.43, p=0.30) and WC over 3 years (regression coefficient: 0.17, p=0.20; units NR).<br>A second large cohort study (n=50,277) reported a large reduction in risk of obesity over 6 years among women who spent 40 hours or more per week walking or standing in the home compared to 0-1 hour per week (RR 0.77, 95% CI 0.61 to 0.96).<br>A third cohort (n=288) found that household activity was associated with a non-significant reduction in WC over 5 years (regression coefficient: -0.03, p=0.07; units NR). It is unclear whether this study was sufficiently powered to detect an effect.<br><br>Children: No studies were identified in children.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>No specific conclusions drawn on household activity. | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>None reported spe ifically for household activity.<br><br>**Review team limitations:**<br>It is unclear whether the smallest study (n=288) was sufficiently powered to detect an effect.<br><br>Funding sources for the individual studies in the review as a whole were reported to include food manufacturers, food industry-related organisations, pharmaceutical companies as well as non-food related funding organisations and governmental organisations (e.g. the US Department of Agriculture).<br><br>The review did not consistently report on whether there was adjustment for confounding in the individual studies, and what was adjusted for.<br><br>Population: Unclear.<br>Setting: Not reported |

Active travel/commuting

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| **Saunders et al. 2013**<br><br>**Quality:** +<br><br>**Search date:** Nov 2012<br><br>**Review design:**<br>Systematic review of non-randomised and randomised controlled trials and prospective observational studies<br><br>**Review aim:**<br>This study aimed to assess the evidence that active travel has significant health benefits<br><br>**Review funding:**<br>National Institute for Health Research, Public Health Research Program<br><br>**Study funding:**<br>Funding sources were not reported<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Normal and overweight children and adults in the general population.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 3 (2, n=282 adults)<br>Cohort: 16 (5, n=4,149 children)<br>Other: 2 (0)<br><br>**Intervention/exposure description:**<br>1 RCT looked at cycling 3km each way three times a week for 6 months and the other active commuting for 10 weeks - walking 2.4km or 9.7km cycle. The cohorts measured active travel to school - either cycling or walking.<br><br>**Outcome(s):**<br>Active travel to school was self-reported. BMI and skinfold thickness were recorded. Follow-up was between 6 months and 6 years. | **Result(s):**<br>Children:<br>The results were mixed. Two of the cohort studies found no significant difference in travel mode to school and BMI though active travel had an average z-score 0.3 (p=0.003) SD lower than other children. 1 found that children who continued to cycle throughout the study were less likely to be overweight OR 0.44 (0.21,0.88). The OR of being overweight was 3.19(1.41,7.24) in children that stopped cycling, compared to no cycling 1.05(0.57,1.59) and started cycling 1.22 (0.40,3.70).<br>1 cohort study found children who took up cycling had significantly lower waist circumference. The last study reported that after adjusting for baseline BMI the partial r=0.03 p<0.05. For overweight children partial r=0.10 p<0.05. For normal weight children, no significant relationship for BMI.<br><br>Adults:<br>Both RCTs found no significant weight change.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The studies identified did not enable them to draw strong conclusions. No studies were identified with obesity as an outcome in | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D, P<br>Partial: Set<br>Unclear: None<br><br>**Authors' limitations:**<br>"Active travel" was not defined consistently across studies. There were high dropout levels in some studies. Journey times were relatively short, and there is a difficulty in disentangling the effects of active travel from more general physical activity. There was variation in the potential confounding factors adjusted for in the different studies but the adjustments did not have large impacts on effect size.<br><br>**Review team limitations:**<br>The study design was assessed as weak in all of the relevant studies. The frequency and duration of active travel/commuting was self-assessed and may not have been reliable.<br><br>Adjusted figures were reported in the review where available, but specific confounders adjusted for were not always reported.<br><br>Setting: Partial: Includes school and workplace based studies |

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| | | adults. Two RCTs in adults found no significant change in body weight with active travel. One of five prospective cohort studies in children found an association between obesity and active travel. | |
| **Schoeppe et al. 2013**<br><br>**Quality:** ++<br><br>**Search date:** March 2012<br><br>**Review design:**<br>Systematic review of cross-sectional and longitudinal studies.<br><br>**Review aim:**<br>This review synthesized the evidence for associations of independent mobility and active travel to school and non-school destinations with physical activity, sedentary behaviour and weight status.<br><br>**Review funding:**<br>Australian Research Council (ARC) and the Merri Community Health Services Victoria, the Moreland City Council, Queensland Health and Queensland Transport.<br><br>**Study funding:**<br>Funding sources were not reported.<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Other than children aged 3-18, no detail on the weight or health status was provided as inclusion criteria.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 4 (4, n=4,354)<br>Other: 16<br><br>**Intervention/exposure description:**<br>Self-reported active travel to and/or from school by cycling and/or walking.<br><br>**Outcome(s):**<br>BMI, skinfold thickness and waist circumference were assessed 2 to 12 years later. | **Result(s):**<br>No association was found in one study and mild association was found in the other 3 between active travel and lower anthropomorphic measures.<br><br>In 1 study, children who had stopped cycling to school after 2004 were more likely to be overweight in 2006 (OR = 3.19, 95% CI = 1.41-7.24) than those who continued cycling to school (OR 0.44, 95% CI 0.21 to 0.88), adjusting for weight status in 2004.<br><br>In another study, compared to non-active travellers to school, active travellers had a significantly lower median sum of four skinfolds (ATS 47. 4 mm [36.0-66.6mm] vs. non-ATS 54.8mm [39.3-71.7mm]; p<0.05) and a lower median fat mass (ATS 21.1% [15.6-26.7] vs. non-ATS 22.7% [17.0-28.7%; p<0.05). However, median BMI and overfatness did not significantly differ among ATS and non-ATS.<br><br>In the last study, Kindergarten children who had sustained AT through the grades 1 and 2 had on average lower BMI z-scores (grade 1: 0.18, p = 0.05; grade 2: 0.30, p = 0.003) compared to those who did not sustain AT | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: Set<br>Partial: D<br>Unclear: P<br><br>**Authors' limitations:**<br>Cycling has previously been associated with greater physical fitness in children compared to walking, so may have a greater potential to prevent excessive weight in children - however only 2 studies assessed just cycling.<br><br>**Review team limitations:**<br>The studies were reliant on self-report of active school travel by the child or parent.<br><br>No information was provided on the length of active school travel.<br><br>Confounders were adjusted for in 75% of included studies, but specific confoudners adjusted for in individual studies were not reported.<br><br>Partial: Study design included many cross-sectional studies.<br>Unclear: Population: Children of all weights |

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| | | through grades 1 and 2. However, using the 85th percentile threshold for overweight and obesity, there were no significant associations between sustained AT and being overweight or obese in grade 1 (OR = 0.66, 95% CI: 0.31-1.42, p = 0.29) or grade 2 (OR = 0.95, 95% CI: 0.44-2.05, p = 0.90).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Associations between active school travel and weight status were inconsistent across the studies.<br><br>This was based on all 20 studies that looked at weight outcome. | were included in the search and it is unclear if any were selected for being overweight/obese. |

Aerobic exercise

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Ismail et al. 2012**<br><br>**Quality:** ++<br><br>**Search date:** Nov 2010<br><br>**Review design:**<br>Systematic review of RCTs.<br><br>**Review aim:**<br>To systematically review the effects of aerobic and resistance training in adults on visceral fat.<br><br>**Review funding:**<br>NR<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>Adults aged ≥18 years.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 35 (5, n=402)<br>Cohort: 0<br>Other: 0<br><br>**Intervention/exposure description:**<br>Interventions had to last at least 4 weeks. Any dietary component of the interventions had to be the same in all groups.<br><br>Across studies, there was variation in type, intensity, frequency and duration of aerobic exercise: Most aerobic exercise involved stationary bicycling. Training was for 20-60 minutes, on 1-7 days per week (most commonly 3 days). Intensity ranged between 40-90% of peak aerobic capacity (measured by maximal heart rate, heart rate reserve, or peak oxygen consumption), sometimes starting at the lower end of the range and increasing over time. Most commonly the intesity was 60-75% of maximal heart rate. Aerobic interventions lasted 1 month to 2 years.<br><br>The 5 relevant studies included exercise on mini-trampoline, treadmill (or just jogging), stationary bicycle, rowing machine, or elliptical machine. These were performed at 55%-90% heart rate maximum on for 20-60 | **Result(s):**<br>Overall, aerobic exercise significantly reduced visceral fat compared with control over 1 month to 1 year (29 comparisons, n=NR; effect size -0.33, 95% CI -0.52 to -0.14; p=0.001; random effects analysis excluding one outlier with large effect size).<br><br>The 5 relevant RCTs (total n=402) individually found no significant effects (effect sizes -0.492 to 0.095).<br><br>**Adverse Effects:** NR<br><br>**Conclusions:** Aerobic exercise is key for exercise programmes aimed at reducing visceral fat. Aerobic exercise at the currently recommended levels for improving cardiorespiratory fitness (≥150 minutes per week of moderate intensity aerobic activity) may be sufficient for visceral fat reduction, despite not reaching the levels recommended for overweight/obesity management (not specified). | **Applicable to the UK:** Unclear<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P<br>Unclear: Set<br><br>**Authors' limitations:**<br>Few studies had participant or assessor blinding. Some studies did not describe the control group. Differences in exercise prescriptions contributed to heterogeneity<br><br>**Review team limitations:**<br>Individual studies were small and may have lacked power to detect an effect. Most of the included studies were outside of the scope of the current review and may not apply to the general population.<br><br>**Population:** 21 RCTs were reported to be in overweight or obese participants and 12 were reported to include people with type 2 diabetes or metabolic syndrome. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | minutes on 2-6 days a week, over 16 weeks to 1 year.<br><br>Controls were often not described, but where described included stretching, yoga, dietary intervention (also given to aerobic group), diabetes intervention, education, or maintaining body weight (not further specified).<br><br>**Outcome(s):**<br>Visceral adiposity, assessed by magnetic resonance imaging or computed tomography. | | |
| **Kelley and Kelley 2006**<br><br>**Quality:** ++<br><br>**Search date:** Jan 2006<br><br>**Review design:**<br>Systematic review and meta-analysis of RCTs that examined the effects of 4 weeks or more of aerobic exercise on C-reactive protein.<br><br>**Review aim:**<br>The aim of the systematic review was to use a meta-analytic approach to examine the effects of aerobic exercise on C-reactive protein in adults, whilst limiting included studies to RCTs. Secondary outcomes included changes in body weight, percentage of body fat, and maximum oxygen | **Study participant inclusion criteria:**<br>Adults aged 18 years or older<br><br>**Total # studies (# relevant and n=):**<br>RCT: 5 (2, n=201)<br>Cohort: 0<br>Other: 0<br><br>**Intervention/exposure description:**<br>Aerobic exercise for 4 weeks or more as the only intervention. Across all RCTs included in the review (as it is unclear which reported body weight and body fat), interventions lasted between 8 weeks and 6 years (mean 65.2 weeks) and consisted of between 3 and 5 sessions of exercise per week (mean 4), each lasting between 15 minutes and one hour (mean 34.2 minutes). The intensity of the exercise was described as between 40 and 80% maximum oxygen consumption (3 | **Result(s):**<br>The meta analysis of the 3 intervention groups (n=NR) which reported body weight as an outcome found that aerobic exercise significantly reduced body weight in kg (mean +/- SEM) (-3.4 +/- 1.0, 95% CI -5.3 to -1.5). This was equivalent to a relative reduction of approximately 4% of body weight.<br>The meta analysis of the 3 intervention groups which reported body fat percentage as an outcome found that aerobic exercise significantly reduced body fat percentage (mean +/- SEM) (-1.4 +/- 0.4, 95% CI -2.3 to -0.6). This was equivalent to a relative reduction of approximately 4% of body fat.<br>**Adverse Effects:**<br>NR<br><br>**Conclusions:** | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P<br>Unclear: Set<br><br>**Authors' limitations:**<br>It is probably inappropriate to generalize the results beyond the subject and training program characteristics of the included studies. Only a small number of studies were included.<br><br>**Review team limitations:**<br>Results from 3 intervention groups were used in the body fat and body weight meta-analyses, the number of people in these analyses was unclear.<br>How outcomes were measured was not |

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| consumption.<br><br>**Review funding:**<br>West Virginia University<br><br>**Study funding: NR**<br>Funding sources for the individual studies was not reported.<br><br>**Multifactor review:** No | interventions), 80-90% of age predicted maximum heart rate (1 intervention), 'moderate' intensity (1 intervention) and not reported (1 intervention). Exercise consisted of cycle ergometry in 2 RCTs, walking and jogging in 1 RCT, a variety of activities, including, but not limited to walking, jogging, cross-country skiing, cycling, and swimming in 1 RCT, and simply 'aerobic exercise' in 1 RCT. Exercise sessions were supervised in 2 studies, a mixture of supervised and unsupervised in 2 studies, and unsupervised in 1 study.<br><br>**Outcome(s):**<br>Body weight in kg and percentage body fat. How these outcomes were measured was not reported. | Aerobic exercise reduces body weight and percentage of body fat in adults (conclusions based on the 3 intervention groups that reported these outcomes, respectively; characteristics of the populations of these studies unclear) | reported.<br><br>Effect sizes for the individual studies were not reported, and unclear which studies themeta-analysis included, meaning that it is unclear whether the population studied met the scope.<br><br>1 RCT had 2 intervention groups. Body weight was a reported outcomes for 3 intervention groups, body fat was an outcome for 3 intervention groups. Which RCTs reported these outcomes is NR. Also, one RCT included in the review reported that all participants were overweight, and one reported that some were overweight. Other RCTs recruited participants with comorbidities<br><br>Population: The population of the included RCTs is described. One RCT included in the review reported that all participants were overweight, and one reported that some were overweight. Other RCTs recruited participants with comorbidities. Which RCTs reported body weight and percentage body mass is not reported.<br>Outcome: also reported on maximum oxygen consumption and C-reactive protein.<br>Setting: Not explicitly reported. |
| **Laframboise and Degraauw 2011**<br><br>**Quality:** + | **Study participant inclusion criteria:**<br>Children aged between 0-18 years old. The two studies relevant to the current review | **Result(s):**<br>One trial in average weight participants found that the aerobic exercise intervention | **Applicable to the UK:** Unclear<br><br>**Alignment to NICE review scope:** |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Search date:** Dec 2010<br><br>**Review design:**<br>Systematic review of RCTs of aerobic physical activity interventions in children aged between 0-18 years old that had a measure of adiposity as an outcome.<br><br>**Review aim:**<br>The review aimed to determine the quality of current evidence on the relationship between aerobic physical activity and adiposity changes in school-aged children and youth.<br><br>**Review funding:**<br>NR<br><br>**Study funding:**<br>Funding for individual studies included in the review not reported.<br><br>**Multifactor review:** No | scope were in children aged 9-14 years.<br><br>**Total # studies (# relevant and n=):**<br>RCTs: 10 (2, n=2,184)<br>Cohort: 0<br>Other: 0<br><br>**Intervention/exposure description:**<br>Interventions lasted between 8 and 28 weeks, and consisted of exercise for between 30 and 90 minutes per day on 3 days per week. The intensity of the exercise was not reported in the individual studies.<br><br>Control groups were not described for individual studies. Overall controls were reported as usual level of physical activity (4 studies) and 1 study had a sedentary control group with lifestyle counselling; controls for the other 5 studies were not reported.<br><br>**Outcome(s):**<br>BMI, body composition, skinfold thickness after between 8 and 28 weeks of intervention.<br>How these outcomes were measured was not reported. | (90 minutes, 3 days per week for 28 weeks) decreased BMI (figures NR), the other trial found that a shorter term, shorter aerobic exercise intervention made no change in BMI or body composition (figures NR),. These two trials were the highest quality and best powered studies in the review.<br>Overall, 5/10 studies found a significant improvement in at least one weight related outcome.<br><br>**Adverse Effects:**<br>The review reports that all of the studies included in the review failed to report the important adverse events that may have been a consequence of the intervention.<br><br>**Conclusions:**<br>The review conclusions appear to be conflicting. They concluded that there is a paucity of evidence to support that aerobic physical activity alone had beneficial effects on adiposity (including those with normal body mass and oveweight individuals). However, they go onto state that there is some evidence to support that school-aged children and youth benefit from aerobic physical activity to decrease adiposity and to limit weight gain (conclusions based on all studies, including those in overweight/obese populations and those with Type 1 diabetes). | Complete: D<br>Partial: P<br>Unclear: Set<br><br>**Authors' limitations:**<br>The review lists the following as limitiations: limitations in the included studies, including the fact that the studies predominantly involved young children and there was a lack of homogeneity; possible language bias (only english-language studies included); EMBASE, MANTIS or Cochrane libraries were not searched; only RCTs included.<br><br>**Review team limitations:**<br>Only 2 studies in a relevant population (text says 3, but this is presumably an error as population is stated as being obese in table of study characteristics).<br>Outcome assessment method not reported.<br><br>D: Only RCTs included<br>O: studies must have had an outcome measure that determined adiposity.<br>Population: Only 2 studies were performed in average weight children and adolescents, other studies were performed in overweight/obese children or children with Type 1 Diabetes.<br>Setting: NR |
| **te Velde et al. 2012**<br><br>**Quality:** + | **Study participant inclusion criteria:**<br>Children aged 4 to 6 years. | **Result(s):**<br>Two studies were identified, with the mean baseline age of participants ranging from 4.4 | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:** |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Search date:** Jun 2010<br><br>**Review design:**<br>Systematic review of prospective cohort and intervention studies.<br><br>**Review aim:**<br>To identify dietary, physical activity and sedentary behaviours in preschool children (aged 4 to 6 years) that are prospectively related to overweight and obesity in later childhood.<br><br>**Review funding:**<br>Seventh Framework Programme of the European Commission<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 2 (2, n=8,203)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Exposures included aerobic exercise and opportunity for activity and aerobic activity compared to other children; both were assessed via parental report.<br><br>**Outcome(s):**<br>BMI, objectively measured. | to 6 years, and study follow-up between 3 and 3.5 years.<br><br>One study (n=203) reported that at higher levels of baseline aerobic activity subsequent changes in BMI decreased (t=-2.153, p=0.033).<br><br>One study (n=8,000) report no association between aerobic exercise days/week and either incident or persistent overweight later in childhood (figures NR).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Insufficient evidence was found to draw conclusions regarding the association between aerobic activity and overweight. | Complete: D<br>Partial: P<br>Unclear: Set<br><br>**Authors' limitations:**<br>Only a few studies (from the total review) were of high methodological quality and used valid and reliable measures for energy balance related behaviours.<br><br>**Review team limitations:**<br>The review did not explicitly report whether confounders were adjusted for in the individual studies, which limits ability to interpret study results.<br>One study included both overweight and healthy weight children. |

Cycling

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Oja et al. 2011**<br><br>**Quality:** +<br><br>**Search date:** NR<br><br>**Review design:**<br>Systematic review of observational and intervention studies<br><br>**Review aim:**<br>To update the evidence regarding the health benefits of cycling.<br><br>**Review funding:**<br>Fonds Gensundes Osterreich<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>NR<br><br>**Total # studies (# relevant and n=):**<br>RCT: 4 (0)<br>Cohort: 8 (1, n=18,414)<br>Other: 4 (cross-sectional)<br><br>**Intervention/exposure description:**<br>The single study relevant to the current review assessed self-reported average weekly time spent walking or cycling.<br><br>**Outcome(s):**<br>The majority of included studies assessed non-weight outcomes (e.g. fitness, cancer incidence, mortality).<br><br>The single study relevant to the current review assessed self-reported weight. | **Result(s):**<br>One study of moderate quality (n=18,414) in women aged 25 to 42 years found significant weight change (-1.81kg, 95% CI -2.05 to -1.56) for each 30/min per day increase in brisk walking) but no significant relationship for slow walking.<br><br>The study also found a significant reduction in weight for each 30min/day increase in cycling (-1.59kg, 95% CI -2.0 to -1.08.<br><br>This analysis was adjusted for baseline age, weight and height; other PA, and multiple dietary variables.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Incidence of overweight and obesity decrease with increasing amount of daily cycling, however the evidence for benefits in considered inconclusive based on assessment of study quality (NB. Conclusion based on all assessed studies, not just the study relevant to the current review). | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: P, Set<br>Partial: D<br>Unclear: None<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>There was poor overlap with the current review scope; only one study met study design, population, setting and outcome criteria.<br><br>Study designs included cross-sectional studies. |

Incidental physical activity

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 2 (2, n=3,957 adults)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Adults<br>The two included studies assessed the number of stairs climbed per day and average level of routine daily physical activity; both studies utilised questionnaires to measure PA.<br><br>**Outcome(s):**<br>Adults<br>Outcomes included weight gain of 10lbs or more over 4 years, weight and WC; methods of outcome measurement were not reported. | **Result(s):**<br>Both studies included females only, with a baseline age ranging from 35 to 52 years, and follow-up between four and ten years.<br><br>One study (n=353) found no significant association between the average stairs climbed per day and risk of gaining >=10lbs over 10 years.<br><br>One study (n=3,604) found a significant inverse association between mean levels of routine PA at baseline and weight and WC increase at four year follow-up (regression coefficient -3.31 (95% CI -4.21 to -2.41, p<0.0001) and -0.92 (95% CI -1.21 to -0.63, p<0.0001), respectively).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The review concluded that physical activity, in general, is not associated with excess weight gain or obesity over time, with studies reporting total PA resulting in no effect or a small inverse association with excess weight gain. No factor specific conclusions were drawn regarding active habits, however, the two identified studies had conflicting results regarding the association between active habits and weight in adult women. | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>No factor specific limitations were reported. Across physical activity studies, reported limitations included:<br>Inprecise exposure measurement (majority of studies used self-report measures) and difficulty capturing the complexity of PA using these instruments.<br><br>Use of change in PA as a measure of the exposure (measured at baseline and follow-up) in some studies renders analysis of the association between PA and weight cross-sectional and retrospective, regardless of the prospective cohort design.<br><br>Included studies adjusted for a wide variety of potential confounding variables; it is, however, not possible to account for all confounders, especially given the complex relationship between PA and weight gain. Imprecise measurement of included covariates can result in residual confounding.<br><br>More recent studies (published after 2000) |

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| | | | tend to find the expected inverse assocation between PA and weight; this may be due to a tendency towards larger sample sizes and resultant higher statistical power, better adjustment for confounders, better measurement of exposure, or high potential for publication bias.<br><br>**Review team limitations:**<br>Unclear if the studies adjusted for confounders.<br><br>Unclear if cohorts were sampled from general population of specific subgroups based on weight or health status; setting unclear in both studies. |

**Physical activity intensity, frequency and duration**

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| **Ekelund et al. 2012**<br><br>**Quality:** +<br><br>**Search date:** 2008 (month NR)<br><br>**Review design:**<br>Systematic review of unclear study designs<br><br>**Review aim:**<br>To examine the independent and combined associations between objectively measured time in MVPA and sedentary time with cardiovascular risk factors.<br><br>**Review funding:**<br>National Preventative Research Initiative, and other government and research funding organisations.<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>Children and adolescents (aged 4 to 18 years) from Australia, Brazil, Europe and the US.<br><br>**Total # studies (# relevant and n=):**<br>Overall: 14 (7, n=6,413)<br>RCT: unclear<br>Cohort: unclear<br>Other: unclear<br><br>**Intervention/exposure description:**<br>5-day mean time in MVPA, assessed via accelerometry and defined as time>3,000 counts/minute (cpm), which corresponds to approximately 4.6 METs.<br><br>**Outcome(s):**<br>WC, BMI; both objectively measured | **Result(s):**<br>Overall analysis (cross-sectional and prospective studies, n=20,871) found that MVPA time was inversely associated with waist circumference (10 minute/day increase in MVPA correlated with (beta) 0.52cm reduction in WC (95% CI -0.76 to -0.28). When adjusting for sedentary time, a 10min/day increase in MVPA is correlated with a 0.54cm reduction in WC (95% CI -0.79 to -0.30). Sedentary time was not significantly associated with WC, in univariate analysis or when adjusting for time spent in MVPA.<br><br>Prospective analyses (n=6,413) with an average follow-up of 2.1 years revealed that baseline MVPA was not associated with WC at follow-up.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>No conclusions were reported for prospective analyses. For overall analysis (including cross-sectional studies) the review concluded that higher levels of time spent in MVPA by children and adolescents were associated with better cardiometabolic risk factors (included abdominal adiposity), regardless of amount of sedentary time. | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: P<br>Unclear: D, Set<br><br>**Authors' limitations:**<br>Some confounding factors were controled for, however, this did not account for dietary intake and some other potential confounding variables which may explain the observation.<br><br>The intensity threshold of MVPA (>3,000cpm) is higher than that used in some other studies. Reducing the threshold to 2,000cpm in sensitivity analysis did not substantially change the results of the meta-analysis.<br><br>The magnitude of the associations between MVPA and WC are small and may not be clinically significant.<br><br>**Review team limitations:**<br>The review included cross sectional and prospective studies. The prospective study designs were described as longitudinal and interventional; this appeared to include some RCTs and cohort studies, but the exact number of each and whether other designs were also included was unclear. |

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| | | Children should be encouraged to increase their participation in at least moderate intensity PA rather than reducing sedentary time as this appears to be more important in terms of cardiometabolic risk factors. | Children were of mixed weight status (74.9% normal weight, 17.7% overweight, 7.4% obese). Study design was unclear, although based on brief descriptions, likely to be cohort studies. |
| **Summerbell et al. 2009 (intensity)**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 8 (7, n=23,530 adults/n=3,406 children)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Adults<br>Work and leisure PA levels (PAL), categorised as mostly sedentary, moderately active or vigorously active (no additional details provided); PAL (categorized into six unspecified levels). Exposures were measured via questionnaire in both studies.<br><br>Children<br>PA intensity classification varied across studies, and included: sedentary, slightly active, light, moderate, moderate-to-vigorous, vigorous, and heavy. Definitions for each category were not reported. Volume at each intensity were variable defined across studies, and included bouts/week, | **Result(s):**<br>Adults<br>Two studies (n=22,748) were included for adult populations. Reported baseline age ranged from 20 to 69 years, and follow-up ranged from 5 to 14 years.<br><br>One study (n=782) reported no significant difference in weight gain over 14 years between the most sedentary and vigorously or moderately active participants (vigorous: regression -0.35, p=0.49; moderate: regression -0.13, p=0.79).<br><br>One study (n=21,966) reported that among participants with no change in PAL over the four year follow-up period, there was a linear inverse relationship between PAL and weight gain, with very active men and women having a 35% and 34% lower weight gain compared to the least active men and women (p<0.01 and p<0.001, respectively).<br><br>Children<br>Six studies were included in child or adolescent age groups, five of which were directly relevant to the current review (n=3,406). Baseline age across these five | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P<br>Unclear: Set<br><br>**Authors' limitations:**<br>No factor specific limitations were reported. Across physical activity studies, reported limitations inlcuded:<br>Inprecise exposure measurement (majority of studies used self-report measures) and difficulty capturing the complexity of PA using these instruments.<br><br>Use of change in PA as a measure of the exposure (measured at baseline and follow-up) in some studies renders analysis of the association between PA and weight cross-sectional and retrospective, regardless of the prospective cohort design.<br><br>Included studies adjusted for a wide variety of potential confounding variables; it is, however, not possible to account for all confounders, especially given the complex relationship between PA and weight gain. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | hours/week, total time.<br><br>The majority of studies either had no reported exposure measurement method, or used an activity diary and/or questionnaire. One study used accelerometry to measure PA.<br><br>**Outcome(s):**<br>Adults<br>Weight; weight was objectively measured in one study and self-reported in the other.<br><br>Children<br>Weight, overweight, BMI, BMI z-score, WHR, WC.<br><br>Height and weight were objectively measured in all studies. | studies ranged from to 6 to 19; follow-up time ranged from 1 to 19 years.<br><br>One study (n=59) found that the amount of time children aged 6 to 9 years spent in physical activity of different intensities (not further defined) was not associated with change in BMI z-score over one year)<br><br>One study (n=1,430) found that the amount of time spent in different intensities of PA (not further defined) was associated with 2 year change in BMI. Children who were active at age 6 had lower BMI at age 8 than sedentary children (regression coefficient -1.181 (95% CI -1.622 to -0.741, p<0.001). Children who were classified as slightly active at age 6 also had lower BMI at age 8 compared to sedentary children (regression coefficient -0.732, 95% CI -1.159 to -0.305, p=0.001).<br><br>One study (n=451) found that time spent in vigorous activity at age 13 to 16 was generally not significantly related to a range of weight related outcomes (sum of four skinfolds, WHR, WC) at age 32 except in the following cases:<br>- vigorous activity at age 13 was associated with WC during the study period (regression coefficient 0.1, p<0.05) in boys and girls<br>- heavy and vigorous activity at age 13 to 16 was associated with smaller increases in WHR during the study period (regression | Imprecise measurement of included covariates can result in residual confounding.<br><br>More recent studies (published after 2000) tend to find the expected inverse assocation between PA and weight; this may be due to a tendency towards larger sample sizes and resultant higher statistical power, better adjustment for confounders, better measurement of exposure, or high potential for publication bias.<br><br>**Review team limitations:**<br>Study size ranged from n=59 to n=21,966.<br><br>All studies were reported to adjust for some potential confounders, but unclear what these were.<br><br>Partial: Population - some studies included participants selected based on overweight status |

Bazian

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | coefficient -0.24, p<0.05) in girls only.<br><br>One study (n=436) found that hours per week of MVPA was significantly associated with BMI after 2 years in girls but not boys. (girls: mean BMI for high levels of MVPA 19.7kg/m2, 95% CI 19.5 to 20.0; for low levels of MVPA 19.4, 95% CI 19.2 to 19.6; p for difference 0.03; data for boys NR). Levels of VPA was not associated with BMI (mean BMI high VPA 19.5, 95% CI 19.3 to 19.7; low VPA 19.6, 95% CI 19.4 to 19.9; p for difference 0.14).<br><br>One study (n=1,030) found that the amount of awake time children aged 4 to 19 spent in light activity was inversely associated with one year weight gain (p=0.007), the amount of awake time spent in either MPA or VPA was not associated with weight gain.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The review concluded that physical activity, in general, is not associated with excess weight gain or obesity over time, with studies reporting total PA resulting in no effect or a small inverse association with excess weight gain. Conflicting results were reported in studies in both children and adults. No factor specific conclusions were drawn regarding PA intensity. | |
| **Summerbell et al. 2009 (frequency,** | **Study participant inclusion criteria:** | **Result(s):** | **Applicable to the UK:** Yes |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **duration)**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 8 (7, n=21,240 adults/n>733 children)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Adults<br>The review separately assessed the association between PA frequency and weight outcomes and PA duration and weight outcomes.<br><br>Where reported, frequency of PA was assessed as times/week, and measured via self-report, and questionnaire and interview. No information was reported for categorisation or measurement of PA duration.<br><br>Children<br><br>**Outcome(s):**<br>Adults<br>Weight, BMI; measured objectively or based on self-report.<br><br>Children<br>Time spent in PA, sport participants, frequency of vigorous PA; aerobic exercise. | Adults<br>Three studies (n=21,240) assessed PA frequency or duration. The baseline age of participants ranged from 16 to 61 years, and follow-up ranged from 1 to 29 (estimated) years.<br><br>One study (n=3,391) found that frequency of PA was not associated with 4 year weight change.<br><br>One study (n=17,733) reported that PA frequency was not significantly associated with BMI gain over 22 to 29 years.<br><br>One study (n=116) found no significant association between minutes of weekly aerobic exercise and changes in BMI over 1 year.<br><br>Children<br>Four relevant studies (n=unclear; >733) reported on the association between PA frequency or duration and weight related outcomes in children. Baseline age ranged from 7 to 11 years, and follow-up periods ranged from 1 to 5 years.<br><br>One study (n=307) found that PA time at baseline was not significantly associated with BMI at 1 year follow-up.<br><br>One study (n=314) found that boys who were the least active were significantly more | **Alignment to NICE review scope:**<br>Complete: D<br>Partial: Set<br>Unclear: P<br><br>**Authors' limitations:**<br>No factor specific limitations were reported. Across physical activity studies, reported limitations inlcuded:<br>Inprecise exposure measurement (majority of studies used self-report measures) and difficulty capturing the complexity of PA using these instruments.<br><br>Use of change in PA as a measure of the exposure (measured at baseline and follow-up) in some studies renders analysis of the association between PA and weight cross-sectional and retrospective, regardless of the prospective cohort design.<br><br>Included studies adjusted for a wide variety of potenital confounding variables; it is, however, not possible to account for all confounders, especially given the complex relationship between PA and weight gain. Imprecise measurement of included covariates can result in residual confounding.<br><br>More recent studies (published after 2000) tend to find the expected inverse assocation between PA and weight; this may be due to |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| | Where reported, assessment methods included parental report and interview. | likely to have excess weight gain over two years compared to the most active (OR 2.18, 95% CI 1.01 to 4.71). No significant association was seen amongst girls.<br><br>One study (n=112) found no significant relationship between frequency of vigorous PA and % body fat at five year follow-up. One study (n=NR) found no significant association between aerobic exercise and development of overweight.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The review concluded that physical activity, in general, is not associated with excess weight gain or obesity over time, with studies reporting total PA resulting in no effect or a small inverse association with excess weight gain. Conflicting results were reported in studies in both children and adults. No factor specific conclusions were drawn regarding PA frequency or duration. | a tendency towards larger sample sizes and resultant higher statistical power, better adjustment for confounders, better measurement of exposure, or high potential for publication bias.<br><br>**Review team limitations:**<br>Small sample sizes were common across the studies in children.<br><br>Unclear if all cohorts were sampled from general population of specific subgroups based on weight or health status; one large cohort study in children assessed PA at school only. |
| **Janssen and Leblanc 2010**<br><br>**Quality:** +<br><br>**Search date:** Jan 2008<br><br>**Review design:**<br>Systematic review of any study type | **Study participant inclusion criteria:**<br>School-aged children aged between 5 and 17 years.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 24 (7, n=483)<br>Cohort: 5 (3, n=4,370)<br>Other: 42 (2 case control, 33 cross-sectional, 7 non-randomised trials controlled trials, 1 | **Result(s):**<br>31 observational studies were identified that assessed the association between PA and obesity. Overall, these studies reported weak to modest relationships between PA and overweight/obesity. The median OR for overweight/obesity in the least active vs. most active group was 1.33 (95% CI NR). | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D, P, Set<br>Unclear: None<br><br>**Authors' limitations:**<br>It is unclear based on the current evidence |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Review aim:**<br>To determine the appropriate total volume, intensity and type of physical activity needed for minimal and optimal healthy benefits in children.<br><br>**Review funding:**<br>Public Health Agency of Canada<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | randomised non-controlled trial)<br><br>**Intervention/exposure description:**<br>Where clear, overall exposures in the observational studies with weight outcomes included MVPA, active commuting to school, PA of all intensities, and organised sports.<br><br>Interventions with weight outcomes ranged in type (aerobic, resistance, Pilates, jumping, load bearing, circuit training and mixed), with 2 to 3.5 hours per week of exercise (mean 17 to 30 minutes per day), and the trials lasted from 4 to 104 weeks (most were 4 to 6 months).<br><br>Objective (accelerometry, pedometer) and subjective (parent report, self-reported questionnaire) measurements were used.<br><br>**Outcome(s):**<br>Weight related outcomes in the observational studies included: healthy weight, overweight, and obesity. Outcomes in the experimental studies included total adiposity (% fat, BMI, weight) and abdominal adiposity (WC, trunk fat, visceral fat).<br><br>Outcome assessment methods were not reported; overweight and obesity were classified using age and gender specific BMI z-scores in the majority of studies. | 24 interventional studies were identified with weight related outcomes (17 were RCTs, and three included populations not selected based on weight or health status). Amongst studies that found significant improvements in adiposity, the effect sizes tended to be small (<0.50 [unit NR]).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>There is strong and consistent evidence that as little as 2 to 3 hours of MVPA is associated with health benefits. Children aged 5 to 17 years old should average at least 60 minutes per day (and up to several hours) of at least moderate intensity physical activity. Some health benefits can be achieved at shorter durations (average of 30 minutes per day), which may be more achievable for less active children. [NB. This conclusion/recommendation is based on weight- and non-weight related benefits]. | whether the total volume of PA must be acquired continuously or if smaller bouts of activity accumulated throughout the week are sufficient to see a health benefit; the review concludes/recommends an average of at least 60 minutes MVPA per day to account for this uncertainty surrounding PA frequency.<br><br>The primary aim of many of the intervention studies that assess weight related outcomes was to improve other aspects of health and not obesity.<br><br>**Review team limitations:**<br>Relevant RCTs had small sample sizes (n<150 in all studies, and n<100 in seven of the eight studies).<br><br>Majority of studies for this factor were cross-sectional in design. Some populations were selected based on overweight, obesity or health status, and some of the interventions took place in schools. |
| **Murphy et al. 2009** | **Study participant inclusion criteria:**<br>NR | **Result(s):**<br>Overall, nine studies assessed the long term | **Applicable to the UK:** Yes |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Quality:** -<br><br>**Search date:** NR<br><br>**Review design:**<br>Systematic review of intervention studies<br><br>**Review aim:**<br>To compare the effects of similar amounts of exercise taken in either a continuous (e.g. single bout) or two or more accumulated sessions on health outcomes.<br><br>**Review funding:**<br>No funding received.<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Total # studies (# relevant and n=):**<br>RCT: 9 (4, n=265)<br>Cohort: 0<br>Other: 7 (uncontrolled intervention studies)<br><br>**Intervention/exposure description:**<br>The four relevant studies assessed walking, with a total walking time ranging from 20 to 30 minutes per week; intensity included 60% to 80%Hrmax and 65% VO2max; frequency ranged from 1 to 5 days/week; duration ranged from 8 to 15 weeks.<br><br>This total PA volume was performed in one bout per session in the continuous arms, and between 2 to 3 bouts for the accumulated PA arms.<br><br>**Outcome(s):**<br>Weight, skinfolds, WC, hip circumference, waist to hip ratio, % body fat; measurement methods NR. | effect of continuous vs. accumulated exercise on body weight. Participant age in these nine studies ranged from 18 to 63 years.<br><br>Five of the nine studies reported significant reductions in body weight in the intervention groups vs. control, with reductions in weight ranging from 1.3% to 11.4% of body mass in the continuous groups and 1.8% to 11.7% in the accumulated exercise arms [NB. Weight loss programmes in overweight and obese individuals included in these studies).<br><br>Of the four studies relevant to the current evidence review, three assessed body weight, and two of these found significant differences in weight between intervention and control groups (range of weight reduction 1.3% to 1.8% in continuous exercise arms, and 1.8% to 2.6% in the cumulative exercise arms. No relevant study reported significant differences in change in weight when the same volume of exercise was taken continuously in a single session vs. Accumulated over multiple sessions.<br><br>Overall, six studies assess effect on % body fat; three reported no significant changes in any group, while three reported significant reductions in at least one group (these three studies were all relevant to the current review; the fourth relevant study did not report this outcome). Two relevant studies | **Alignment to NICE review scope:**<br>Complete: None<br>Partial: D, P<br>Unclear: Set<br><br>**Authors' limitations:**<br>Deliberate alterations to exercise habits may result in alterations in dietary habits/energy intake; the current review cannot rule out the influence of such dietary changes on body composition outcomes.<br><br>The studies included mainly female, middle aged participants with relatively low baseline cardiovascular fitness levels. Whether results hold in mixed sex populations or amongst those with better cardiovascular fitness, or other populations is not know.<br><br>**Review team limitations:**<br>Randomisation status of included studies not reported (either at study level or as an inclusion criteria).<br><br>Generally studies had small sample sizes (n<150 for all relevant studies).<br><br>Some studies selected participants based on overweight/obesity status; some included studies were uncontrolled. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | reported significant differences in both the continuous and accumulated groups vs. control, but no significant difference between the intervention arms. One study noted a significant reduction vs. control in the continuous group only (6.7% reduction in % body fat; reduction significantly greater in the single-30mins/wk. vs. the three-10 minute bouts/week).<br><br>Overall, five studies reported on the association between exercise and waist circumference (two of these were relevant to the current review). Results were mixed across the studies, with two reporting no significant differences in intervention vs. control groups (including one relevant study). One study found significant reductions in both the continuous and accumulated groups vs. control (reduction of 1.2% continuous group and 0.3% in the accumulated group). One study, which is relevant to the current review, reported significant difference in the accumulated vs. control comparison but not between continuous and control groups (3.8% reduction in accumulated group, NS 2.3% reduction in continuous group). The remaining two studies reported significant reductions in waist and hip circumference and waist to hip ratio for both groups vs. control.<br><br>No study found significant difference in waist | |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | and hip circumference between the continuous and accumulated groups.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>For adiposity, there is insufficient evidence to determine whether accumulated exercise is as effective as a continuous approach. | |

Sport

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Nelson et al. 2011**<br><br>**Quality:** +<br><br>**Search date:** Feb 2011<br><br>**Review design:**<br>Systematic review of observational studies<br><br>**Review aim:**<br>To assess the influence of sports participation on weight status, physical activity and diet<br><br>**Review funding:**<br>National Cancer Institute<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Children aged 6 to 18 years<br><br>**Total # studies (# relevant and n=):**<br>RCT: 1 (0)<br>Cohort: 1 (1, n=5,184)<br>Other: 19 (18 cross-sectional, 1 quasi-experimental)<br><br>**Intervention/exposure description:**<br>Exposures were described as 'sport participation' (not otherwise specified. Based on the results, it is clear that some specific sports were assessed at least in subgroup form (e.g. rugby, swimming, judo, tennis, gymnastics, horse riding, handball, dance) but these were not specified as the individual focus of any particular study. Comparisons were made to non-participants.<br><br>**Outcome(s):**<br>Weight, BMI, obesity and overweight; measurement methods not reported | **Result(s):**<br>Twelve of the 18 studies reported that sports participants had lower weight status than non-participants, although many of these significant comparisons were in specific subgroups of the overall population; seven studies found no association between sports participation and weight status.<br><br>One longitudinal study (n=5,184) reported that males who participated in sports at age 11 to 12 were significantly less likely to be overweight at age 14. However, this study found no significant association between sport and weight status amongst males or females between the aged of 14 and 17 (data NR).<br><br>One study compared weight associations according to sport type, and reported that participants in some sports (including rugby, swimming, judo and tennis) were more likely to be overweight than non-participants. Participants in other sports (including gymnastics, handball, horse riding and dance) were less likely than non-participants to be obese; the sample sizes for these comparisons were relatively small.<br><br>Two intervention studies (one RCT and one quasi-experimental study) found that an after-school football programme was in overweight and previously inactive youth | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: Set<br>Partial: D, P<br>Unclear: None<br><br>**Authors' limitations:**<br>Many of the included studies were cross-sectional in design, and any observed associations may arise due to overweight or obese children being less likely to participate in sport, as opposed to the impact of sport participation on energy expenditure and energy balance.<br><br>**Review team limitations:**<br>The reported study was described as longitudinal, unclear if it is strictly a prospective cohort study<br><br>18 of the 21 studies were cross-sectional in design, 1 was longitudinal, one was a RCT, and 1 a quasi-experimental study; some study participants were recruited based on overweight status. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | found small but statistically significant decreases in BMI at 3 and 6 months follow-up compared to a group that received health education. The small quasi-experimental study found no significant differences in BMI among obese youth attending a sport camp vs. the control group.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>There is no clear pattern between sport participation and weight. It is unclear whether you participation in sports programmes is protective against overweight and obesity. | |

Strength training

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Benson et al. 2008**<br><br>**Quality:** +<br><br>**Search date:** Dec 2006<br><br>**Review design:**<br>Systematic review of intervention studies<br><br>**Review aim:**<br>To systematically review the health effects of resistance training in children and adolescents.<br><br>**Review funding:**<br>NR<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Children or adolescents aged 18 years or younger<br><br>**Total # studies (# relevant and n=):**<br>RCT: 6 (1, n=29)<br>Cohort: 0<br>Other: 6 (4 non-randomised controlled trials, 2 uncontrolled trials)<br><br>**Intervention/exposure description:**<br>Across all studies, there was variation in type, intensity, frequency and duration of resistance training (RT):<br><br>Exercise types included:<br>three studies included RT only;<br>eight studies included a circuit training component, eight included an aerobic component. Four of the studies also included a dietary component for weight loss.<br><br>Session duration ranged from 20 to 80 minutes, 1 to 3 times per week, for 6 weeks to 5 months.<br><br>The relevant RCT assessed circuit training at 10 stations, with stretching, 8 RT exercises, cycling and sit-ups. Each session lasted 45 minutes, 3 times per week for 14 weeks; participants completed as many repetition as possible in 30 seconds, starting at the lowest resistance setting and increasing resistance. | **Result(s):**<br>Five of the twelve studies reported increased body mass in the intervention and/or control group from baseline to follow-up. Only four of the studies reported between group comparisons over time. Of these, three found no significant differences in change in body mass between RT and control groups. One study (the study most relevant to this review) reported that the intervention group increased body mass more than the control group (pre-post intervention mean (SD): 29.9 (6.8) to 31.5 (7.6), control: 27.3 (6.1) to 27.9 (5.5); $p<0.05$).<br><br>No studies reported favourable BMI changes in RT vs. control groups. Six studies (none relevant to the current review) assessed whole body fat via DEXA, and found no significant differences between the groups over time.<br><br>WC was assessed in three studies; one showed significant increases in both groups over time, but no significant difference in WC change between the RT and control group; one study (relevant to this review) resulted in a significant increase in WC in the RT group but not in the control (intervention mean (SD): 57.8cm (6.3) to 60.2cm (6.7), control: 57.6 (6.0) to 57.6 (4.9); $p<0.05$ within and between groups). The third study showed no significant differences in WC | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D, P<br>Unclear: Set<br><br>**Authors' limitations:**<br>Sample sizes were generally small (ranged from 15 to 82, and recruited from school or sports teams. Four studies were from a hospital/medical setting.<br><br>Many reveiwed studies lacked a control group, were not adequately randomised or blinded, had small sample sizes, and limited description of training content, and did not stratify analyses by participant age.<br><br>**Review team limitations:**<br>Only one study meet review scope in terms of population; the majority of included studies recruited participants based on overweight/obesity status (8 of 12 studies). This limits the generalizability of review conclusions to preventing obesity in healthy weight or general populations between 5 and 18 years of age.<br><br>Several studies included an unspecified dietary component and/or behaviour modification component; the relative impact of these factors is not clear. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | **Outcome(s):**<br>Body mass and BMI; assessment methods NR. | either within groups over time, or in change in WC between groups.<br><br>**Adverse Effects:**<br>Six studies reported on adverse events; two reported that RT was safe, one reported no adverse events, two reported no injuries, one reported no injuries or illness. The only AE reported across the studies was hypoglycaemia in a participant with insulin dependent diabetes mellitus.<br><br>**Conclusions:**<br>Health benefits were found in several studies, however, limitations in terms of study design and reporting preventing drawing definitive conclusions on the isolate role of resistance training. | 6 of the 12 studies included in the review met study design scope criteria; of these studies, 5 specifically recruited overweight or obese children; intervention setting was unclear. |
| **Ismail et al. 2012**<br><br>**Quality:** ++<br><br>**Search date:** Nov 2010<br><br>**Review design:**<br>Systematic review of RCTs.<br><br>**Review aim:**<br>To systematically review the effects of aerobic and resistance training in adults on visceral fat.<br><br>**Review funding:**<br>NR | **Study participant inclusion criteria:**<br>Adults aged ≥18 years.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 35 (4, n=196)<br>Cohort: 0<br>Other: 0<br><br>**Intervention/exposure description:**<br>Interventions had to last at least 4 weeks. Any dietary component of the interventions had to be the same in all groups. Most of the resistance training (RT) involved weight machines. RT interventions lasted 3 months to 2 years. | **Result(s):**<br>Overall, resistance training did not significantly affect visceral fat (14 comparisons, n=NR; effect size 0.09, 95% CI -0.17 to 0.36; p=0.49; random effects analysis).<br><br>3/4 relevant RCTs found no significant effect (effect sizes -0.340 to 0.000), and one found a significant reduction over 1 year (-0.59, 95% CI -1.16 to -0.02).<br><br>**Adverse Effects:** NR<br><br>**Conclusions:** Resistance training did not | **Applicable to the UK:** Unclear<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P<br>Unclear: Set<br><br>**Authors' limitations:**<br>Few studies had participant or assessor blinding. Some studies did not describe the control group. Differences in exercise prescriptions contributed to heterogeneity<br><br>**Review team limitations:**<br>Studies were small and may have lacked power to detect an effect. Most of the |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Study funding:**<br>NR<br><br>**Multifactor review:** Yes | Across studies, there was variation in type, intensity, frequency and duration of resistance training (RT): Training was on 2-5 days per week (most commonly 3 days). Intensity ranged between 30% and 100% of the 1 repetition maximum (not further defined).<br><br>The 4 relevant studies included 25-90 minute sessions (NR in 2 studies), 2-3 days a week over 6 months to 1 year.<br><br>Controls were often not described, but where described included flexibility exercises (also given to RT group), dietary intervention (also given to RT group), diabetes education, or walking.<br><br>**Outcome(s):**<br>Visceral adiposity, assessed by magnetic resonance imaging or computed tomography. | significantly reduce visceral adiposity. | included studies were outside of the scope of the current review and may not apply to the general population.<br><br>**Population:** 21 RCTs were reported to be in overweight or obese participants and 12 were reported to include people with type 2 diabetes or metabolic syndrome. |

Walking

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Murphy et al. 2007**<br><br>**Quality:** ++<br><br>**Search date:** Sep 2004<br><br>**Review design:**<br>Systematic review and meta-analysis of RCTs<br><br>**Review aim:**<br>To review walking interventions and quantify the magnitude and direction of walking-induced changes on selected risk factors, including body composition.<br><br>**Review funding:**<br>NR<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Sedentary but otherwise healthy individuals aged 18 or over<br><br>**Total # studies (# relevant and n=):**<br>RCT: 24 (20, n=894)<br>Cohort: 0<br>Other: 0<br><br>**Intervention/exposure description:**<br>Overall (across relevant and non-relevant RCTs) walking interventions ranged in frequency from 2 to 7 days per week (mean 4.4 days per week); intensity descriptions included 'brisk', 'self-paced', or description of predicted maximum heart rate (average 70.1%, range 50 – 86%) or heart rate reserve, or VO2 max (average 56.3%, 45% to 65%); minutes walked per week ranged from 50 to 270 (average 188.8 minutes/week) taken in bouts of average 38.3 minutes (range 9.5 to 65 minutes); invention duration ranged from 8 to 104 weeks.<br>(There were some discrepancies between reporting in the study table and text, figures reported here are from the text).<br><br>**Outcome(s):**<br>Body composition assessed as body weight, BMI and percent body fat (assessed either as waist circumference or skinfold measurements). | **Result(s):**<br>Eighteen studies assessed body weight, with intervention group decreases from baseline weight ranging from 0.2 to 2.0kg following the interventions. Meta-analysis resulted in a weighted mean treatment effect of -0.95kg (SD 0.61kg); p<0.001. This represents a relative reduction in body weight of 1.4%.<br><br>Sixteen studies assessed BMI, with a weighted mean treatment effect of -0.28kg/m2 (SD 0.2kg/m2); p<0.001. This is a relative reduction in BMI of 1.1%.<br><br>Twelve studies assessed body fat, 11 of which saw intervention group decreases in skinfold measurements ranging from 0.2% to 2.5%. Meta-analysis resulted in a weighted mean treatment effect of -0.63% (SD 0.66%); p=0.015. This is a relative reduction in percent body fat of 1.9%<br><br>The review reported that there was no difference in treatment effect for any of the measured outcomes by volume of walking (<150 min/week vs. ≥150 min per week), but figures from these analyses were not reported for any outcome. They noted that studies using a lower volume of walking tended to use higher relative intensity (70-85% heart rate reserve) compared with those of a higher volume (55-75% heart rate reserve). | **Applicable to the UK: Unclear**<br><br>**Alignment to NICE review scope:**<br>Complete: D, P<br>Partial: None<br>Unclear: Set<br><br>**Authors' limitations:**<br>The review and meta-analysis included mainly female subjects (82.9%). Some included primary studies analysed data from completers only instead of taking an intention to treat approach. These two factors may reduce the degree to which review findings can be generalised to the general population.<br><br>**Review team limitations:**<br>Included studies were small in size (ranging from 9 to 55 participants per arm).<br><br>No information was provided on outcome assessment (whether objective or subjective).<br><br>No information on either review or study funding was provided.<br><br>Intervention setting was not specified.<br><br>There appeared to be discrepancies between text and table in intervention characteristics e.g. length of intervention. It was unclear |

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| | Methods of outcome assessment not reported. | **Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>A programme of regular brisk walking is sufficient stimulus to reduce body weight, BMI and body fat in previously sedentary but otherwise healthy individuals. As walking was the only intervention provided in the selected studies (i.e. no dietary change), and weight loss was not an intervention goal, the review concludes that the reduction is likely the result of increased energy expenditure due to walking. | which of the figures was correct, and figures reported here are from the text. |

## Sedentary Behaviour

**Amount of sedentary time**

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 25 (4, n=77,922 adults/21, n>22,322 children)<br>Other: 1 (SR)<br><br>**Intervention/exposure description:**<br>Hours/day lying down or sitting; time spent sitting at home, outside the home, at work or while driving; hours sitting/week while visiting friends, driving, reading, watching TV or working at a desk or computer;<br><br>Self-report via questionnaire<br><br>**Outcome(s):**<br>Height and weight were objectively measured in one study, and self-reported in the remaining studies. | **Result(s):**<br>Adults<br>Four studies (n=77,922) assessed the association between physical inactivity (see applicability and limitations) and weight related outcomes. Participant age at baseline (where reported) ranged from 18 to 69, and follow-up periods ranged from 4 to 7 years.<br><br>One study in post-menopausal women (n=336) reported that hours per day spent lying down or sitting was not significantly associated with a 10 lb or more weight gain at 4 years' follow-up (data NR).<br><br>One study in women (n=50,277) reported that sitting at home >40 h/week was not significantly associated with obesity at six years follow-up compared to those who sat at home for 0-1 hours/week (RR 1.11, 95% CI 0.85 to 1.45). Sitting for >40 h/week at work, away from home or while driving was significantly associated with obesity at six years' follow up, compared with sitting for 0-1 h/week (RR 1.28, 95% CI 1.04 to 1.58).<br><br>One study in women (n=8,726) reported that sitting >=52 hours/week was associated with a lower risk of weight gain over four years compared to sitting <=33 hours/week (RR 0.8, 95% CI 0.7 to 0.91). | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>No factor specific limitations were reported. Across physical activity studies, reported limitations inlcuded:<br>Inprecise exposure measurement (majority of studies used self-report measures) and difficulty capturing the complexity of PA using these instruments.<br><br>Use of change in PA as a measure of the exposure (measured at baseline and follow-up) in some studies renders analysis of the association between PA and weight cross-sectional and retrospective, regardless of the prospective cohort design.<br><br>Included studies adjusted for a wide variety of potenital confounding variables; it is, however, not possible to account for all confounders, especially given the complex relationship between PA and weight gain. Imprecise measurement of included covariates can result in residual confounding. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | One study in post-menopausal women (n=18,583) reported that among women who were not overweight at baseline, >6 hours/day of non-occupational sedentary behaviour was associated with higher likelihood of a weight gain more than 10 lb over 7 years compared to <3 hour/day (OR 1.47, 95% CI 1.21 to 1.79).<br><br>Children<br>The review included one systematic review and 21 cohort studies (some of which were identified through the systematic review). The large majority of the cohort studies assessed TV viewing or more general screen time, therefore the section of this review relating to children was considered in the section on screen time to avoid double reporting.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The review concluded that physical activity, in general, is not associated with excess weight gain or obesity over time, with studies reporting total PA resulting in no effect or a small inverse association with excess weight gain. Conflicting results were reported in studies in both children and adults. No factor specific conclusions were drawn regarding amount of physical | More recent studies (published after 2000) tend to find the expected inverse assocation between PA and weight; this may be due to a tendency towards larger sample sizes and resultant higher statistical power, better adjustment for confounders, better measurement of exposure, or high potential for publication bias.<br><br>**Review team limitations:**<br>All studies in adults included women only; associations should not be generalised to men.<br><br>A systematic review was reviewed for evidence of the association between amount of sedentary time and weight related outcomes in children, this is outside of the current revew scope as it is a review of reviews.<br><br>This review assessed physical inactivity. A distinction has been made between physical inactivity (which could include low MET activities such as standing) and sedentary behaviour (such as sitting or lying down). However, this review has been included here as the exposures assessed were largely sedentary behaviours.<br><br>Physical inactivity was not explicitly defined in the review, but physical activities utilising less than 1.5 metabolic equivalents (METs) |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | inactivity. | were considered 'not active'. The exposures assessed in the individual studies included non-occupational sedentary behaviour, sitting or lying down, and standing or walking at home. |
| **van Uffelen et al. 2010**<br><br>**Quality:** +<br><br>**Search date:** Apr 2009<br><br>**Review design:**<br>Systematic review of studies examined the association between occupational sitting and the risk of lifestyle diseases, or markers of lifestyle diseases. Studies were not excluded on the basis of design.<br><br>**Review aim:**<br>The review aimed to systematically review the evidence on associations between occupational sitting and health risks.<br><br>**Review funding:**<br>Health Promotion Queensland<br><br>**Study funding:**<br>Funding sources for individual studies were not reported.<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Adults<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 3 (3, n=66,912)<br>Other: 9<br>NB One study reported both cross-sectional and prospective data.<br><br>**Intervention/exposure description:**<br>Self-reported occupational sitting. 1 cohort study used a continuous measure for occupational sitting and then categorized the data for analyses. The other two cohort studies used a categorical measure of occupational activity with sitting or sedentary as one of the response options.<br><br>**Outcome(s):**<br>BMI. BMI was self-reported in 1 cohort study, and objectively measured in 2 cohort studies. | **Result(s):**<br>Of the three prospective cohort studies, one found a positive association between occupational sitting and BMI, but the other two found no association (data NR). The prospective cohort study that found a positive association found that sitting for more than 40 hours has a relative risk of 1.25 (95% CI 1.02 to 1.54) of having a BMI of 30 or more for compared to women sitting for between 0 and 1 hours (n=50,277).<br><br>**Adverse Effects:**<br>Using World Cancer Research Fund/American Institute for Cancer Research evidence grades, the researchers concluded there was limited evidence-suggestive of an association between occupational sitting and mortality; and limited evidence- no conclusion of associations between occupational sitting and cancer, cardiovascular disease or diabetes.<br><br>**Conclusions:**<br>Using World Cancer Research Fund/American Institute for Cancer Research evidence grades, the researchers concluded there was limited evidence relating to of associations between occupational sitting and BMI and no | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D, Set, P<br>Unclear: None<br><br>**Authors' limitations:**<br>There is a possibility that relevant papers may have been missed due to lack of standard search terms for occupational sitting. The quality assessment used assessed quality based on whether specific study characteristics were reported rather than rating the study quality on the basis of these characteristics.<br><br>**Review team limitations:**<br>Only 3 prospective cohort studies, although these were large and long term (one recruited 1943-1977 and followed-up in 1982-1982 and 1991-1993; one recruited in 1992 and followed-up in 1992, 1994, 1996, 1998; and one recruited 1976-1978 and followed-up 1981-1983 and 1992-1994). 2/3 cohort studies adjusted for leisure time physical activity/exercise. Average quality score of cohort studies was 10/15. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | conclusions could be drawn (conclusion based on all study types). | Outcome: Also looked at the association between occupational sitting and cancer, cardiovascular disease, diabetes mellitus, and mortality.<br>Population: in 1 cross-sectional study, the sample included obese people (selected from the general population along with non obese controls).<br>Setting: Some studies included employees- but this wasn't a work-place intervention.<br>D: prospective cohort and cross-sectional studies identified and included.<br><br>Although the review specifically addressed sitting, this is a sedentary behaviour, and the studies and results described overlapped with those included in the review of physical inactivity by Summerbell et al. 2009 [++] so this review has been described alongside this review under the factor ‘Amount of sedentary time’. |

More active screen time

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| **Leblanc et al. 2013**<br><br>**Quality:** +<br><br>**Search date:** 2012 (month NR)<br><br>**Review design:**<br>Systematic review of studies of any design that had a specific measure of time spent using active video games and reported at least one relevant health or behaviour indicator.<br><br>**Review aim:**<br>To explain the relationship between active video games and health and behaviour indicators in children (aged less than 18). The health and behaviour indicators were: physical activity and energy expenditure, adherence and appeal, opportunity cost, adiposity, cardiometabolic health indicators, energy intake, adaptation, learning and rehabilitation, and video game evolution.<br><br>**Review funding:**<br>Active Healthy Kids Canada (a charity).<br><br>**Study funding:**<br>Funding sources for individual studies were not reported.<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Age (under 18) was the only population inclusion criterion.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 6 (3, n unclear)<br>Cohort: 0<br>Other: 4 (0; described as intervention (not otherwise specified), cross-sectional, or case report/study)<br><br>**Intervention/exposure description:**<br>Interventions were video games that required physical activity beyond that of a passive video game (i.e. conventional hand-held games). Type, intensity, frequency and duration of the interventions varied across trialsRCTs, where reported ranging from 10-15 minute sessions received in a single session or repeatedly (up to 4 times a week).<br><br>**Outcome(s):**<br>Adiposity. Studies included in the synthesis were between 10 weeks and 6 months long, and measured adiposity through BMI, BMI z-score, % body fat, waist circumference and weight gain.<br>How these were measured is not reported. | **Result(s):**<br>Due to the heterogeneity in active video games, no meta-analysis was performed. According to the review only 1 of the 3 RCTs that included normal-weight participants, “reported attenuated weight gain in the intervention group." It appeared that this is referring to a trial finding mean difference in waist circumference from baseline to end of week 12 active gaming intervention between intervention and control groups of -1.4 cm (95% CI -2.68 to -0.04, p=0.04 [n=20]), although due to inconsistencies in reporting in the review this is difficult to say with any certainty. This RCT appeared to also have assessed BMI, but results for this outcome were not reported. Results of the other 2 RCTs that included normal-weight participants were not reported.<br><br>**Adverse Effects:**<br>The review reported that 1 RCT and 2 observational studies (case reports and cross-sectional study) provided information on adverse events. Whether the RCT was one that reported on adiposity outcomes or included normal weight participants was not possible to determine with certainty, due to inconsistencies in reporting. The RCT reported that none of the adverse events tfoudn no adverse events during the study were related to the active video game intervention. The observational studies | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Most included trials had small sample sizes and short intervention period (applies to all trials included in the review, which also reported other outcomes).<br>The review included studies of "first gneration" active video games.<br><br>**Review team limitations:**<br>Reporting of study detail in the review was unclear, with some conflicting information in tables and text and inconsistencies in referencing. It was difficult to clearly identify which of the studies were in overweight or obese participants only, or to determine whether studies that included normal weight participants also included overweight or obese participants.<br><br>The studies were generally small with the RCTs including around 500 participants in total, with over 300 of these included in one RCT.<br><br>How outcomes measured NR.<br>This review does not provide much nuance. |

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| | | reported some injuries associated with active video game use, such as back pain, fractures, bruises (figures NR).<br><br>**Conclusions:**<br>The review concluded that "in overweight and obese children and youth [active video games] may attenuate weight gain whereas evidence in normal-weight children is inconclusive." Conclusions included studies on overweight and obese populations, and all study designs, some of which were outside of the current review scope. | As the researchers report "future work should …[use] both direct (e.g., accelerometer, pedometer, heart rate) and indirect (e.g., self-, parent-, caregiver-report) measurers to assess total [active video game] use. Both measures are needed to reflect the nuances associated with capturing [active video game] play such as body position or intensity of play."<br><br>Studies of any design were included, including 'intervention' studies and cross-sectional studies.<br>The setting of studies was NR.<br>Population: Apart from age, no inclusion criteria. Some studies were on overweight/obese children. |

Screen time

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Costigan et al. 2013**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2011<br><br>**Review design:**<br>Systematic review of cross-sectional, longitudinal and experimental studies.<br><br>**Review aim:**<br>To investigate the relationship between recreational screen-based sedentary behaviour and health indicators among adolescent girls.<br><br>**Review funding:**<br>National Health and Medical Research Council, Australia.<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Females aged 12 to 18 years.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 7 (5, n=14,138)<br>Other: 25 (cross-sectional)<br><br>**Intervention/exposure description:**<br>Of the 33 studies, 22 assessed combined screen time exposures (television, video, sedentary electronic gaming, computer and internet usage), 8 examined TV viewing only, two assessed computer or internet usage, and one examined electronic gaming.<br><br>Leisure time screen exposure was assessed; screen time related to school or homework was excluded from the analyses.<br><br>Exposure measurement was mainly via self-report questionnaires or surveys; four studies used PA/sedentary behaviour recall, two used interviews or focus groups, and two utilised more objective measures such as accelerometry or direct observation.<br><br>**Outcome(s):**<br>19 of the 33 studies assessed weight related outcomes, including: BMI, body fatness, overweight and/or obesity. Outcome assessment methods were not reported. | **Result(s):**<br>18 of the 19 studies with weight status outcomes reported significant positive associations between screen time and weight in adolescent girls. When examining studies with low risk of bias only, 7 of the 8 studies identified a significant positive relationship.<br><br>No pooled analysis was reported. No outcome data was reported, however, the review suggests that there is a strong positive association between screen-based sedentary behaviours and weight status, particularly when screen time exceeded 2 hours.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>There is strong evidence of a positive association between screen based sedentary behaviour and weight in adolescent females. | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Fewer than half the identified studies adjusted sedentary behaviour indicators for physical activity level.<br><br>**Review team limitations:**<br>Studies reported as longitudinal or cross-sectional; it is unclear based on the review level information if all longitudinal studies were prospective cohorts.<br><br>One study is referenced in the discussion in regards to hours/day threshold beyond which screen time is particularly associated with weight; it is unclear based on review reporting if other studies provided similar threshold information.<br><br>Majority of identified studies were cross-sectional (25/33). Unclear if participants were selected based on weight status. |

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| **Leblanc et al. 2012**<br><br>**Quality:** ++<br><br>**Search date:** May 2011<br><br>**Review design:**<br>Systematic review of RCTs, quasi-experimental, intervention, prospective cohort, or any study that has either a comparison group or a follow-up period.<br><br>**Review aim:**<br>The review aimed to examine the relationship between sedentary behaviour and health indicators (including adiposity) at between 0 and 4 years of age.<br><br>**Review funding:**<br>NR. Individual researchers were supported by the Canadian Institute of Health Research, Queen's University, and the Social Sciences and Humanities Research Council.<br><br>**Study funding:**<br>The funding of included studies was not reported.<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Children aged under 5.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 1 (1, n=163)<br>Cohort: 21 (10, n=15,187)<br>Other: 1<br><br>**Intervention/exposure description:**<br>The review aimed to include any screen time, but all included studies assessed TV viewing. These were assessed by parental reported TV viewing (in one study combined with accelerometer, and another with "stationary time") and direct observation of TV (in one study in combination with stationary time).<br>The RCT assessed an educational program to decrease TV viewing time.<br><br>**Outcome(s):**<br>Adiposity (BMI, BMI z-scores, percent body fat, tricep skinfold, sum of skinfolds, weight status, waist-to-hip ratio and prevalence of overweight or >95th percentile) | **Result(s):**<br>One prospective cohort reported on the relationship between TV viewing and BMI z-scores across young children (aged 0-6 years old). Increased TV viewing was associated with increased adiposity: each additional hour of commercial television (with advertisements) was associated with an increase of 0.11 BMI z score, although no significant association was seen with non-commercial TV viewing.<br>Four studies assessed the association of TV viewing on adiposity in toddlers (aged 1-2 years old). Three of these studies found a dose-response relationship between hours of TV watched and increased BMI (2 studies) and percent body fat (1 study). Due to inconsistencies in reporting in the review the absolute estimate of effect found in the studies cannot be extracted with any confidence [lists a result as an OR in the footnotes but is presented as a beta in the table. Also included results from Zimmerman and Bell in all tables, without mentioning the study in the bibliography for the table]. The fourth study divided toddlers into those who watched less than or more than 2 hours TV per day, and found no association between at least 2 hours TV viewing and adiposity.<br>1 RCT and 5 cohort studies looked at the association between TV viewing and adiposity in preschoolers. The RCT decreased the amount of TV watched, but had no significant effect on BMI. Of the 5 | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>TV watching often caregiver reported-caregivers may underestimate the time spent watching TV.<br><br>**Review team limitations:**<br><br>Population: only the age group was reported (weight status/health status NR) |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | prospective studies, one reported a dose-response relationship with body fat, and this study and one other reported that those who watched more television during the preschool period had higher skinfold measurements and BMI in later life (at age 6 and 11).<br><br>**Adverse Effects:**<br>No adverse effects associated with decreased TV viewing were found.<br><br>**Conclusions:**<br>The review found low- to moderate-quality evidence that increased television viewing is associated with unfavourable measures of adiposity. | |
| **Tremblay et al. 2011**<br><br>**Quality:** ++<br><br>**Search date:** Feb 2010<br><br>**Review design:**<br>Systematic review of all study designs including a specific measure of sedentary behaviour. Population-based studies (cross-sectional, cohort studies) had to have at least 300 participants, RCTs had to have at least 30 participants. Meta-analysis of RCTs.<br><br>**Review aim:**<br>To determine the relationship between sedentary behaviour and health indicators in | **Study participant inclusion criteria:**<br>Studies in children aged 5-17 years.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 7 (7, n=1,752)<br>Cohort: 32 (29, n=78,256)<br>Other: 172 (These included unspecified 'intervention' and cross-sectional studies)<br><br>**Intervention/exposure description:**<br>TV viewing, computer time, video game playing, or a composite measure of two or more screen activities (the majority of studies had time spent watching TV as the exposure). Screen time was assessed indirectly in the majority of studies (parent, teacher, or self-report questionnaires). One | **Result(s):**<br>A meta-analysis of RCTs of interventions designed to reduce sedentary time which reported screen time as their exposure and BMI as their primary outcome was performed (4 RCTs). It found an significant effect of -0.89kg/m2 decrease in mean BMI associated with the interventions (95% CI -1.67 to -0.11). The narrative recommendation and main finding from the cohort studies was that TV watching and overweight/obesity were related in a dose-response manner (i.e. those who watched more TV were more likely to be overweight/obese).<br><br>**Adverse Effects:**<br>NR | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>The meta-analysis result is based on a small number of RCTs.<br><br>Studies included in the review primarily used indirect measures (parent, teacher, self-report questionnaires) to assess screen time.<br><br>The majority of included studies were cross-sectional observational studies. Some studies |

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| school-aged children and youth aged 5-17 years.<br><br>**Review funding:**<br>Public Health Agency of Canada<br><br>**Study funding:**<br>Funding for the included studies was not reported<br><br>**Multifactor review:** Yes | study measured TV viewing through a monitoring device.<br><br>**Outcome(s):**<br>Body composition, including body mass index (BMI), sum of skin folds, percent body fat, and various composite measures. Outcome assessment methods NR. | **Conclusions:**<br>Each additional hour of TV viewing increased risk for obesity. More than 2 hours TV/day significantly increased risk for overweight/obesity (conclusion based on all study types). | had missing information on participant characteristics, many studies grouped variables into tertiles, or groups that took into account physical activity levels, and many strudies grouped classified participants as 'high users' if they wantched more than 2 hours of TV per day. This could have led the review to falsely conclude that 2 hours is the critical cut-off point.<br><br>**Review team limitations:**<br>Adjustment for confounders in the individual studies NR.<br><br>Method of measurement of outcomes NR.<br><br>Population: criteria other than age NR.<br>Setting: NR<br>Outcome: also included studies with fitness, metabolic syndrome and cardiovascular disease risk factors, self-esteem, behavioural conduct/pro-social behaviour and academic achievement outcomes. |
| **USDA 2010l**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2009<br><br>**Review design:**<br>Systematic review of RCTs, clinical controlled studies, large non-randomized observational studies, cohort studies, case- | **Study participant inclusion criteria:**<br>Healthy adults and children and with elevated chronic disease risk<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 8 (6, n=88,900 adults*)<br>Other: 1 (SR and meta-analysis)<br>*Some studies assessed exposure in childhood and outcome in adulthood | **Result(s):**<br>Adults<br>Eight prospective cohort studies examined the relationship between TV screen time and body weight in adults. All eight studies found a positive relationship between the variables.<br><br>Follow-up time ranged from 6 months to 17 years. One study assessed postpartum weight | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D, P<br>Unclear: Set<br><br>**Authors' limitations:**<br>NR |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| control studies, and systematic reviews and meta-analyses<br><br>**Review aim:**<br>To assess the relationship between screen time and body weight and/or adiposity<br><br>**Review funding:**<br>Funding not explicitly reported. Reviews written by the US Department of Agriculture to support development of their guidelines.<br><br>**Study funding:**<br>Funding sources not explicitly stated but study funding was considered for quality rating and validity.<br><br>**Multifactor review:** No | **Intervention/exposure description:**<br>Adults<br>Although all types of screen time were searched for, the included studies all assessed TV screen time. This included included measures such as mean hours per day or per week, average weeknight or weekend viewing, and categorical measures (often, sometimes, never, hardly) that were not further defined.<br><br>Where reported, methods of assessment included self-report, parental report.<br><br>Children<br>The review in children assessed TV, computer and video game use, no assessment methods were reported.<br><br>**Outcome(s):**<br>Adults<br>Outcomes included BMI, overweight, obesity, WC; assessment methods included self-report, research team measurement.<br><br>Children<br>The review in children assessed body fatness, no assessment methods were reported. | loss, and another was related to maintenance of long term weight loss, and are not discussed further in this review.<br><br>One study (n=927) found that both childhood TV viewing (age 5 to 15) was significantly associated with adult obesity at age 32 (OR 1.30, 95% CI 1.07 to 1.58 for each hour of mean childhood viewing). This relationship remained after controlling for adult viewing (OR 1.25, 95% CI 1.16 to 1.70 for each hour of mean childhood viewing).<br><br>One study (n=980) found that average weeknight TV viewing from ages 5 to 15 was associated with higher BMI at age 26 (data NR, p=0.0013), and that 17% of overweight in adults was attributable to watching TV for over two hours per day (Population Attributable Fraction 17%, 95% CI 7% to 25%).<br><br>One study in women only (n=50,277) reported that TV viewing was positively correlated with obesity risk, with each additional two hours per day of TV viewing being associated with a 23% (95% CI 17% to 30%) increase in obesity.<br><br>One study (n=16,587) reported that higher TV watching (hours/day NR) was association with a 0.30cm increase in WC (p=0.02).<br><br>One study (n=11,971) found that watching TV "often" (not further defined) at age 16 was | **Review team limitations:**<br>The six relevant studies included long follow-up and reasonably low drop-out rates, however, the date range of the studies may reduce applicability to current UK populations - childhood screen time exposure during the 1970s-1980s may not be comparable to current childhood screen exposure, especially in relation to computer and mobile device screen time. Conclusions should be restricted to TV viewing, and not other forms of screen-based sedentary behaviour.<br><br>The section of the review specifically on screen time in children did not meet inclusion criteria for the current review, as reviews of reviews were not included. The two studies assessing the effect of childhood viewing on adult weight-related outcomes are considered in the “children and young people” section of the current review. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | associated with a faster rate of BMI increase between ages 16 and 45 in both males (0.011kg/m2/year, 95% CI 0.0003 to 0.019) and females (0.013kg/m2/year, 95% CI 0.003 to 0.023).<br><br>One study (n=8,158) found that average childhood daily TV viewing on weekends predicted BMI z-scores at age 30 (coefficient 0.30, 95% CI 0.01 to 0.05, p=0.01). Each additional hour of TV viewing on the weekends at age five was associated with a 7% increased likelihood of adult obesity (OR 1.07, 95% CI 1.01 to 1.13, p=0.02).<br><br>Children<br>The review included one systematic review and meta-analysis in the section on children.<br>.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>There is strong and consistent evidence that screen time is directly associated with overweight and obesity in children and adults. The strongest association is for TV screen time.<br><br>This conclusion is based on all identified studies (including those with populations and study designs outside of the current review scope). | |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Wahi et al. 2011**<br><br>**Quality:** ++<br><br>**Search date:** Apr 2011<br><br>**Review design:**<br>Systematic review and meta-analysis of RCTs<br><br>**Review aim:**<br>To assess the impact of interventions aimed at reducing screen time in children<br><br>**Review funding:**<br>None reported.<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Age 18 or younger<br><br>**Total # studies (# relevant and n=):**<br>RCT: 13 total, 6 in meta-analysis (3, n=311)<br>Cohort: 0<br>Other: 0<br><br>**Intervention/exposure description:**<br>Of the 13 identified interventions, five were classroom based health promotion curricula, three included and individual or family counselling component for parents and children, four related to automated monitors for controlling screen time, one was a home-based screen time reduction intervention, and one involved a workshop and newsletter.<br><br>Four interventions included a dietary component, five included a physical activity component, and eight included neither dietary nor PA cointerventions.<br><br>Intervention duration ranged from 1 to 24 months (median duration 6 months); number of sessions ranged from 1 to 33 and session duration ranged from 30 minutes to 2 hours (where reported); session frequency ranged from once a week to once a month. The review did not state what type of screen time was being targeted in the individual included studies.<br><br>**Outcome(s):** | **Result(s):**<br>Across the 13 trials, average participant age ranged from 3.9 to 11.7 years. Two studies did not assess adiposity; 7 found no significant intervention effect; four found that the intervention decreased adiposity. Six trials were included in the meta-analysis (the other 7 trials either did not report the outcome of interest, or reported data in a manner incompatible with the planned analysis). Of these six trials, three were classroom based health promotion interventions.<br><br>Pooled analysis found a non-significant difference in mean change in BMI in the intervention vs. control groups (mean change -0.10, 95% CI -0.28 to 0.09, p=0.32; I2=38% and p=0.20).<br><br>**Adverse Effects:** NR<br><br>**Conclusions:**<br>Pooled analysis of low quality evidence showed no apparent effect of the interventions on reduction of BMI.<br><br>Five of the six studies included in the pooled analysis had no cointerventions addressing diet and/or physical activity, suggesting that interventions targeting screen time alone may be insufficient to effect a change in childhood adiposity. | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: Set<br>Unclear: P<br><br>**Authors' limitations:**<br>Based on GRADE criteria, the identified studies poorly reported partipant and assessor outcome blinding.<br><br>Lack of observed effect may be due to short intervention duration.<br><br>Seven trials were excluded from the analysis, some because unadjusted outcomes were not available; inclusion of these trials may have impacted the pooled effects.<br><br>**Review team limitations:**<br>Sample size ranged from 21 to 1,295.<br><br>Unclear whether participants were selected based on weight or health status; half of the studies included in the meta-analysis were classroom based. |

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| | Adiposity, assessed as mean BMI. Assessment methods NR. | | |

## Food and drink

### Alcohol

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| **Bendsen et al. 2013**<br><br>**Quality:** +<br><br>**Search date:** Nov 2010<br><br>**Review design:**<br>Systematic review and meta-analysis of all available cohort, case-control, cross-sectional and experimental studies describing the association between consumption of beer and an obesity measure.<br><br>**Review aim:**<br>To assess the evidence linking beer consumption to abdominal and general obesity.<br><br>**Review funding:**<br>The Dutch Beer Institute<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Adult men or women who were not in hospital or alcoholic.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 9 (7, n=157)<br>Cohort:10 (10, n=215,997)<br>Other:28<br><br>**Intervention/exposure description:**<br>Beer consumption – any frequency or amount, self-reported.<br><br>**Outcome(s):**<br>Abdominal and general obesity between 3 and 12.9 years follow up. Abdominal obesity was measured by WC or WHR, general obesity was measured by BMI or body weight. | **Result(s):**<br>Overall findings were mixed in terms of direction and significance of effect.<br><br>Results for the cohort studies were as follows:<br>Women (general obesity):<br>0 cohorts found a positive association<br>1 found no association (data NR)<br>1 found an inverse association(drinking five or more days/week association with 0.44kg/m$^2$ lower change in 10y BMI vs. non-drinkers)<br><br>Women (abdominal obesity):<br>3 cohort studies found a positive association (data NR in two studies, drinking >4 days/week association with 1.3 cm greater change in 6y WC vs. non-drinkers)<br>2 found no significant associations (one positive [0.25 cm increase in WC per MJ/day beer] and one inverse [10y OR abdominal weight gain 0.8 for drinking five or more days/week vs. non-drinkers])<br>2 found an inverse association (data NR).<br><br>Men (general obesity):<br>1 found a positive (U-shaped) association<br>1 found no association (direction positive, change in BMI per 250mL beer/cider regression coefficient=0.0045 kg/m$^2$)<br>1 found an inverse association (-0.11 kg/m2 | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Study results were reported in a number of very different ways e.g. linear trend associations for various obesity measures across beer intake categories, odds ratios for gain above a certain cutoff level, simple regression or correlation coefficients or simple comparisons of beer drinkers with non-drinkers.<br><br>**Review team limitations:**<br>The heterogeneity of results presented complicates comparison of findings across studies, and precludes presentation of a simple range of effects.<br><br>Partial: Study design included cross-sectional studies and experimental studies which were randomised parallel studies, monosequence crossover studies and randomised crossover studies.<br>Unclear: population appeared to be general population but it is not clear if they had any other illnesses.<br>Unclear: Setting |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | lower change in BMI in men drinking 5 days/wk or more compared with non-drinkers))<br><br>Men (abdominal obesity)<br>3 found a positive correlation (2 data NR; 1 found change in WC per 250mL beer/cider regression coefficient=0.0038 cm)<br>2 found no association (1 data NR; small positive association with 10y abdominal weight gain, OR 1.1).<br>2 were reported as inverse associations, however, both were non-significant (1 data NR; 5 year change in WC -0.14 cm per MJ/day beer)<br><br>RCT findings were as follows:<br>The experimental studies compared alcoholic beer versus no alcohol (3 randomised/3 non-randomised studies), or alcoholic beer versus low-alcohol or non-alcoholic beer (6 randomised) over 21 to 126 days. In most cases body weight was not the primary outcome of the study, and the review noted that the quality of the studies was generally low.<br><br>The 3 RCTs (n=120; mainly men; 1 crossover design) comparing alcoholic beer (330 to 1,125 mL/day; 20 to 41 g/day ethanol) versus no alcohol found no significant effect of beer on weight related outcomes (body | |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | weight or fat mass) over 21 to 30 days (figures not reported). This was supported by an overall meta-analysis of randomised and non-randomised studies (1 RCT, 2 non-randomised; mean difference 0.54 kg, 95% CI -1.00 to 4.50; I2=0%).<br><br>The 6 RCTs (n=287, all men; 4 with a crossover design) comparing alcoholic beer (4.6% to 5.0% ethanol by volume) versus low-alcohol or non-alcoholic beer (0% to 0.9% ethanol by volume) included 2 RCTs in overweight men with mild hypertension or stable treated essential hypertension. The difference in consumption between groups was reported in the text to be about 1.1 to 1.8L alcoholic beer consumption, or 40 to 64 g/day ethanol per day (figures presented in the tables differed).<br><br>All of these RCTs individually found that drinking alcoholic beer was associated with greater body weight over 21 to 126 days ($p<0.05$), and this was supported by meta-analysis (mean difference 0.73 kg, 95% CI 0.53 to 0.92; I2 = 0%).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Overall, the review found that the majority | |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | of observational studies (including cross sectional studies) either showed a positive or no association between beer intake and general or abdominal obesity in men, but results in women were less consistent. It concluded that there is insufficient evidence regarding the association between moderate beer consumption (<500mL/day) and general or abdominal, but that higher consumption (>500mL/day) may be positively associated with obesity. | |
| **Sayon-Orea et al. 2011**<br><br>**Quality:** +<br><br>**Search date:** Mar 2010<br><br>**Review design:**<br>The review included cross-sectional, prospective cohort and intervention trials.<br><br>**Review aim:**<br>The study aim was to analyse the effects of alcohol consumption on body weight.<br><br>**Review funding:**<br>NR<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Health or weight status not specified in the inclusion criteria.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 1 (0)<br>Cohort:13 (13, n=207,533)<br>Other: 19*<br>*Includes 2 baseline cross sectional analyses from included cohort studies.<br><br>**Intervention/exposure description:**<br>Cohort exposures: number of alcoholic drinks, the percentage energy intake from alcohol, alcohol from alcoholic drinks (g/day), number of standard drinks (12 g of pure alcohol).<br><br>**Outcome(s):**<br>BMI, weight gain, waist circumference and waist to hip ratio. | **Result(s):**<br>For weight gain and BMI the cohort studies found:<br>- a positive association between alcohol intake and weight gain or BMI in 5 studies (3 in men and 2 in women ; male drinkers at higher risk of obesity at 3.6y than non-drinkers OR 1.42; risk of BMI ≥28 kg/m2 at 5y greater in men with very heavy alcohol intake OR 1.42 [OR in light to moderate drinkers 0.92, NS]; OR for weight gain ≥5 kg at 8y among women drinking heavily [>2.2 drinks per day] versus non-drinkers 1.07 [NS], with significant OR 1.64 in women <35 years, also OR 2.43 for light drinking among African American women; lower BMI increases at 9y in male abstainers [-0.62 kg/m2] and females drinking less than once a month [-0.38kg/m2] than drinkers [quarter to half a glass per week]; ≥2 servings of alcohol per week positively associated with BMI at 1y in women [+0.11, type of statistic not reported, SE 0.05]); | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Use of self-reported weight, height and waist circumference and the tendency to underestimate weight and overestimate height.<br><br>**Review team limitations:**<br>These were a similar pool of cohort studies to those described in the USDA2010x [++] review. Two studies were included as cohort studies in this review, but they were not described as such by the USDA2010x [++] review.<br><br>Partial: study design included cross-sectional studies and intervention trials but only one |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | - an inverse association in 2 studies (1 in men and women and 1 in study of women): OR for overweight/obesity at 12.9y in women who drank ≥2.2 drinks/day vs. non-drinkers 0.73; OR for major weight gain among women drinking 1-6.9 drinks per week vs. non-drinkers at 10y 0.7, among men OR 1 [NS]<br><br>- no association in 2 studies (1 in men and women and 1 study in of women)<br><br>For waist circumference or waist to hip ratio the cohort studies also found mixed directions and significance of effect: a positive association in 3 studies, an inverse association in 1 study (in women), no association in 2 studies (1 in men and 1 in women).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>It is unclear whether alcohol consumption is a risk factor for weight gain because studies performed to date have found mixed results (in terms of direction and significance of associations). Positive associations were mainly found in studies assessing higher levels of alcohol consumption or spirits. The effect of different types of alcoholic beverages may vary. | was described as randomised, and this was in overweight or obese participants only.<br>Unclear: The setting seems to have included 2 schools.<br>Unclear: It was not clear if people were selected for being overweight/obese or had other health problems. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans.<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 20 (20, n= 375,421)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Exposure range: The included studies assessed either total alcohol intake or intake of different types of alcohol e.g. beer, wine, liquor.<br><br>Exposures were assessed as amount of wine, beer or spirits consumed per week, average number of alcoholic drinks per week, frequency of alcohol consumption, heavy alcohol consumption (based on median consumption), alcohol consumption in past year (yes/no)moderate alcohol consumption (based on median consumption), alcohol intake (g/day), MJ/d of alcohol energy, alcohol dietary pattern, frequency of alcohol use over 10 years, daily alcohol consumption, alcohol consumption (6 categories).<br><br>**Outcome(s):**<br>Participants were followed up between 1 and 18 years.<br>Outcomes included BMI, abdominal obesity, | **Result(s):**<br>Alcohol was not associated with change in BMI or other weight related outcomes in 14/20 of the studies (n=124,675; mixed directions of effect). The significant findings from the other 6 studies were also mixed in direction.<br><br>Inverse direction of effect (2 studies):<br>In 1 study (n=184,448), no association was found for wine, beer or liquor and waist circumference. However men drinking beer for more than 4 days per week gained less weight, BMI -0.11 kg/m2 (95% CI -0.19 to -0.03; p=0.007). Women drinking beer more than 4 days per week gained less weight, BMI -0.44 kg/m2 (95% CI -0.62 to -0.26; p<0.001) and similar results were found for wine and liquor in women. In 1 study (n=14,407 ), women who drank ≥2 units per day had an OR 0.5 (95% CI 0.3 to 1.0) for major weight gain (≥10lb). Men had an OR of 0.9 (95% CI 0.5 to 1.6).<br><br>Mixed positive and inverse associations by drink type and gender (1 study):<br>In 1 study (n=42,696), no association was found between total alcohol consumption or beer and waist circumference. However wine was associated with non-significant decreased waist circumference in women -0.39cm (95%CI -0.68, 0.10) and increased waist circumference in men 0.34 (95%CI 0.15-0.53). There was no change for men | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>There is evidence that people may under report their alcohol intake.<br><br>**Review team limitations:**<br>One study was a retrospective cohort study (n=75,039) relying on 40-70 year old women estimating what their weight was in early adulthood.<br><br>Unclear: Population appears to be the general public, but some studies have included people who stopped alcohol due to ill-health. Worldwide studies.<br>Setting not reported. |

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| | waist circumference, skinfold thickness and major weight gain (≥10lb). | drinking spirits but an increase for women of 1.15cm per MJ/day (95% CI 0.07 to 2.23; p=0.04).<br><br>Positive association (3 studies):<br>In 1 study (n=855) men who were drinking ≥30oz/month and then stopped lost 4.86kg while those that did not drink to start with who gained 0.3kg (p>0.001).<br><br>1 study (n=4,785) found no association in men, but in women the amount of alcohol consumed per week was positively correlated with increased waist circumference (reg coeff=0.01, 95%CI (0.03, 0.17, p<0.05).<br><br>1 study (n=3,555) found no association in women but in men who were heavy drinkers, weight circumference was significantly increased (p<0.05)<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>No specific conclusions were made for alcohol consumption. Overall the review concluded that the consumption of beverages of any type was not associated with a subsequent weight gain and obesity, although results were inconsistent. | |
| **USDA 2010x**<br><br>**Quality:** ++ | **Study participant inclusion criteria:**<br>Healthy individuals, those with elevated chronic disease risk, those diagnosed with | **Result(s):**<br>Results for weight were:<br>-One cohort study indicated that female | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:** |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Search date:** May 2009<br><br>**Review design:**<br>Systematic review of mixed study designs (RCTs and prospective cohorts)<br><br>**Review aim:**<br>What is the relationship between alcohol intake and weight gain?<br><br>**Review funding:**<br>Funding not explicitly reported. Reviews written by the US Department of Agriculture to support development of their guidelines.<br><br>**Study funding:**<br>Funding sources not explicitly stated but study funding was considered for quality rating and validity.<br><br>**Multifactor review:** No | the highly prevalent chronic diseases (coronary heart disease/cardiovascular disease, hypertension, T2D, osteoporosis, osteopenia and obese) and those with breast cancer, colon cancer or prostate cancer.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 1(0)<br>Cohort: 7(7, n=124,768)<br>Other:0<br><br>**Intervention/exposure description:**<br>Included cohorts recorded self-reported total alcohol consumption at baseline. Alcohol consumption was reported differently in each study - some in units per week, others in grams per day or according to the categories light, moderate or heavy.<br><br>**Outcome(s):**<br>Included trials compared change in weight, WC or BMI over 4 to 10 years. | drinkers (1 to 6.9 drinks per week) were less likely to have major weight gain (≥10 kg) than non-drinkers, but there was no effect for men (women: OR 0.7, 95% CI 0.5 to 0.9; men: OR 1.0, 95% CI 0.6 to 1.6).<br>-Two other cohort studies also found that alcohol consumption was not associated with substantial weight gain (average drinks per week in those who gained ≥10lb: 7.3 [SD 15.2] vs. 8.5 [SD 19.0] in those who did not, p=0.784; data not clear from other study but p=0.116 for men and p=0.734 women).<br>-Two studies (1 in men and 1 in women) found that light to moderate drinking appeared not to significantly increase weight, but heavy drinking was associated with increased weight (Men: adjusted OR for >4% weight gain over 5 years vs. stable none to occasional drinkers: stable light to moderate drinkers [1-20 units/week] 0.96, 95% CI 0.81 to 1.12, stable heavy drinkers [21-42 units/week] 1.29, 95% CI 1.10 to 1.51; Women: OR of weight gain >5kg vs. non-drinkers over 8 years: 0.94 to 0.86 for consumption categories between 0.1 and 29.9g alcohol per day [CIs indicating significant reductions], 1.07 for ≥30g per day [95% CI 0.89 to 1.28, p for quadratric trend=0.007). However, the study in women found that light drinking was associated with increased odds of weight gain in African American women.<br><br>Two studies looked at changes in waist | Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>The conclusions include the results of the RCT and cross-sectional studies.<br><br>Unclear population: 1 RCT was out of scope as it studied overweight or obese adults. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | circumference:<br>-1 found no significant association in total alcohol consumption and nine-year waist gain (data NR)<br>-1 found drinking was significantly inversely associated with major waist circumference gain ("major" not defined; OR vs. those drinking on >0 but <1 day a week: ranged from 0.97 [95% CI 0.73 to 1.28] among never drinkers to 0.79 [95% CI 0.69 to 0.9] for drinking 7 days a week, p<0.0001 for trend; data reported as similar for women).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Moderate evidence suggests that moderate drinking is not associated with weight gain. However, heavier consumption over time is associated with weight gain. | |

Confectionery

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 6 (4, n=19,144 adults; 1, n=881 children)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Adults<br>Exposures included: a 'sweet' or 'healthy' dietary pattern (not further defined), servings of sweets (not defined) per week, servings of sweets (desserts and candy) per day, sweets (chocolates, pralines, candy bars, ice cream and sugar; g/day). 'Servings' were not defined.<br><br>These were assessed using FFQ alone or with interview, and 7 day food records.<br><br>Children<br>Exposures were: frequency of sweets (desserts and candy) consumption, energy intake from fructose sucrose, and added sugars.<br><br>They were assessed with a maternal questionnaire (not further described), or 24 hour dietary recall assessed by a dietician. | **Result(s):**<br>Adults<br>Follow up in the studies ranged from 25 months to 12 years.<br><br>Results of the studies varied with 2 finding no association, 1 finding an inverse association, and 1 finding mixed directions of effects in different analyses:<br><br>Non-significant effects:<br>One study (n=783) found that people with a dietary pattern in the 'sweets' cluster did not differ in BMI or WC change over 2 years to those with a pattern in the 'healthy' cluster (regression coefficient for change in WC 0.17 cm; for change in BMI 0.04 kg/m2, both non-significant, p values not reported).<br><br>One study (n=556) found that the total servings of 'sweets' (not defined) per week at baseline was not associated with change in BMI over 12 years (regression coefficient for effect of unit change in servings per week on weight: -0.31 [units NR], p=0.52).<br><br>Inverse association:<br>One study (n=436 women) found that those who gained >10 lb in weight over 4 years reported eating fewer (p=0.015) servings of sweets (desserts and candy) at baseline (0.9 servings, SD 0.9) compared with those who gained <10 lb (1.5 servings, SD 2.3). The OR | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Definitions of "sweets" used in the studies varied. Few studies adjusted for physical activity levels but all adjusted for at least some potential confounders.<br><br>**Review team limitations:**<br>This section of the Summerbell review was called "sugar (as foods)" as opposed to "sugar (as nutrients)". The exposures assessed were largely "sweets", and included items such as candy, chocolate, desserts and ice cream where defined. Definitions in the individual studies varied. Although this section of the review dealt with sugars as foods, one of the studies in children looked at fructose, sucrose, and added sugar intake. One study in adults looked at dietary pattern as whole and results may not reflect the effect of confectionery specifically. Although the studies were reported to have adjusted for potential confounders it was unclear exactly what these were. The relevant cohort study in children was small. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | **Outcome(s):**<br>Outcomes included BMI, weight, WC, and ≥10lb weight gain<br><br>Outcomes were measured in all studies, except in the largest study in adults, where it was measured at baseline and self reported at follow up. | for gaining 10 lb given an increased consumption of sweets at baseline was 0.74, (95% CI 0.6 to 0.91; p=0.004).<br><br>Mixed associations:<br>One large study (n=17,369) found that men who reported higher 'sweets' intake at baseline (chocolates, pralines, candy bars, ice cream and sugar) were at increased risk of both large weight gains (OR 1.48, 95% CI 1.03 to 2.13; p<0.05) and small weight losses (OR 1.43, 95% CI 1.07 to 1.90; p<0.05). Women who reported lower 'sweets' intake at baseline were more likely to have large weight loss (OR for higher versus lower sweets intake 0.67, 95% CI 0.49 to 0.92; p<0.05). These ORs were described as "relative to those who had remained weight stable over the study period". The weigth change categories were described as being predefined, but definitions were not reported in the review.<br><br>Children<br>Follow up in studies ranged from 1 year to 10 years.<br><br>One study (n=881) found that the frequency of 'sweets' intake at baseline did not affect the risk of being overweight at 10 year follow-up (figures NR). Risk of overweight was significantly increased if the mother did not know her child's 'sweets' intake at baseline (OR 4.5, 95% CI 1.7 to 12.1; | Population (i.e. weight status) and setting for the individual studies was unclear. |

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| | | p<0.003).<br><br>The second study (n=1,030) found that energy intake from fructose, sucrose and added sugars was not associated with weight gain at 1 year. However, this study did not assess confectionery specifically and therefore was not relevant to the "confectionery" part of the current review scope.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The evidence reviewed suggested that sugars as foods (also fats and oils as foods) were not associated with levels of subsequent excess weight gain and obesity, although results are inconsistent. They noted that these foods can be classified as high-energy-dense foods. | |

Dietary pattern

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Fogelholm et al. 2012**<br><br>**Quality:** +<br><br>**Search date:** NR<br><br>**Review design:**<br>Systematic review of cohorts with a follow up of more than 1 year and RCTs.<br><br>**Review aim:**<br>The purpose was to examine the associations of dietary macronutrient composition, food consumption and dietary patterns in prevention of weight or waist circumference gain, with and without prior weight reduction.<br><br>**Review funding:**<br>Nordic Council of Ministers<br><br>**Study funding:**<br>Funding sources were not reported<br><br>**Multifactor review:** Y | **Study participant inclusion criteria:**<br>Adults aged 17 to 80 years. No inclusion criteria for body weight status.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 5 (5, n=529,768)<br>Other:0<br><br>**Intervention/exposure description:**<br>3 cohorts used an index of the Mediterranean diet (based on the consumption of positive [e.g. fruit, vegetables, legumes, whole grains, fish, olive oil] and negative [e.g. meat and dairy] food items). One cohort used the Mediterranean Diet Score (MDS) on a scale of 0 to 9: the index was based on consumption of positive items - vegetables, fruit and nuts, legumes, MUFA:SFA, moderate alcohol consumption, fish; negative items - meat, poultry and dairy. A second cohort used a scale of 0 to 18 to assess adherence to the Mediterranean diet (MED), and the third assessed adherence to a Mediterranean dietary pattern (MDP).<br><br>2 cohorts used the American Diet Quality Index. In one case this was reported to measure compliance with US dietary recommendations on fat intake (<30% of energy), saturated fatty acids (SFA, <10% of energy), cholesterol (<300mg/day), sodium (<2.4g/day), carbohydrate (>50% energy); | **Result(s):**<br>Mediterranean diet:<br>In one cohort (n=15,339), those with lowest adherence to a Mediterranean diet (≤3 points on MDS score) had the highest average yearly weight gain whereas participants with the highest adherence (≥6 points on MDS score) exhibited the lowest weight gain at mean follow up 5.7 years (adjusted difference: -0.059 kg/y, 95% CI not clearly reported as only one figure shown [0.008 kg/y]; p for trend =0.02).<br><br>In a second cohort (n=497,735) with Mediterranean diet assessed on a scale of 0 to 18, greater adherence (a two point increase in score) predicted less weight gain in 5 years (-0.05kg, 95%CI -0.07 to -0.02). High adherence (11-18 points) predicted 0.16kg (95% CI -0.24 to -0.07) less weight gain in 5 years compared with people with low adherence (0 to 6 points).<br><br>In the third cohort (n=7,908), lowest baseline MDP-scores showed a higher weight gain at 28 months, but the inverse association did not remain significant after adjusting for confounders (figures NR).<br>US dietary guideline adherence:<br>In the 20 year cohort (n=4,913), high adherence (high diet quality) was associated with significantly less weight gain than low adherence (11.2 vs. 13.9, units NR). Overall | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Mixed methods of assessing weight as well as dietary intake and different follow-up periods.<br><br>The Mediteranean diet studies were judged to be subject to some bias but not enough to invalidate results.<br><br>One of the studies of guideline adherence was judged to be at a low level of potential bias, and the final study was judged to be subject to some bias but not enough to invalidate results.<br><br>**Review team limitations:**<br>Drop-out in the 20 year cohort assessing US dietary guideline adherence was relatively high (28%).<br><br>The review covered multiple factors and did not provide its own defintion of the Mediterranean diet.<br><br>Population: unclear<br>Setting: unclear |

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| | the exact amounts were only reported in one cohort and may have differed in the other. One study used the DQI score to generate 3 categories of low, medium and high diet quality.<br><br>FFQ was used to assess diet in 4/5 cohorts, and a 3 day dietary record in the other cohort.<br><br>**Outcome(s):**<br>Three studies on Mediterranean diet measured change in self-reported weight after 2 to 11 years. The cohorts measuring adherence to American Dietary Guidelines measured weight gain. | HR risk for 10kg weight gain was 0.75 (95% CI: 0.65 to 0.87) for high diet quality compared with low.<br><br>The second US dietary guideline adherence study (n=3,873) found that higher adherence (higher DQI score) was associated with lower weight gain over 8 years (p for trend <0.01; beta for 1-unit difference in DQI 0.48 lb for men and -0.60 lb for women).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>There is suggestive evidence that meeting the US dietary recommendations is associated with less weight gain. Evidence on the Mediterranean diet is inconclusive. | |
| **Kastorini et al. 2011**<br><br>**Quality:** +<br><br>**Search date:** Apr 2010<br><br>**Review design:**<br>Meta-analysis of prospective cohorts, cross-sectional and clinical trials including RCTs.<br><br>**Review aim:**<br>To meta-analyse epidemiological studies and clinical trials that have assessed the effect of a Mediterranean diet on metabolic syndrome as well as its components. | **Study participant inclusion criteria:**<br>No population inclusion<br><br>**Total # studies (# relevant and n=):**<br>RCT: 11 (0)<br>Cohort: 1 (1, n=2,563)<br>Other: 4 (0)<br><br>**Intervention/exposure description:**<br>The Mediterranean diet was reported by the review as including high consumption of monounsaturated fatty acids (mainly from olives and olive oil), encouraging daily consumption of fruit, vegetables, whole grain cereals, and low fat dairy products; | **Result(s):**<br>For the cohort, (n=2,563) the mean difference in WC in cm between the highest versus the lowest diet score was -0.5 (-1.96 to 0.96) but this was not statistically significant, p value NR. This analysis was adjusted for total energy intake and other confounders.<br><br>Results of the RCTs and other studiy types are not reported here as they are outide of the scope of the current review.<br><br>**Adverse Effects:**<br>NR | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D, P<br>Unclear: Set<br><br>**Authors' limitations:**<br>The meta-analysis finding for WC was mainly attributed to 1 RCT (n=101) that found a beneficial effect of the Mediterranean diet for people who were overweight or obese.<br><br>**Review team limitations:**<br>The section on the effect of a Mediterranean |

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| **Review funding:**<br>Funding was not reported.<br><br>**Study funding:**<br>Funding sources were not reported.<br><br>**Multifactor review:** No | weekly consumption of fish, poultry, tree nuts and legumes; a relatively low consumption of red meat (about twice per month), and moderate daily consumption of alcohol, normally with meals. However, it was unclear whether it required studies to comply with this definition to be included.<br><br>The cohort had their diet assessed using the Mediterranean Diet Scale. It is not reported how or when this information was taken.<br><br>**Outcome(s):**<br>The cohort was followed up for at least a year according to inclusion criteria for prospective studies for the review, but the exact amount of time was not recorded. Whether WC was a self-measurement or not was not reported. | **Conclusions:**<br>The meta-analysis of clinical studies revealed a benefit of the Mediterranean diet on metabolic syndrome and its individiual components, including waist circumference, with results supported by epidemiological studies.<br><br>(This conclusion was based on meta-analysis of the RCTs in overweight and obese individuals, and/or those with high cardiovascular risk, ischaemic heart disease, type 2 diabetes or metabolic syndrome, as well as cross sectional studies.) | diet on waist circumference does not mention the cohort study. It only discusses the three cross-sectional studies and the RCTs. The result for the cohort is only in a table.<br><br>Partial: Study design included cross-sectional studies. The RCTs included only people who had comorbid illness and/or overweight/obesity<br><br>Unclear: Setting |
| **Kuhl et al. 2012**<br><br>**Quality:** -<br><br>**Search date:** NR<br><br>**Review design:**<br>Systematic review of any study design (included cross-sectional, longitudinal and experimental studies). Prevention programs included cluster RCTs,<br><br>**Review aim:**<br>The aim of the review was to examine what | **Study participant inclusion criteria:**<br>Preschool children ages 2-5 years old and weight outcomes reported. Weight and health status not specified.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 1 (1, n=7,758)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Researcher-developed questionnaire classifying children's diets as junk, healthy, traditional and fussy types. Questionnaire | **Result(s):**<br>Diet type at age 3 was not related to obesity status at age 7 (figures NR).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>NR | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>Limited information was provided on individual studies, which were broadly grouped according to exposure assessed in |

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| is known about behavioural correlates of obesity in preschool children and to review prevention and intervention programs in order to develop an optimized intervention to reduce obesity.<br><br>**Review funding:**<br>Grants from the National Institutes of Health<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | used multiple times from birth to age 7.<br><br>**Outcome(s):**<br>Obesity status at age 7. | | tables, but not clearly separated in the results reporting.<br><br>Unclear: Population recruitment and health status.<br>Unclear: Setting |
| **Smithers et al. 2011**<br><br>**Quality:** +<br><br>**Search date:** Dec 2009<br><br>**Review design:**<br>Systematic review of randomized, cross-sectional, and prospective observational studies.<br><br>**Review aim:**<br>To evaluate whether whole-of-diet patterns of children between 1 and 5 years of age are associated with later health and development.<br><br>**Review funding:**<br>Conduct of the systematic review and preparation of the manuscript was not supported by grant funds. Two authors were | **Study participant inclusion criteria:**<br>Children between the ages of 1 and 5 who were born at full term. Studies of children with known disease states were excluded. No criteria was provided for weight status.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 2 (2, n=5,292)<br>Other: 8<br><br>**Intervention/exposure description:**<br>Both cohorts used data driven analysis (principal components analysis) to identify dietary patterns from FFQs.<br><br>2 studies (n=782; n=1,841) used data from the same cohort, full diet was assessed with a maternal FFQ at baseline when the child was 12 months old. Dietary patterns compared in 1 study were the "infant guidelines" pattern | **Result(s):**<br>In the first study (n=782), higher "infant guidelines" pattern score at 12 months was associated with increased lean mass but not fat mass or BMI (figures NR). In a second study (n=1,841) that used data from the same cohort, there was no effect of either pattern score (infant guidelines or adult foods pattern) on weight or skinfolds. However, this assessment appeared to be cross sectional (i.e. outcomes and exposures both assessed at 12 months).<br><br>In a second (separate) cohort (n=4,510), the 'meat' pattern, but not other patterns were associated with increased odds of BMI>85th percentile (OR 1.37, 95% CI 1.04 to 1.81).<br><br>**Adverse Effects:**<br>NR | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Limited evidence available.<br><br>**Review team limitations:**<br>The review included additional studies looking at non-weight related outcomes, which are not described here.<br><br>It is not clear when the outcomes reported in the second cohort were assessed.<br><br>Partial: Study design included cross-sectional surveys. One study appears to have used cross-sectional data for the BMI |

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| supported with fellowships from the National Health and Medical Research Association of Australia.<br><br>**Study funding:**<br>Funding sources were not reported.<br><br>**Multifactor review:** No | (including home-prepared foods, cooked and salad vegetables, beans, meat, fish egg, cheese, and fresh fruit) and the "adult foods pattern" (including cow's milk white bread, french fries, potato chips, processed meat, tinned vegetables, biscuits, and sweets).<br><br>The second cohort had 6 patterns at age 3 - meat, staples, noodles and pasta, fruit and vegetables, breakfast foods, and snacks (no further detail provided).<br><br>**Outcome(s):**<br>For the cohort with diet assessed at 12 months, lean mass, fat mass and BMI were measured aged 4 were assessed in 1 study and weight and skinfolds was assessed in the other cohort. In the other cohort, it is not clear when the BMI was measured. | **Conclusions:**<br>Given the limited evidence, further studies are needed to establish the predictive validity of whole of diet methods in childhood. | measurement at baseline.<br>Unclear: population health and health status not reported<br>Unclear: Setting |
| **Vadiveloo et al. 2013**<br><br>**Quality:** +<br><br>**Search date:** Jun 2012<br><br>**Review design:**<br>Systematic review of cross-sectional, case-control, cohort and experimental studies.<br><br>**Review aim:**<br>To examine the evidence of the associations between dietary variety and measures of | **Study participant inclusion criteria:**<br>Healthy population. No criteria reported for weight status.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 3 (0)<br>Cohort: 1 (1, n=100,886)<br>Other: 22 (21 cross sectional, one non-randomised intervention study)<br><br>**Intervention/exposure description:**<br>130 item FFQ administered 1986 and 1990 in men; 1984, 1986 and 1990 in women. From | **Result(s):**<br>In the one cohort study relevant to the current review scope, dietary variety via the Recommended Foods Score was found to be protective against obesity in men, but the reverse in women:<br><br>-Men (n=38,615): mean BMI was significantly lower in individuals who had the highest RFS (quintile 5, Q5) compared to the lowest scores (25.4 kg/m2 in Q5 vs. 25.6 kg/m2 in Q1; p for trend <0.001) | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Definitions and measurements of dietary variety were inconsistent across studies.<br><br>**Review team limitations:**<br>It is unclear whether the change in BMI |

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| adiposity and its consistency across epidemiological studies.<br><br>**Review funding:**<br>American Heart Associations Founders Affiliate Predoctoral Fellowship<br><br>**Study funding:**<br>Funding sources were not reported.<br><br>**Multifactor review:** No | this, a Recommended Foods Score(RFS) was taken which measures the number of 23 recommended foods consumed at least weekly.<br><br>**Outcome(s):**<br>Self-reported BMI after 8 to 12 years. | -Women (n=62,271): mean BMI significantly higher in individuals who had the highest RFS compared to the lowest scores (25.0 kg/m2 in Q5 vs. 24.7 kg/m2 in Q1; p for trend <0.001).<br><br>Across all study designs the review reported that variety in recommended foods was mostly inversely associated (6 of 10 studies) or non-significantly associated (3 of 10 studies) with body adiposity; however, variety in non-recommended foods (e.g. sources of added sugars and solid fats) was associated with increased likelihood of excess adiposity in most studies (6 of 9 studies).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Dietary variety was inconsistently associated with adiposity in varied populations. This was contributed to by differing definitions and measurement of dietary variety. | refers to the initial report and the last follow-up. It is also unclear whether all of the FFQs were taken into account over the time period when determining a persons Recommended Foods Score.<br><br>One additional study was described as a longitudinal study, but was then listed under cross sectional studies in a table. This has not been reported here.<br><br>Partial: The majority of studies were cross-sectional.<br>Unclear: Population health professionals, health and weight status unclear.<br>Unclear: Setting |

**Fruit and vegetables**

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| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 8 (adults 7, n=107,643*; children 1, n=16,882)<br>Other: 0<br>* numbers differed between text and evidence tables, this number is based on the text except for the largest study where the number from the evidence table was used basedon checking the original paper<br><br>**Intervention/exposure description:**<br>Adults<br>Exposures included: servings/day; servings/day; g/day; sum of servings of fruits, juices, vegetables and green salads; fruit and vegetables (non-including French fries); and fruit and vegetables (not otherwise specified)<br><br>Studies used validated FFQs, dietary history questionnaires to assess exposures.<br><br>Children<br>Exposures were assessed via FFQ, and included:<br>Fruit and vegetables (not including French fries) | **Result(s):**<br>Adults<br>Follow up in the studies ranged from 1 to 10 years. Results were split into fruits and non-starchy vegetables combined, general fruits, non-starchy vegetables, and starchy vegetables (roots, tubers and plantains; not reported here).<br><br>Fruits and non-starchy vegetables combined:<br>- three studies (n=10,457) found no correlation between fruit and vegetable intake and weight gain or WC in adults (2 studies data NR; 1 study regression coefficients for WC -0.03 in women and 0.002 in men at 6 years [unit of exposure not defined]).<br><br>Fruits (general, not further defined) four studies (n=24,269) found no significant associations between fruit consumption and weight related outcomes in adults after adjusting for potential confounders (regression coefficient for change in body weight per serving per week 0.400; results not clearly reported for other studies but appeared to be mixed directions of effect of small size i.e. OR for weight change [not defined] 0.94 low vs. high fruit intake, OR for weight change 1.03 high vs. low fruit intake; mean change in body weight 0.77 in low fruit group vs. 0.68 in high fruit group [exposure and outcome units not defined]). | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>Adjustments made in the individual studies were not fully reported.<br><br>Population and setting unclear. |

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| | **Outcome(s):**<br>Outcomes included BMI, weight, WC, and ≥10lb weight gain<br><br>Outcomes were assessed were assessed by the research team in 3 studies, and via self-report or not stated in the remaining studies. | Vegetables (non-starchy) - Four studies (n=97,186) assessed non-starchy vegetables only and reported varying, but mainly non-significant, results:<br><br>One study (n=79,236) reported an inverse association with 10-year BMI change (mean BMI change in highest vs. lowest consumption quintile -0.12 kg/m2, 95% CI -0.22 to -0.02 [minus sign for the upper CI missing in Summerbell, based on original publication this 95% CI should indicate non-significance]). The review reported that high vegetable consumption was also inversely associated with WC in men (OR 0.81 [CI NR]) and women (OR 0.71 [CI NR]), however the significance of this comparison and details of the exact exposure and outcome units were not reported.<br><br>One study (n=116) reported that women with increased BMI over one year were significantly less likely to eat cruciferous vegetables (OR 0.15, 95% CI 0.05 to 0.52, p<0.001).<br><br>Two studies (n=17,834) found no significant associations between vegetable consumption and weight related outcomes (regression coefficient for servings per week and change in body weight -0.05 [units NR]; OR for weight change over time high intake vs. low intake 0.99 [CI NR]). | |

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| | | Children<br>Fruits and vegetables - One study (n=16,882; age range 9 to 14 years) reported no relationship between intake of fruit, vegetables or fruit and vegetable combined and three year changes in BMI z-scores in children aged 9 to 14 at baseline (regression coefficients: ranged from -0.003 for non-starchy vegetables in boys to 0.001 for fruit in boys, with values for girls also lying in this range; exposure units NR).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Fruits and non-starchy vegetables are not associated with subsequent weight gain and obesity. | |
| **USDA 2010e**<br><br>**Quality:** +<br><br>**Search date:** July 2009<br><br>**Review design:**<br>Systematic review of mixed study designs (prospective cohorts, RCTs, case-control study, cross-sectional studies).<br><br>**Review aim:**<br>In adults, what is the relationship between the intake of vegetables and fruits, not | **Study participant inclusion criteria:**<br>Adults aged 19 years and older. Population inclusion criteria was healthy people and those with elevated chronic disease risk.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 3 (0)<br>Cohort: 3 (3, n=163,701)<br>Other: 1 case-control study, 4 cross-sectional studies<br><br>**Intervention/exposure description:**<br>Cohort exposures: baseline fruit and vegetable intake, vegetable and/or fruit | **Result(s):**<br>Overall the review reports the 3 cohorts showed a weak inverse relationship between vegetable and fruit consumption and weight gain.<br><br>Individual cohort results:<br><br>1 cohort (n=89,432) of men and women found fruit and vegetable intake was weakly inversely associated with weight change (6.5 year follow up); per 100 g intake of fruit and vegetables, weight change was -14 g per year (95% CI -19 to -9 g per year, p value | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>Review conclusions are based on study designs that match (RCTs and prospective cohorts) and do not match the scope review |

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| including juice, and body weight?<br><br>**Review funding:**<br>Funding sources not explicitly reported. Reviews written by the US Department of Agriculture to support development of their guidelines.<br><br>**Study funding:**<br>Funding sources not explicitly stated but study funding was considered for quality rating and validity.<br><br>**Multifactor review:** No | intake<br><br>Cohort exposure assessments: NR<br><br>**Outcome(s):**<br>Cohort outcomes: change in weight, risk of obese and weight gain (not further defined).<br><br>Cohort outcome assessment: NR<br><br>Follow up in the 3 cohorts was 6.5 years, 10 years and 12 years. | NR).<br><br>1 cohort (n=74,063) of women with a 12 year follow up found those with the largest increase in fruit and vegetable intake had a 24% lower risk of becoming obese compared with those who had the largest decrease in intake after adjustment for age, physical activity, smoking, total energy intake and other lifestyle variables (RR 0.76; 95% CI 0.69, 0.86; p<0.0001). For major weight gain (25 kg or more), women with the largest increase in intake of fruits and vegetables had a 28% lower risk compared to those in the other extreme group (RR 0.72; 95% CI 0.55, 0.93; p=0.01). Similar results were observed for changes in intake of fruits and vegetables when analysed separately (no further detail or figures provided).<br><br>1 cohort (n= 206) found 10-year weight gain was significantly lower with increasing quartile of fruit and vegetable intake (p=0.0001). Compared to participants in the lowest quartile of fruit consumption (less than 149 g per day), participants in the third quartile (249 to 386 g per day) reduced their risk of gaining more than 3.41 kg by 69% (OR 0.31, 95% CI 0.11, 0.85; p=0.044; unclear why the 3rd quartile was selected for reporting, or why the weight change threshold was set at 3.41 kg). For vegetable intake, the risk of weight gain was lowest in participants with the highest intake (fourth | (Case-control and cross sectional studies).<br>2 of the 3 RCTs assessed weight loss programs and a third RCT was carried out in obese adults, and as these interventions and populations were outside the scope of this overview, results have not been extracted for the RCTs.<br><br>Study design: Partial - the review included study designs on fruit and vegetables outside the scope of this review (case-control studies and cross-sectional studies)<br>Population: 1 cohort reported the population at baseline were free of cardiovascular disease (CVD), cancer and diabetes, but it is unclear in the remaining 2 cohorts if participants were selected based on weight status or if they had selected conditions. |

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| | | quartile, more than 333 g per day), who had an 82% reduced risk of gaining 3.41 kg or more over the 10-year period (OR 0.18, 95% CI 0.05, 0.66; p=0.017). For fruits and vegetables combined, the risk of weight gain decreased with increasing intake, with the lowest risk among those with the highest intake (fourth quartile; OR 0.22, 95% CI 0.06, 0.81; p=0.022).<br><br>**Adverse Effects:** NR<br><br>**Conclusions:**<br>There is modest evidence for an association between increased fruit and vegetable intake and lower body weight, with a trend towards decreased weight gain over 5 or more years in middle adulthood. | |
| **USDA 2010t**<br><br>**Quality:** ++<br><br>**Search date:** July 2009<br><br>**Review design:**<br>Systematic review of RCTs and cohorts (treatment trials of less than 8 weeks not including duration of follow up were excluded as were prevention trials of less than 6 months not including duration of follow up). Definitions of treatment and prevention trials not provided.<br><br>**Review aim:** | **Study participant inclusion criteria:**<br>Children and adolescents aged 0 to 18 years (range 2 to 14 yrs)<br><br>**Total # studies (# relevant and n=):**<br>RCT: 1 (0)<br>Cohort: 6 publications of 5 cohorts (4 cohorts, n=25,428)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Fruit and vegetable intake and parental feeding practices (not further detail provided), usual number of fruit and vegetable servings/day, diet (not further defined). | **Result(s):**<br>Overall, 1 study found evidence for an inverse protective association between dietary intake of fruits and vegetables and adiposity in a subsample of children, based on gender (1 cohort). Results from the other 3 cohorts (4 studies) found no association between intake of fruits and vegetables and adiposity in children.<br><br>Individual study results:<br>1 cohort (n=971) found greater parental offering of fruit was associated with reduced adiposity gain bu this did not reach significance (figures NR, p=0.06). Actual reported intake of fruits and vegetables was | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Interpretation of results and comparison of results across studies is hampered by lack of uniformity as to which vegetables and fruits were included in each respective food group, or whether fruit juice was included in the fruit food group. In addition, none of the studies rigorously assessed or adjusted for implausible energy intake and all used body |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| Is intake of fruits and vegetables associated with adiposity in children?<br><br>**Review funding:**<br>Funding sources not explicitly reported. Reviews written by the US Department of Agriculture to support development of their guidelines.<br><br>**Study funding:**<br>Funding sources not explicitly stated but study funding was considered for quality rating and validity.<br><br>**Multifactor review:** No | Assessment was by parent completed questionnaires (not further defined) on children's fruit and vegetable intake, Youth/Adolescent Questionnaire (YAQ - a self-administered semi-quantitative FFQ), questionnaire (not further defined)<br><br>**Outcome(s):**<br>Adiposity gain (not further defined), BMI Z score, weight change.<br><br>Outcome assessment: weight and height obtained from study records (not further defined) (n=1), self-reported weight and height (n=1), weight and height measured (not further defined) (n=2).<br><br>Follow up was 3 years in 1 cohort and unclear in the remaining cohorts. | NS associated with adiposity gain (figures and p value NR).<br><br>1 cohort (n=14,918; also included in the review by Summerbell et al 2009 [++]) found NS associations between intake of fruits, fruit juice or vegetables (alone or combined) and subsequent change in BMI z-score among girls (figures and p value NR). Among boys intake of fruit/fruit juice was not predictive of changes in BMI; vegetable intake was inversely associated with change in BMI z-score (beta=-0.003) but this was NS after data were adjusted for total energy intake (figures and p value NR). After adjusting for total energy intake, fruit intake (beta=0.003 for girls and beta=0.002 for boys) was predictive of having slightly larger BMI z-score at the end of the follow up period (significance NR; unclear follow up).<br><br>1 cohort (n=1,379) found a 0.09 kg weight change (95% CI 0.05 to 0.13 kg) for each additional serving of vegetables in multivariate, energy-adjusted models (p value NR). When all food groups were considered in a single model, relationship between vegetable intake and weight change was NS (figures and p value NR). Intake of fruit was NS related to weight change in any of the models tested and this finding remained when fruit juices were excluded from analyses (figures and p value NR). | mass index (BMI) as an estimate of fatness, which has been shown to be a poor measure of adiposity in children.<br><br>**Review team limitations:**<br>2 of the cohort studies were reported to use the same cohort, but it is unclear which studies this referred to .<br>Some studies included fruit juice in addition to fruit and vegetable intake and did not separate results.<br>The conclusions were based on all included studies, including 1 RCT and 1 cohort study not relevant to the current review scope.<br><br>Population: 1 cohort included children who were overweight at baseline (results not extracted for this study) and it is unclear if the remaining 5 cohorts had populations that were selected based on weight status or selected conditions. 1 RCT also included overweightchildren (>85$^{th}$ BMI percentile).<br><br>Setting: Unclear |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | 1 cohort (n=8,170) found NS associations between vegetable or fruit intake and weight change over 3 years (figures and p value NR).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>A limited body of evidence suggests that greater intake of fruits and/or vegetables may protect against increased adiposity in children and adolescents (Grade of evidence: Limited). (The conclusion was based on all included studies, including 1 RCT and 1 cohort study not relevant to the current review scope, both of which found a protective effect of higher fruit and vegetable intake). | |

**Fruit juice**

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br><br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 7 (1 in adults, n=7,194; 6 in children, n=20,114)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Reported exposures included 100% fruit juice and fruit juice not otherwise defined. 1 cohort in children assessed sugar sweetened beverage consumption including fruit juices.<br><br>Exposure assessment included FFQ<br><br>**Outcome(s):**<br>Outcomes included weight, BMI, ponderal index (kg/m3), obesity (not further defined), adiposity (not further defined), excess weight gain (not further defined)<br><br>Height and weight were measured in all children's studies, and self-reported in the adults study.<br><br>Follow up in the study on adults was 28 months. Follow up in the studies on children ranged from 3 years to 11 years (also described as 10 years, 11 months). | **Result(s):**<br>Adults<br>One study (n=7,194) reported that consumption of sweetened fruit juice was not associated with increased likelihood of weight gain over 28 months after adjusting for potential confounders, including energy intake (figures NR). No studies of unsweetened juice were identified.<br><br>Children<br>Overall, directions of effect were mixed (where reported), with two studies finding an inverse direction of effect (for BMI and ponderal index), one both inverse and positive directions of effect (for fat mass) depending on length of follow up, and two a positive direction of effect (for weight and obesity risk). All but one of the findings (for ponderal index) were non-significant.<br><br>100% fruit juice: Two cohorts (n=17,304) in pre-school children with follow ups of 8.4 months to 3 years found no significant association between 100% fruit juice and changes in weight or BMI (1 cohort [n=72]: regression coefficient [exposure unit unclear] for association with BMI -0.057, p=0.09; 1 cohort [n=17,232] regression coefficients [oz/day] for change in body weight: 0.01, p=0.15; change in BMI: 0.001, p=0.31). One of the cohorts (n=72) found fruit juice was inversely associated with | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Assessment methods varies, and definition of fruit juice was not standard across studies.<br><br>Studies adjusted for some potential confounders, but not for overall physical activity levels.<br><br>**Review team limitations:**<br>Sample sizes in children's studies ranged from 72 to 17,304; three studies had sample sizes of n<500.<br><br>Adjusting for energy intake may reduce any assocations. The cohort study in adults and 1 study in children were reported to adjust for energy intake; whether the other studies adjusted for energy intake was unclear.<br><br>Population and setting was unclear across studies. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| | | ponderal index at a borderline level of significance (regression coefficient -0.065 kg/m3, p=0.05).<br><br>Fruit juice (not further defined): Four cohorts (n=2,810) with follow up ranging from 3 to 11 years found no association between fruit juice consumption (not further defined) and changes in weight or BMI (1 cohort; correlation coefficient for BMI -0.117, for weight NR), adiposity (regression coefficient [per serving – not further defined] for fat mass at 2 year follow up: 0.25, p=0.14; at 4 year follow up: -0.11, p=0.66), excess weight gain in adolescence (figures or p value NR) or obesity in adolescence (1 cohort, OR for obesity in adolescence for participants who often consumed juices at age 3: 1.24, 95% CI 0.83 to 1.86, p value NR).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>No specific conclusions were reported for fruit juice; the review concluded that there were no associations between consumption of beverages of any type and subsequent weight gain or obesity, although results were inconsistent. | |
| **USDA 2010s** | **Study participant inclusion criteria:**<br>No information on inclusion criteria for | **Result(s):**<br>Children | **Applicable to the UK:** Yes |

Bazian

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| **Quality:** ++<br><br>**Search date:** Jul 2009<br><br>**Review design:**<br>Systematic review of cohort studies.<br><br>**Review aim:**<br>To assess whether intake of 100% fruit juice is associated with adiposity in children<br><br>**Review funding:**<br>Funding not explicitly reported. Reviews written by the US Department of Agriculture to support development of their guidelines.<br><br>**Study funding:**<br>Funding sources not explicitly stated but study funding was considered for quality rating and validity.<br><br>**Multifactor review:** No | weight or health status.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 12 (12, n=47,201)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Although the review stated that it was assessing 100% fruit juice consumption, exposures were reported as: fruit juice consumption (not further defined), consumption of beverages (not further defined) including fruit juice, beverage consumption (not further defined), changes in beverage consumption patterns, diet (not further defined), excess fruit juice intake (not further defined), juice intake (not further defined), sweet drink consumption including fruit juice.<br><br>Exposure assessment: intake of fruit juice was assessed in a number of ways including FFQ, 24 hour diet recall, 3 day weighed food records and parental questionnaires. One study looked at children consuming less than 12oz per day compared to those consuming more than 12oz per day.<br><br>**Outcome(s):**<br>Self-reported or measured BMI, weight change, weight, or adiposity.<br><br>Follow up ranged from 1 to 6 years. | 8 cohorts (n=33,627) found no association between intake of fruit juice and adiposity in children. One cohort (n=8,170) was reported at one point in the text as finding no association for girls (figures or p value NR) but a positive association for boys (figures or p value NR), but at 2 other places in the text and table as finding no associations between as finding no association between fruit juice consumption and weight change over 3 years.<br><br>2 cohorts (n=11,875) found no association in normal weight children, but found a positive association for children who were at-risk of overweight or who were overweight at baseline: the OR was 1.3 to 1.5 in 1 cohort, reported as borderline significance ( p value NR); in the other cohort, for children at risk of overweight at baseline, each additional daily serving of fruit juice intake (not further defined) was associated with an additional BMI z-score increase of 0.009 SD per month, ($p<0.01$), and boys showed a greater adiposity increase than girls, ($p=0.04$).<br><br>1 cohort (n=244) found no association for boys (figures or p value NR), but a positive association for girls (change in beverage intake significantly predicted change in BMI-SDS –for each MJ of fruit juice consumed, BMI-SDS increased by 0.096 units ($p=0.01$). As change in consumption and change in BMI was assessed over the same time period it is | **Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>Although the review reported that it assessed 100% fruit juice, only 3 out of the 12 individual cohort studies were explicitly described as assessing 100% fruit juice.<br><br>It is unclear if the cohorts were all identified from the literature search or if some of them were identified from an earlier conducted systematic review.<br><br>1 cohort is reported to be a cross-sectional in the evidence table but it is described as a cohort everywhere else and it followed children for 3 years.<br><br>Results for 2/12 studies were explicitly reported as being adjusting for energy intake; adjustments for the other studies were unclear. Adjusting for energy intake may remove associations.<br><br>It was unclear whether the analyses in overweight or obese children were a priori or post hoc. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | not possible to say which change preceded the other.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Limited and inconsistent evidence suggested that for most children, intake of 100% fruit juice was not associated with increased adiposity, when consumed in amounts that are appropriate for age and energy needs of the child. However, intake of 100% juice was prospectively associated with increased adiposity in children who are overweight or obese. | Population: It is unclear if the population was chosen for their weight status and if they had any other illnesses.<br>Unclear: Setting |

Bazian

Legumes

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 2 (2, n=23,688)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Exposures were legume intake (g/day) in both cohorts with follow up of 2.2 years (reported as 2 years in the results) or 28 months (2.3 years). Both cohorts used a FFQ (semi-quantitative FFQ in 1 cohort) to assess dietary intake (self administered in 1 study, NR in 1 study).<br><br>**Outcome(s):**<br>Weight (measurement NR), weight change (self reported) | **Result(s):**<br>No studies identified that were specifically in children.<br><br>1 study (n=17,369) found for men, the consumption of legumes (not further defined) predicted small weight change losses over 2 years (OR 0.68, 95% CI 0.49 to 0.94, p<0.05; exact comparison and outcome unclear). No significant association found between legume consumption and weight change in women (OR for highest vs. lowest legume consumption: 0.71, CI or p values NR; exact outcome unclear).<br><br>1 study (n=6,319) found NS association between varying levels of legumes intake at baseline and weight gain over 28 months (mean weight change 0.58 in the lowest legume group vs. 0.57 in the highest legume group, units NR, p for trend = 0.96).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The epidemiological evidence that pulses (legumes) are not associated with levels of subsequent excess weight gain and obesity is limited and generally consistent. | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>It is unclear if participants from the 2 cohorts were overweight, obese or had specific conditions.<br><br>Population: Unclear, it is unclear if participants from the 2 studies were overweight, obese or had specific conditions.<br>Setting: Unclear |
| **USDA 2010o**<br><br>**Quality:** + | **Study participant inclusion criteria:**<br>Children aged 2 to 18 years and adults aged 19 years and above. Population inclusion | **Result(s):**<br>No studies identified specifically in children. | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:** |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| **Search date:** Aug 2009<br><br>**Review design:**<br>Systematic review of a mixed study designs including a meta-analysis of unclear study designs, 2 systematic reviews of unclear study designs, 3 RCTs, 1 non-RCT, 1 cohort and 1 cross-sectional study.<br><br>**Review aim:**<br>What is the relationship between the intake of cooked dry beans and peas and body weight?<br><br>**Review funding:**<br>Funding not explicitly reported. Reviews written by the US Department of Agriculture to support development of their guidelines.<br><br>**Study funding:**<br>Funding sources not explicitly stated but study funding was considered for quality rating and validity.<br><br>**Multifactor review:** | criteria were healthy people and those with elevated chronic risk disease (not further defined). To be included studies had to have at least 10 subjects per study arm.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 3 (2, n=83)<br>Cohort: 1 (1, n=1,418)<br>Other: 1 non-RCT, 1 cross-sectional, 1 meta-analysis (unclear study design, n=NR), 2 SRs (unclear study designs, n=NR)<br><br>**Intervention/exposure description:**<br>Beans and peas, not including soy:<br>1 crossover RCT compared a chickpea-supplemented diet (140 g/day; as canned, drained chickpeas, chickpea bread and chickpea shortbread biscuits provided by the researchers) vs. a wheat-supplemented diet for at least 5 weeks (washout NR).<br>1 crossover RCT compared a chickpea supplemented diet (140 g/day; similar foods to other RCT, unclear if provided) vs. a wheat based diet for 5 weeks with a 6 to 8 week washout between interventions, followed by an additional low fibre diet for 3 weeks (this part of the trial appeared un-randomised).<br><br>Soy foods:<br>1 cohort assessed the relationship between lifetime soy consumption and BMI among women (5 year follow up). Dietary intake was assessed by a self-administered Diet and | Beans and peas, not including soy:<br>2 crossover RCTs (n=83) comparing chick-pea to wheat-supplemented diets found NS differences in body weight or BMI (figures NR, p>0.2 for 1 crossover RCT).<br><br>Soy foods:<br>1 cohort (n=1,418) found women who consumed high levels of soy over their lifetime (childhood and adult) had lower BMI (figures NR, p<0.0001). The study also found a link between adult soy intake and BMI, but it was unclear whether this analysis was solely cross sectional. This study was reported as a prospective cohort, but it appeared to assess soy intake retrospectively and assess relationship with current BMI. Women with high adult soy intake had 0.9 kg/m2 lower BMI than those with low intake (high and low intakes not defined; p=0.002). After stratification by ethnicity, the effect was only significant for Caucasians (p=0.001) with a 2.35 kg/m2 lower BMI for the high adult soy intake category as compared to the low intake category.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Limited evidence exists to establish a clear relationship between intake of cooked dry beans and peas and body weight. | Complete: None<br>Partial: D, P<br>Unclear: Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>Both RCTs had small populations (n=52 and n=31) and were of short duration and may not have been large or long enough to detect a change in weight or BMI. Both trials were mainly focusing on effect on serum lipids rather than weight.<br><br>The cohort study focused on consumption of soy foods and it is unclear what was considered a soy food. Results are reported separately for studies interested in beans and peas (not including soy) or soy foods.<br><br>Comparator: Partial, 2 crossover RCTs had comparators outside the scope of the review (wheat-supplemented).<br>Population: Partial, inclusion criteria of the review were healthy and those with elevated chronic risk. 1 of the RCTs targeted weight loss in only obese people and has not been extracted. The cohort included women from 2 previous studies and reported women from 1 of these studies were primarily post-menopausal.<br>Study design: Partial, included some study designs outside scope of review (1 non-RCT, |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | Health Questionnaire (DHQ) and a Life-time Soy Questionnaire (LTSQ).<br><br>**Outcome(s):**<br>Weight, BMI, WC. Assessment method for outcomes NR for any study. | | 1 cross-sectional, 1, meta-analysis of unclear study designs, 2 SRs of unclear study designs).<br>Setting: Unclear |

Meat

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Fogelholm et al. 2012**<br><br>**Quality:** +<br><br>**Search date:** NR<br><br>**Review design:**<br>Systematic review of cohorts with a follow up of more than 1 year and RCTs.<br><br>**Review aim:**<br>The purpose was to examine the associations of dietary macronutrient composition, food consumption and dietary patterns in prevention of weight or waist circumference gain, with and without prior weight reduction.<br><br>**Review funding:**<br>Nordic Council of Ministers<br><br>**Study funding:**<br>Funding sources were not reported<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>Adults aged 17 to 80 years. No inclusion criteria for body weight status.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohorts: 8 (8, n=623,922)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Exposures were: meat eating, fish-eating, vegetarian and vegan (not further defined); meat consumption (red meat, processed meat and poultry, not further defined); adherence to a Mediterranean dietary pattern (not further defined); different food groups (not further defined); different food and beverage groups (not further defined); change in food consumption at baseline of each 4 year period (20 year follow-up) (not further defined); red meat consumption (not further defined).<br><br>Exposure assessment was by FFQ in 4 cohorts, semi-quantitative FFQ in 3 cohorts and 1 dietary questionnaire (not further defined). 5 cohorts reported validated questionnaires.<br><br>Exposure assessment (e.g. self report) was NR in all studies.<br><br>Follow up ranged from 2 to 20 years. | **Result(s):**<br>Of 8 cohorts looking at meat (general), poultry, processed meat, unprocessed meat or red meat, 6 found significant associations with increased weight gain, 2 found NS association and 1 found significant associations with decreased weight gain (BMI and waist circumference reported to not be separated).<br><br>Meat:<br>3 cohorts (n=380,122) found intake of meat (general) was significantly association with increased weight gain; strength of evidence rated as probable.<br>-1 cohort found mean annual weight gain was higher in meat eaters (406 g, 95% CI 373 to 439 in men and 423 g, 95% CI 403 to 443 g in women) than in vegans (284 g, 95% CI 178 to 390 g in men and 303 g, 95% CI 211 to 396 g in women; p value NR). In this study fish eaters (women only) also had lower annual weight gain (338 g, 95% CI 300 to 376 g) than meat eaters (p value NR).<br>-1 cohort found a 100 kcal/day increase in meat consumption was associated with a 30 g (95% CI 24 to 36 g) annual increase in weight (reported to be significant for all types of meat with the strongest association found for poultry (no further detail provided).<br>-1 cohort found higher meat consumption at baseline was associated with greater weight | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>The review authors report 2 studies were not totally independent, with1 based on a subgroup of a larger cohort study and another that was reported to use the entire cohort for analyses. No further detail provided.<br><br>**Review team limitations:**<br>2 cohorts in this review are also reported by Summerbell et al. (++).<br><br>Vegan diets are likely to involve broader changes than just amount of meat consumed; therefore comparison of weight outcomes in meat eaters and vegans may not solely reflect the effect of meat consumption alone.<br><br>Population: 1 cohort reports including vegans, vegetarians and the general population; 1 cohort included apparently healthy people, 1 cohort included the general population, 1 cohort reported to exclude people with chronic conditions. Populations NR in 2 cohorts. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | **Outcome(s):**<br>Outcomes included: annual weight gain during follow up; 5 year weight change; change in weight and BMI; changes in WC; weight change (mean of 4 year periods); WC.<br><br>Outcome assessments were by self-report in 3 cohorts and were NR in 4 cohorts. 1 cohort reported using a validated outcome.<br>1 other cohort had weight measured or self-reported at baseline and self-reported at follow up. | gain over 28 months (0.41 kg vs. 0.85 kg in lowest vs. highest third of consumption [not further defined]).<br><br>1 cohort (n=42,696) found intake of poultry was significantly associated with increased WC for women (beta-coefficient 0.19, 95% CI 0.01 to 0.37 [assessed against 60 kcal of food item]) but not men (figures NR). The evidence on poultry was rated as inconclusive.<br><br>1 cohort (n=120,877) found intake of processed meats was significantly associated with increased weight gain (0.42, 95% CI 0.36 to 0.49 for average 4 yr. weight gain in kg against changes in servings).<br><br>Of 2 cohorts (n=91,327) on intake of processed meat and WC, 1 cohort had a significant association with WC (beta-coefficient 0.04, 95% CI 0.02 to 0.06) whilst 1 cohort found a significant association for women (beta-coefficient 0.20, 95% CI 0.04 to 0.36 [assessed against 60 kcal of food item]) but not men (figures NR). The evidence on processed meats was rated as inconclusive.<br><br>Of 2 cohorts (n=128,071) on intake of red (unprocessed) meat and weight, 1 cohort had a significant association with increased average 4 year weight gain (0.43 kg, 95% CI 0.25 to 0.61 kg) and one had no significant association with weight gain (figures NR). | Setting: Unclear |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | Of 2 cohorts (n=45,132) on intake of red meat and waist circumference, 1 cohort was significantly associated with decreased waist circumference (β coefficient -0.13, 95% CI -0.24 to -0.03 for women; -0.06, 95% CI -0.11 to -0.003 for men) and 1 cohort had no significant association with waist circumference (figures NR). The evidence on red meats was rated as inconclusive.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Probable evidence was found for a positive asssociation between intake of meat and weight gain. | |
| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 6 (6, n=219,671)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Exposures included: g/day, meat consumption (not further defined), meat products (not further defined), red meat servings/week,. | **Result(s):**<br>No studies were identified specifically in children.<br><br>Adults:<br>For the individual results reported below, exposures associated with each result were not reported unless specified.<br><br>Meat (not further defined; 4 cohorts): 3 cohorts found at least one positive association between meat and weight or waist circumference, while 1 study found no association with waist circumference (mixed direction of effect by gender). Individual | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: Set, P<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>Population: Unclear if populations were representative of the general population<br>Outcome measurement method NR. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | Exposure assessment: FFQ 2 cohorts, semi-quantitative FFQ in 2 cohorts, FFQ and interview in 1 cohort and dietary questionnaire in 1 cohort.<br><br>Follow up ranged from 2.2 to 12 years.<br><br>**Outcome(s):**<br>Weight, change in weight, change in BMI, WC, change in WC. | results:<br><br>-2 cohorts (n=190,767) found significant positive associations between higher consumption of meat and increase in BMI, waist circumference or weight at 28 months' to 10 years' follow up (weight gain at 28 months: +0.82 kg, 95% CI 0.59 to1.04, p for trend ≤0.001; highest quintile vs. lowest quintile of consumption, difference in BMI increase at 10y: 0.34 kg/m2 in men, 0.19 kg/m2 in women [p<0.001 for both]; OR for gaining weight at the waist at 10y: men OR 1.46 [95% CI 1.25 to 1.71] and women OR 1.50 [95% CI 1.20 to 1.87]).<br>-1 cohort (n=17,369) found a significant association of meat intake with decreased risk of large weight loss in men but not women at 2.2 year follow up (highest vs. lowest meat consumption; men: OR 0.79, 95% CI 0.63 to 1.00, p<0.05; women: OR 0.81, CI or p value NR)<br>-One cohort (n=3,785) found no significant associations with meat intake and waist circumference (regression coefficient -0.1 for men, 0.21 for women; p values NR)<br><br>Fresh meat (not further defined):<br>No cohorts identified.<br><br>Processed meat (not further defined):<br>1 cohort (n=17,369) found a significant association between processed meat consumption and a decreased risk of a large | Population: 1 cohort reports including vegans, vegetarians and the general population; 1 cohort included apparently healthy people, 1 cohort included the general population, 1 cohort excluded people with chronic conditions and populations were NR in 2 cohorts. It is unclear if people included in the cohorts were overweight, obese and for some of the cohorts it is unclear if populations had specific conditions.<br>Setting: Unclear |

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| | | weight loss was found in women (highest vs. lowest consmuption: OR 0.75, 95% CI 0.61 to 0.93, p<0.05) but not men (OR 1.08, CI or p value NR) over 2 years.<br><br>Red meat:<br>-1 cohort (n=7,194) found that high level of red meat intake (>128.7 g/day) was associated with higher risk of weight gain of borderline significance at a follow up of 28 months (OR 1.16, 95% CI 1.00 to 1.36, p value NR), although this result did not remain significant following multivariate adjustment (figures NR).<br>-1 cohort (n=556) found no significant association between red meat consumption and weight change after 12 years (regression coefficient 0.245, 95% CI -1.42 to 1.91, p=0.77)<br><br>Fish (3 cohorts):<br>All 3 cohorts (n=27,473) looking at fish intake found no significant association:<br>1 cohort (n=17,369) found NS association between fish intake and weight change over 2.2 years (OR for lowest vs. highest fish consumption: 0.92 for women and 1 for men, CI or p values NR).<br>1 cohort (n=3,785) found NS association between fish intake and change in waist circumference over 6 years' follow up (regression coefficient for women -0.07, men -0.08; units of exposure and outcome and p value NR). | |

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| | | 1 cohort (n=6,319) found NS association between fish consumption and weight change over 28 months' follow up (mean change in body weight [units NR] 0.71 in the lowest fish consumption group vs. 0.88 in the highest consumption group, p for trend 0.92).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Higher total meat intakes are associated with greater subsequent excess weight gain and obesity, although results are inconsistent. However, the evidence also suggests that there is no association between processed meat or red meat consumption and the level of subsequent weight gain or obesity over time. Therefore, although the evidence suggests a positive association between meat intake and weight gain, the results are not robust. | |
| **USDA 2010n**<br><br>**Quality:** +<br><br>**Search date:** Sept 2009<br><br>**Review design:**<br>Systematic review of mixed study designs (cohorts, RCTs and cross-sectional studies)<br><br>**Review aim:** | **Study participant inclusion criteria:**<br>Population inclusion criteria were children aged 2 to 18 years and adults aged 19 and older<br><br>**Total # studies (# relevant and n=):**<br>RCT: 1 (0)<br>Cohorts: 1 (1, n=1,152)<br>Other: 1 (cross-sectional)<br><br>**Intervention/exposure description:** | **Result(s):**<br>No studies identified specifically in children.<br><br>1 cohort (n=1,152): NS differences for BMI or WC at 10 year follow up for thirds of red or processed meat consumed at baseline (figures NR). However, a 10 g increase in red meat consumption from baseline to 10 year follow up was associated with a 0.3 cm increase in WC of men (p=0.035) and women (p=0.048) at 10 year. A similar association | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D, P<br>Unclear: Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:** |

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| What is the relationship between the intake of animal protein products and body weight?<br><br>**Review funding:**<br>Department of Agriculture to support development of their guidelines.<br><br>**Study funding:**<br>Funding sources not explicitly stated but study funding was considered for quality rating and validity.<br><br>**Multifactor review:** No | High consumption of red or processed meat (not further defined; self recorded using 5-day diary) over 10 years.<br><br>**Outcome(s):**<br>BMI, WC(both measured by researchers in cohort; assessment method NR in RCT), body mass, fat mass, fat-free mass (assessment method NR in RCT). | was reported to be found for consumption of processed meat (figures NR).<br><br>If red and processed meat were combined, the men with the highest consumption at baseline had significantly higher BMI (p=0.027) and WC (p=0.009) at follow up (no further figures reported).<br><br>Additional results were also presented, but these appeared to be cross sectional analyses.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Insufficient evidence is available to link animal protein intake and body weight. | The population in the RCT were overweight postmenopausal women, so not relevant to the current review scope, and its findings are note reported here. It is unclear if the population in either study were overweight/obese or had specific conditions.<br><br>Study design: Partial, included studies outside scope of review (cross-sectional)<br>Population: Partial, the RCT population were postmenopausal women and the authors refer to the women as overweight (inferred inclusion criteria for BMI greater than 25 kg/m). The population in the cohort was a birth cohort and appears to be representative of the general population.<br>Setting: Unclear |

Fish

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 3 (3, n= 27,473)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Exposures included: g/day, fish consumption (not further defined).<br><br>Exposure assessment: FFQs<br>Follow up ranged from 2to 6 years.<br><br>**Outcome(s):**<br>Change in weight, change in WC. | **Result(s):**<br>No studies were identified specifically in children.<br><br>Adults:<br>All 3 cohorts (n=27,473) looking at fish intake found no significant association:<br>1 cohort (n=17,369) found NS association between fish intake and weight change over 2.2 years (OR for lowest vs. highest fish consumption: 0.92 for women and 1 for men, CI or p values NR).<br>1 cohort (n=3,785) found NS association between fish intake and change in waist circumference over 6 years' follow up (regression coefficient for women -0.07, men -0.08; units of exposure and outcome and p value NR).<br>1 cohort (n=6,319) found NS association between fish consumption and weight change over 28 months' follow up (mean change in body weight [units NR] 0.71 in the lowest fish consumption group vs. 0.88 in the highest consumption group, p for trend 0.92).<br>Results were reported to be highly adjusted (confounders not fully listed, included BMI and sociodemographic factors for individual studies).<br><br>**Adverse Effects:**<br>NR | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: Set, P<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>Population: Unclear if populations were representative of the general population<br>Outcome measurement method NR.<br><br>Population: It is unclear if people included in the cohorts were overweight, obese and for some of the cohorts it is unclear if populations had specific conditions.<br><br>Setting: Unclear |

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| | | **Conclusions:**<br>The evidence suggests that there is no association between fish consumption and level of subsequent weight gain or obesity over time. | |

**Milk and other dairy**

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| **Abargouei et al. 2012**<br><br>**Quality:** ++<br><br>**Search date:** Oct 2011<br><br>**Review design:**<br>Systematic review and meta-analysis of RCTs<br><br>**Review aim:**<br>To summarise the published evidence from RCTs regarding the effect of dairy consumption on weight, body fat mass, lean mass and waist circumference in adults.<br><br>**Review funding:**<br>NR<br><br>**Study funding:**<br>Funding sources were not reported.<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Adult population, no inclusion criteria specified for weight or health status.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 16 (unclear)<br>Cohort: 0<br>Other: 0<br><br>**Intervention/exposure description:**<br>In the trials without energy restriction, 3-5 daily servings of dairy products compared to normal diet in 4 studies. Daily 1300-1400mg calcium via dairy products in one study, and an increase of 610mg of calcium via milk in another compared to normal diet. 1 study compared 3 daily servings of milk with normal diet. The latter 3 trials appeared not to specifically be in overweight or obese participants.<br><br>**Outcome(s):**<br>Weight change was assessed after between 21 and 144 weeks. 4 studies also reported on fat mass, and 3 studies reported on lean mass and 2 on waist circumference. | **Result(s):**<br>Subgroup meta-analysis was performed for studies with energy restriction (n=10) and without energy restriction (n=5). One RCT was considered in both categories. Sub group analysis of studies with energy restriction are not reported here as most of these RCTs appeared to be in overweight or obese participants.<br><br>The meta-analysis of non-energy restricted RCTs found not significant effect on weight related outcomes:<br><br>Weight change: 5 RCTs (n=453) with follow up between 21 and 48 weeks found WMD for weight change of 0.33kg (95% CI -0.35 to 1.00, p=0.34, heterogeneity: p=0.67).<br><br>Fat mass: 4 RCTs (n=253); WMD -0.16kg (95% CI -0.97 to 0.66, p=0.71; significant between study heterogeneity (p=0.02).<br><br>Lean body mass: 3 RCTs (n=NR); WMD 0.35kg; 95% CI -0.15 to 0.86, p=0.17.<br><br>Waist circumference: 2 RCTs (n=NR); WMD -2.68cm; 95%CI -8.02 to 2.66 p=0.32<br><br>3 RCTs appeared not to specifically be in overweight or obese individuals baserd on study titles. In the two RCTs using added fluid milk as the intervention participants | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: Set, P<br><br>**Authors' limitations:**<br>Owing to the small number of studies that presented data for lean mass and waist circumference, excluding each study could change the overall effect size.<br><br>**Review team limitations:**<br>No information was provided on the weight of the participants in any of the studies.<br><br>The review did not assess the different types of dairy products separately.<br><br>Population: The weight and health status of the population was not reported, but titles of the included studies suggested that at least 12 were in overweight or obese participants.<br><br>Setting: unclear |

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| | | gained more weight than controls (no data reported for 1 study, no overall data presented for 1 study [figures presented by gender in forest plot, both showing non-significant trend for increase]), and in the third RCT (adding dairy products) there was no effect on weight or fat mass (mean difference in weight 0.70 kg, 95% CI -0.74 to 2.14; mean difference in fat mass 1.0, 95% CI -0.25 to 2.25). The review noted that total energy intake increased in the dairy groups where weight increased (data NR), but not in the trial which found no effect, and this could explain results.<br><br>**Adverse Effects:** NR<br><br>**Conclusions:**<br>Increasing dairy consumption to recommended daily intakes in adults who do not follow any calorie restricted diet, would not affect weight, fat mass, lean body mass and waist circumference. | |
| **Louie et al. 2011**<br><br>**Quality:** ++<br><br>**Search date:** Apr 2010<br><br>**Review design:**<br>Systematic review of prospective cohort studies.<br><br>**Review aim:** | **Study participant inclusion criteria:**<br>People of all ages and weights were included. There was no inclusion criteria for health status.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 19 (9 adults, n=93,006/10 children, n=18,529)<br>Other: 0 | **Result(s):**<br>Children and adolescents:<br>6/10 (n=5,193) studies in children and adolescents aged 2 to 14 years old reported no significant association (direction of association NR in 5 studies, 1 study reported a weak inverse association between a 100g increase in daily dairy intake associated with a 0.002 kg/m2 decrease in BMI), while 3/10 studies (n=507) reported an inverse (protective) association between dairy | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>The unit of measure of dairy consumption was inconsistent among the studies, with some reporting weight/volume of dairy |

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| To examine the relationship between dairy consumption and overweight/obesity.<br><br>**Review funding:**<br>Dairy Australia<br><br>The authors declare that Dairy Australia had no influence on the review process or the conclusions drawn.<br><br>**Study funding:**<br>Funding sources were not reported.<br><br>**Multifactor review:** No | **Intervention/exposure description:**<br>Children: total milk intake, milk only, total dairy (given as calcium equivalents of 240 ml milk), total dairy.<br><br>Adults: total dairy, full cream dairy only, milk only, low fat/skim milk and yoghurt, total dairy and low fat dairy, low fat and high fat dairy products.<br><br>Intake was measured using FFQ and 3 to 7 day recall.<br><br>**Outcome(s):**<br>Outcomes were change in BMI in 8/19, body weight 8/19, body fat 6/19, waist circumference 5/19 and a few studies measured skinfold thickness, waist to hip ratio and obesity.<br><br>Children: change in BMI, change in BMI per year, change in body fat (as gram or %), change in % body fat, change in fat mass, sum of skin fold thickness, change in weight (lb) per year, BMI >85th percentile.<br><br>Adults: change in weight (kg), odds of mean weight gain (kg) of 1 or more kg per year, change in WC, , change n sum of skin fold thickness, change in % body fat, change in WHR, obesity (BMI >30 or WHR >0.85 [f]/0.90 [m]), change in truncal fat.<br><br>Overall, follow up was over 7 months to 12 | consumption and overweight/obesity: two studies assessed change in body fat, and found that each serving of dairy was associated with a 0.35 to 0.91kg reduction in body fat or body fat 3 to 4 years later ($p<0.01$); one study found that higher consumption of dairy at age 3 to 6 was associated with a lower BMI 8 years later (21.1kg/m$^2$ in lowest tertile vs. 19.9kg/m$^2$ in highest tertile of consumption; p for trend = 0.046). One study (n=12,829) reported a positive association with BMI in children aged 9 to 14 years: consuming >3 servings of milk per day was associated with a BMI 0.081 kg/m2 higher in boys and 0.093 kg/m2 higher in girls over 4 years than those consuming ≤0.5 servings of milk per day ($p<0.05$ for both); this study did not adjust for total energy intake, and this was suggested to account for the positive relationship seen.<br><br>Adults:<br>One study (n=1,124) showed no association between dairy consumption and weight related outcomes (BMI, weight, WC, WHR; figures NR).<br><br>5 studies (n=70,352) showed a significant inverse (protective) association (protective exposures included cheese, whole milk and sour milk, total dairy, high fat dairy, milk and milk drinks, low fat dairy, milk and yoghurt; exposure units not usually quantified but included per serving and per 1 | consumed while others reported servings of dairy per day, with varying definitions of serving size used.<br><br>Meta-analysis was not possible on the studies either in children or in adults, because of the high heterogeneity of the studies as well as inconsistent exposure and outcome measures.<br><br>**Review team limitations:**<br>The review was funded by Dairy Australia - the national service body for dairy farmers and the industry.<br><br>Most studies adjusted for total energy intake, this would reduce ability to detect an effect if dairy foods were solely having an effect via total energy intake.<br><br>The review did not assess the different types of dairy products separately.<br><br>Population: health status not recorded. Unclear if they were chosen for their weight status.<br>Setting: unclear if any of the studies occurred in the school or workplace. |

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| | years, with the majority over 5 years. Follow up in the adult studies was 7 months to 12 years. Follow up in the children studies was 8 months to 10 years. | daily eating occasion where reported; OR ranged from 0.70 to 0.85). One of these studies found a protective effect of low-fat dairy but not total dairy (figures NR).<br><br>3 studies (n=21,530) found both positive and inverse associations depending on the type of dairy and the population subgroup assessed: one found a protective effect (inverse association) of yoghurt in men who were initially overweight but a detrimental effect (positive association) in normal weight women (figures NR); one study reported that increased high-fat dairy intake at baseline protected against weight gain (mean weight change in kg [SE] for lowest and highest quintiles: Q1 3.24 [0.11] vs. Q5 2.86 [0.11], p for trend= 0.03), while the opposite was found for total dairy (Q1 2.57 SD 0.13 vs. Q5 3.14 SD 0.11, p for trend =0.001) and/or high fat dairy (mean Q1 2.70 SD 0.14 vs. Q5 3.27 SD 0.11, p for trend <0.001); the third found that for waist circumference, skimmed and partly skimmed milk was associated with a protective effect (beta -0.23 [SE 0.09], p=0.02), while low-fat yoghurt was associated with a detrimental effect (beta 0.42 [SE 0.19], p=0.02).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Even though there was a much higher | |

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| | | proportion of studies among adults which showed a protective effect, the association between dairy consumption and weight status does not seem to be consistent in either children/adolescents and adults. However, the review concluded that at the very least dairy products showed no harmful effect on weight status, in both children and adults. | |
| **USDA 2010r**<br><br>**Quality:** +<br><br>**Search date:** Aug 2009<br><br>**Review design:**<br>Systematic review of systematic reviews, RCTS and cohort studies in children.<br><br>**Review aim:**<br>Is intake of calcium and/or dairy (milk and milk products) related to adiposity in children?<br><br>**Review funding:**<br>Funding not explicitly reported. Reviews written by the US Department of Agriculture to support development of their guidelines.<br><br>**Study funding:**<br>Funding sources were not reported.<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Children up to the age of 18. No inclusion criteria on health or weight status.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 5 (1, n=59)<br>Cohort: 12 (12, n=35,799)<br>Other: 3<br><br>**Intervention/exposure description:**<br>The RCT compared a calcium-rich diet (target: 1,500mg calcium per day; average 1,656mg calcium per day) or normal diet (average 961 mg calcium per day) for 2 years in girls. This calcium came primarily from dairy foods.<br><br>Exposures in the cohorts were: Beverage consumption (not further defined); milk, calcium, fat from foods and beverages; dietary calcium; dietary intake (not further defined); calcium and dairy food consumption (not further defined); dairy, dietary factors (not further defined). Assessed using a FFQ. | **Result(s):**<br>The relevant RCT found no difference in changes in body weight, BMI, or fat mass between the calcium-rich diet and normal diet groups at 2 years (mean BMI 19k/m2 in both groups; mean weight increase: 34% [range 17% to 59%] with intervention vs. 33% [range 16% to 72%] with control; mean fat mass: 10.7 [SD 10.7] with intervention vs. 11.4 [SD 4.9] with control, units not reported, reported as NS, p values NR).<br><br>In the cohort studies, no association between calcium or dairy and adiposity was found in 5/11 (direction of effect NR), and an inverse association in 4/12 (3 assessed calcium intake rather than dairy; 1 found that those in the lowest tertile of dairy intake [<1.25 servings/day for girls, <1.70 servings /day for boys] had the highest BMI from ages 10 to 13 [21.1kg/m2 in the lowest tertile vs. 19.3 kg/m2 in the highest tertile (>1.85 servings/day for girls, >2.35 servings/day for boys]). | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: Set, P<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>There may be some overlap in two cohort studies which reported on the same group of children from the Growing Up Today Study (GUTS). One analysis was described as cross sectional analysis of a cohort, but it was described in another review (Louie et al. 2011 [++]) as cohort analysis so has been included here.<br><br>Study design: three systematic reviews were included. 1 RCT looked at whether high milk consumption lead to greater weight loss in 9 year olds so this was out of scope as it implied they were overweight. 1 RCT |

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| | **Outcome(s):**<br>BMI was measured or self-reported between 12 months and 23 years after baseline. DEXA scan assessed body composition in the 3 RCTS and in 4 cohorts. Skinfold thickness was assessed in two studies. | One study reported no association overall, but mixed non-significant and inverse results for calcium intake, depending on child age and cholesterol level (no association with adiposity in children ages 4 to 6 years; inversely associated with BMI and skinfolds among children aged 7 to 10 years with normal cholesterol levels).<br><br>In 1 cohort (n=12,829) a positive association with BMI and obesity was found for milk (>3 vs. ≤0.5 servings of milk/day associated with a BMI 0.081 kg/m2 higher for boys [beta 0.019 per serving, SE 0.009] and 0.093 kg/m2 higher for girls [beta 0.015 per serving, SE 0.007]). It also found a positive association for 1% milk intake in boys and skim milk in girls (data NR). Energy intake was the most important predictor of weight gain in this study.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Moderate evidence suggests that there is no relationship between intake of calcium and/or dairy (milk and milk products) and adiposity in children and adolescents. | measured the effects of a prebiotic supplement, with both groups having calcium-fortified orange juice or milk.<br>Unclear: Health and weight status of the population was not reported.<br>Unclear: Setting |

Nuts

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| **Flores-Mateo et al. 2013**<br><br>**Quality:** +<br><br>**Search date:** Dec 2012<br><br>**Review design:**<br>Systematic review and meta-analysis of RCTs.<br><br>**Review aim:**<br>To perform a systematic review and meta-analysis of published randomised nut-feeding trials to estimate the effect of nut consumption on adiposity measures.<br><br>**Review funding:**<br>NR<br><br>**Study funding:**<br>Funding sources were not reported<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Adults aged 18 years and above. Inclusion criteria for body weight status NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 31 (unclear, n=unclear) (19 crossover RCTs)<br>Cohort: 0<br>Other: 1 (quasi-experimental study)<br><br>**Intervention/exposure description:**<br>Nut interventions were: nut intake in g/day (range 35 to 120 g/day); supplementation with nuts in g/day (range 15 to 100 g/day); nut paste 150 g/week; partial replacement of other foods with nuts (range 41 to 56 g/day); % of energy or calories (range 15 to 50%); 1,440 kJ portion of nuts; 16.6 g/1,000 kcal of diet; 2.9 g/4.2 MJ of diet.<br><br>The controls used were: habitual diet (13 trials), habitual diet plus meat without walnut paste (2 trials), habitual diet plus cereal (1 trial), low fat diet (7 trials), National Cholesterol Education Program Step I or II diet (4 trials); Mediterranean diet (2 trials); American Diabetes Association diet (1 trial); low calorie diet (1 trial); low-fat, low-cholesterol, high-carbohydrate diet (1 trial); other foods added to the background diet (85g cheddar cheese, 28 g butter, 21 g rye crackers; 1 trial). | **Result(s):**<br>Body weight: A meta-analysis of 28 trials (27 RCTs, 1 quasi-experimental study; n=1,836) found no significant difference in body weight changes between nut-enriched and control diets (WMD -0.47kg, 95% CI -1.17 to +0.22 kg, I2=7%). A subgroup analysis showed energy restriction significantly pooled estimates, p=0.046).<br><br>A non-significant reduction in weight in the nut group was shown in studies that had energy restriction interventions (WMD -2.61 kg, 95% CI -12.1 to +6.84 kg, I2=0%). In studies without an energy restriction, no significant effect of nut-enriched diets were found (WMD -0.18 kg, 95% CI -0.70 to +0.37 kg, I2=0%). Study follow up, study design, quality and type of intervention did not influence pooled estimates.<br><br>BMI: A meta-analysis of 14 trials (13 RCTs, 1 quasi-experimental study; n=1,057) found a non-significant reduction in BMI when participants consumed a nut-enriched diet compared with a control diet (WMD -0.40 kg/m2, 95% CI -0.97 to +0.17 kg/m2, I2=49%. In a subgroup analysis of heterogeneity nut consumption had a greater effect on BMI (-2.50 vs. -0.08 kg/m2) when assessed studies focused on energy restriction interventions were compared to weight maintenance interventions. The duration of intervention, | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>The author's report they aimed to avoid heterogeneity by including only RCTs, however they report heterogeneity was present for all outcomes and only partially explained by subgroup analyses. The authors report they were able to exclude publication bias with some confidence.<br>The authors report they did not observe change in waist circumference in the 681 participants for whom data were available and state that weight changes were probably too small to identify any such changes.<br><br>**Review team limitations:**<br>Both the meta-analyses for weight and BMI include 1 study that was a quasi-experimental study.<br><br>The review may have been too small to identify changes in outcomes such as waist circumference.<br><br>The weight characteristics of the included participants was not clear. |

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| | In most of the studies, nuts were reported to be used in isocaloric diets to replace other food items with high energy density. Only 2 studies included energy restriction. The review did not report whether participants in the individual trials were overweight or obese. Therefore some of the trials may not be relevant to the current review scope.<br><br>Assessment method NR.<br>Types of nuts were almonds, cashews, peanuts, walnuts, pecans, pistachios, hazelnuts, walnut-enriched frozen meat, walnut paste.<br>Length of follow up ranged from 2 to 156 weeks.<br><br>**Outcome(s):**<br>Weight, BMI, WC (assessment methods NR). | study design (parallel vs. crossover), quality or type of nuts did not modify the effect on BMI.<br><br>Waist circumference: A meta-analysis of 5 RCTs (n=681) found that compared with control diets, nut-enriched diets had no significant effect on WC (WMD -1.25 cm, 95% CI -2.82 to +0.31 cm, I2=28%). The estimated effect of nut consumption on WC was greater for studies that had energy restricted interventions compared to studies that focused on weight maintenance (-5.00 vs. -0.49 cm, p=0.031. Follow up, study quality and intervention diet did not modify the effects on WC<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Compared with control diets, diets enriched with nuts did not increase body weight, BMI or waist circumference in controlled clinical trials. | The paper appeared to have been corrected after publication, and results of the meta-analyses in the pdf version of the paper differed from the full test html version. The latter figures were reported here as they appeared the most recent.<br><br>Comparator: Partial, comparators included habitual diet, habitual diet plus cereal, habitual diet and meat without walnut paste, low-fat diet, Mediterranean diet, National Cholesterol Education Program (NCEP) Step I or II diet, low-calorie diet, American Diabetes Association (ADA) diet. Comparator diets are not further defined.<br>Study design: Partial, 1 included study was a quasi-experimental study.<br>Population: Unclear if participants were representative of the general population of if studies included solely overweight or obese people or people with specific conditions.<br>Setting: Unclear. |
| **Fogelholm et al. 2012**<br><br>**Quality:** +<br><br>**Search date:** NR<br><br>**Review design:**<br>Systematic review of cohorts with a follow up of more than 1 year and RCTs. | **Study participant inclusion criteria:**<br>Adults aged 17 to 80 years. No inclusion criteria for body weight status.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohorts: 3 (3, n=180,930)<br>Other: 0 | **Result(s):**<br>3 cohorts reported an inverse association between intake of nuts and weight gain or obesity risk (figures NR):<br><br>1 cohort (n=8,865) found participants who ate nuts 2 or more times per week (not further defined) had significantly lower risk of gaining ≥5 kg (OR 0.69, 95% CI 0.53 to | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>The authors report 2 of the studies were not |

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| **Review aim:**<br>The purpose was to examine the associations of dietary macronutrient composition, food consumption and dietary patterns in prevention of weight or waist circumference gain, with and without prior weight reduction.<br><br>**Review funding:**<br>Nordic Council of Ministers<br><br>**Study funding:**<br>Funding sources were not reported<br><br>**Multifactor review:** Y | **Intervention/exposure description:**<br>2 cohorts had exposures that were nut consumption (not further defined; 28 month median follow up in 1 cohort, 8 year follow up in 1 cohort). 1 cohort had exposure reported as change in food consumption at baseline of each 4 year period (no further detail provided; 12 to 20 year follow up). Dietary intake was assessed using a FFQ in 3 cohorts (semi-quantitative FFQ in 1 cohort; self-reported in 1 cohort, NR in 2 cohorts).<br><br>**Outcome(s):**<br>Weight gain (self-report in 1 cohort), increase in body weight of at least 5 kg during 28 month follow up (method of assessment NR), weight change (mean of 4 year periods; self reported weight). | 0.90, p for trend 0.006) than those who ate nuts never or almost never (not further defined) at 28 months follow up. Participants with little nut consumption (never/almost never) gained an average of 424 g (95% CI 102 to 746 g) more than frequent nut eaters. 1 cohort (n=51,188) found nut consumption of 2 or more times per week (not further defined) compared with never or almost never eating nuts was associated with a slightly lower risk of obesity across 8 years (HR 0.77, 95% CI 0.57 to 1.02, p for trend=0.003). These first 2 cohorts may overlap in participants.<br>1 cohort (n=120,877) found nut consumption was inversely associated with mean weight gain ov er 4 years (-0.26 kg, 95% CI -0.44 to -0.08).<br><br>**Adverse Effects:** NR<br><br>**Conclusions:** The review concluded that there is probable evidence for high intake of nuts being associated with less weight gain. | fully independent (not further defined) as they are partly or totally based on data from another study.<br><br>**Review team limitations:**<br>Unclear if populations were representative of the general population.<br>There may be overlap in 2 of the cohorts that partly or totally used data from a larger study.<br><br>The analyses were adjusted for various confounders, but these did not appear to include total energy intake.<br><br>Population: Unclear if participants were representative of the general population of if they were overweight/obese or had specific conditions.<br>Setting: Unclear. |
| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 3 (3, n=32,553)<br>Other: 0 | **Result(s):**<br>No studies identified that were specifically in children.<br><br>1 study (n=17,369) found for males, no significant association between consumption of nuts and seeds and 2 year weight gain (OR for highest vs. lowest consumption: 0.88, CI or p value NR). For females, small weight losses were found to be attributable to nuts | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>NR |

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| **Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Intervention/exposure description:**<br>1 study looked at the association between nut and seed intake (absolute intake in g/day) and weight change over 2.2 years (reported as 2 years in the results).<br>1 study looked at the effect of nut consumption (g/day) and mean weight change (28 months follow up).<br>1 study looked at the frequency of nut consumption (50 g serving) and risk of weight gain of at least 5 kg (the outcome is reported as weight change of more than 5 kg) (28 month follow up).<br>All 3 studies used a food frequency questionnaire to assess nut/seed intake (self administered in 2 studies, NR in 1 study).<br><br>**Outcome(s):**<br>Weight (1 study, measurement NR), weight change (1 study, self-reported), weight change of more than 5 kg (1 study, self-reported) | and seeds (OR 0.33, 95% CI 0.12 to 0.90, p<0.05). Results were not presented separately for nuts and seeds.<br><br>1 study (n=6,319) found no significant association between nut consumption and weight change over 2 years (mean change in body weight: 0.73 in lowest consumption group vs. 0.57 in highest consumption group [units NR] p for trend = 0.07). This was the only study which explicitly adjusted for energy intake.<br><br>1 study (n=8,865) (also identified by Fogelholm et al. 2012 [+]) found frequent nut consumption (serving of 50 g more than 2 times per week) was associated with a significantly reduced risk of weight gain after a median of 28 months (OR 0.61, 95% CI 0.47 to 0.79, p for trend <0.001) compared with weight gain in those who never or rarely (not further defined) ate nuts. Significance reported to remain after adjustment for age, sex, smoking, leisure time physical activity and other risk factors of obesity (not further defined), (OR 0.69, 95% CI 0.53 to 0.90, p for trend = 0.006).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>There is limited but consistent evidence that nuts and seeds are not associated with | **Review team limitations:**<br>This review looked at the associations of nuts and seeds and results are not provided separately, therefore the results apply to intake of nuts and seeds and not to nuts only.<br>The outcome measurement was subjective in 2 studies and NR in 1 study. The exposure measurement was subjective in 2 studies and NR in 1 study.<br><br>The studies were reported to be highly adjusted, with one study (with non-significant results) explicitly adjusted for total energy intake.<br><br>Population: Unclear, 1 study describes participants as non-smoking adults but no further information is described. It is unclear if participants from the 3 studies were representative of the general population or if they were overweight/obese or had specific conditions.<br>Setting: Unclear |

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| | | subsequent excess weight gain and obesity. | |

Bazian

Refined grains

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| **Bautista-Castano and Serra-Majem 2012**<br><br>**Quality:** ++<br><br>**Search date:** 2008 (month NR)<br><br>**Review design:**<br>Systematic review of studies that assessed bread consumption and ponderal status (all study designs).<br><br>**Review aim:**<br>To assess the influence eating patterns that include refined and whole-grain bread are associated with overall obesity or excess abdominal adiposity in the general population and in people undergoing obesity management<br><br>**Review funding:**<br>INCERPAN (The Spanish Association of Bread Producers and Retailers)<br><br>**Study funding:**<br>Funding for the individual studies included in the review was not reported<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>None reported.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 3*(0)<br>Cohort: 11(5, n=146,764)<br>Other: 22*<br>*Includes whole grain and refined grain studies and general studies on bread; relevant study number refers to solely refined grain studies<br><br>**Intervention/exposure description:**<br>Dietary patterns rich in refined bread (sometimes analysed in a cluster as refined bread), intake of refined bread, intake of refined grains and cereals assessed used food frequency questionnaires or dietary recalls.<br><br>**Outcome(s):**<br>Weight related outcomes (ponderal status) including body weight/weight change, BMI, and waist circumference after between 4 and 12 years. How these were measured was not reported. | **Result(s):**<br>Overall, groups of food items that included refined bread were associated with unfavourable effects (a positive association) on waist circumference in 3 studies (2 found this in women only) and one study found unfavourable effects on weight. Individual studies are described below (effect sizes were not reported by the review):<br><br>-One study (n=74,091) found that weight gain was positively associated with intake of refined cereals.<br>-One study (n=459) found that the dietary pattern including refined bread had the greatest increase in waist circumference.<br>-One study (n=2,436) found that no dietary factor, including a refined grain bread pattern, was consistently associated with changes in BMI or the development of obesity, although an earlier publication from the same study found that a high intake of refined bread was associated with increased waist circumference in women (but not in men).<br>-One study (n=27,082) found no relationship between intake of refined cereals and changes in ponderal status.<br>-One study (n=42,696) found that refined cereals were associated with an increase in waist circumference in women only.<br><br>**Adverse Effects:** | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D, P<br>Unclear: Set<br><br>**Authors' limitations:**<br>Variations in sample size, quality of study design, length of follow-up make it difficult to compare results of studies.<br>Measurement of dietary intake is less precise than, for example, measurement of blood analytes.<br>Some of the included studies evaluated groups of food items that included bread, but the resulting data did not indicate the proportion with which bread consumption influenced the effect studied.<br>Heterogenity of methods used (for example diet index, factor analysis, cluster analysis).<br><br>**Review team limitations:**<br>Although refined grain (and whole grain) bread consumption were the focus of the review, often the studies analysed whole grain bread as part of a dietary pattern or cluster of refined grain food. The results may therefore be more representative of the effect if these dietary patterns rather than the effects of refined grain breads alone, and also may not apply to other forms of refined grain (not specifically bread). |

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| | | NR<br><br>**Conclusions:**<br>Most cross-sectional studies indicated beneficial effects of refined bread, while most of the cohort studies indicated a possible relationship with excess abdominal fat. | All RCTs were performed in overweight/obese populations and therefore were not extracted.<br>All extracted studies were in adults.<br><br>Systematic review funded by The Spanish Association of Bread Producers and Retailers<br><br>Study design: cross-sectional studies also included, which are not relevant to the current review scope<br>Population: all RCTs were performed in overweight/obese populations. Cohort studies did not have weight status as a reported entry criteria<br>Setting: Not a reported inclusion/exclusion criterion. |
| **Fogelholm et al. 2012**<br><br>**Quality:** +<br><br>**Search date:** NR<br><br>**Review design:**<br>Systematic review of cohorts with a follow up of more than 1 year and RCTs.<br><br>**Review aim:**<br>The purpose was to examine the associations of dietary macronutrient composition, food consumption and dietary patterns in prevention of weight or waist circumference | **Study participant inclusion criteria:**<br>Adults aged 17 to 80 years. No inclusion criteria for body weight status.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 5 (5, n=290,852)<br>Other: 0<br><br>**Intervention/exposure description:**<br>The exposure was refined grains in 2 studies, (n=194,968); refined (white) bread in 2 studies (n=51,067); and carbohydrates from refined grains in one study (n=44,817).<br>Refined grain intake was assessed using a | **Result(s):**<br>Overall, all of the cohorts reported positive associations between refined grain intake (measured in different ways) and weight or waist circumference. (The review did not report quantities of refined grain associated with individual results.) Individual results are reported below:<br><br>Refined grains: One cohort study (n=74,091) found that greater increase in refined grain intake was associated with greater weight gain. The average change in weight in 2-4 years was 1.57kg +/- 0.03kg in the quintile with the greatest increase in refined grain | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: Set, P<br><br>**Authors' limitations:**<br>The number of studies for a specific combination of exposure and outcome was limited.<br>All studies identified for this exposure were cohort studies.<br>Meaurements of dietary intake and food consumption at baseline are usually |

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| gain, with and without prior weight reduction.<br><br>**Review funding:**<br>Nordic Council of Ministers<br><br>**Study funding:**<br>Funding sources were not reported<br><br>**Multifactor review:** Yes | food frequency questionnaire in one study, method of measurement not reported in other study but as there was some overlap in populations likely to have also been assessed using a food frequency questionnaire.<br>Refined bread intake was assessed using food frequency questionnaires in both cohort studies.<br>The method of assessing carbohydrate from refined grain sources was not reported.<br><br>**Outcome(s):**<br>Two studies reported changes in body weight (self-reported in one study, method of measurement not reported in other study but as there was some overlap in populations likely to also be self reported) over between 12 and 20 years of follow-up (both studies reporting this outcome looked at refined grain intake as the exposure).<br>Three studies reported waist circumference as an outcome (method of measurement not reported) after between 5 and 6 years (studies reporting this outcome looked at refined bread intake or carbohydrate from refined grains as the exposure). | intake and 1.14kg +/- 0.03kg in the quintile with the lowest change in intake of refined grains, p for trend <0.0001. The other cohort study (n=120,877) found that the average 4 year weight gain in kg was positively associated with changes in servings of refined grains (0.18 kg, 95% CI 0.10 to 0.26).<br>Refined (white) bread: One cohort study (n=2,436) found that intake of refined bread was positively associated with change in waist circumference (beta=0.29, 95% CI 0.07 to 0.51 with adjustment for BMI or beta=0.42, 95% CI 0.11 to 0.73 without adjustment for BMI). The other cohort study (n=48,631) found a positive associated in annual change in waist circumference with white bread consumption (beta= 0.01, 95% CI 0.01 to 0.02, adjusted for BMI).<br>Carbohydrate from refined grains: In one cohort study (n=44,817) carbohydrates from refined grains were positively associated with waist circumference in women only (data NR; results or figures for men NR).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Suggestive evidence was found for high intake of refined grains being associated with more weight gain and refined (white) bread intake and larger increases in waist circumference. | innacurate, and dietary pattern may change during follow-up.<br>Many of the cohort studies were initiated more than 10 years ago.<br>The review only covered publication years 2000-2012, and may exclude important older studies.<br><br>**Review team limitations:**<br>One of the refined grains studies reported results from the nurses' health study, the other from the nurses' health study and nurses' health study II and health professionals follow-up study (overlap).<br><br>Study design: although all studies included for this exposure were cohorts, the review also included intervention studies and case-control studies.<br>Population: BMI/weight was not an inclusion criterion for the systematic review. All cohort studies included for this factor appear to have populations that meet the scope (random population sample, or nurses or health care professionals)<br>Setting: not reported explicitly. |
| **Summerbell et al. 2009** | **Study participant inclusion criteria:** | **Result(s):** | **Applicable to the UK:** Yes |

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| **Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>Refined grains: study funders included The Danish Medical Research Council, National Institutes of Health, National Institutes of Diabetes and Digestive and Kidney Diseases, Alcoholic Beverage Medical Research Council, American Cancer Society, Amgem, The Californian Prune Board, the Centres for Disease Control and Prevention, the Ellsion Medical Foundation, the Florida Citrus Growers, the Glaucoma Medical Research Foundation, Hoffman-La Roche, Kelloggs, General Mills, Lederle, the Massachusetts Department of Public Health, Mission Pharmacal, the National Dairy Council, Rhone Poulenc Rorer, the Robert | To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 7 (6, n=112,589 adults/1, n=737 children)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Adults<br>Assessed exposures varied across the studies and included high vs. low quintiles refined grain intake (defined comprehensively; a list of foods was provided by the primary study [but not reported by the review], and included breakfast cereals ≤25% whole grain or bran content by weight); refined bread intake (refined whole-wheat and refined-rye breads); white-bread vs. healthy eating patterns (categorised using cluster analysis, not further defined); breads and cereals (not further defined); bread (included white and whole-wheat roles, bread, croissant and pretzels); >=1 serving/day refined grain breakfast cereals.<br><br>Five of the six included studies used FFQ to assess refined grains consumption (comprehensiveness of questionnaire reported to vary across studies), a 7-day food diary was used in the remaining study. Refined grains were only comprehensively | Adults<br>Six studies were identified in adults, with an age range of 30 to 84, and a follow-up range of 2 to 12 years. Results were mixed in the studies, with 3 studies finding a positive association in at least one analysis (by gender or outcome), and 3 finding no association (1 data NR, 2 with mixed directions of non-significant effect):<br><br>One study in women (n=74,091) reported that over a 12 year period, there was a significant relationship between likelihood of obesity between participants who consumed the highest level (quintile) vs. lowest level of refined grains (OR 1.18, 95% CI 1.08 to 1.28, p for trend=0.0001). There was also a significant association between refined grain intake and likelihood of gaining more than 25kg over 12 years and consumption (OR 1.26, 95% CI 0.97 to 1.64, p for trend=0.04).<br><br>One study (n=2,436) reported that consumption of refined bread was significantly associated in WC at 6 year follow-up in women (beta=0.42, 95% CI 0.11 to 0.73, p<0.05) but not men (beta= -0.24, 95% CI -0.50 to 0.01, p≥0.05).<br><br>One study (n=459) found that the average change in WC over 25 months was significantly higher in participants in the 'white-bread' group compared to the 'healthy' eating pattern group (beta=0.90cm, 95% CI | **Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Exposure varied widely across studies. The definition of refined grains was comprehensive for one study (n=74,091 females), see exposure definition for further details on the range included.<br><br>Across the studies, ORs were adjusted for various factors, including: age; baseline BMI; changes in exercise; change in smoking status; change in HRT status; change in dietary intake.<br><br>**Review team limitations:**<br>Refined grains were only defined comprehensively by one study. The exposures assessed included some assessing dietary patterns including refined grains rather than refined grain foods specifically, and therefore may not reflect their effect alone. Also, some studies included exposures that were not clearly of refined grains only, e.g. 'breads and cereals'. Of the studies that clearly appeared to be dealing with refined grain foods (not patterns or other non-specified grain products), 2 found a positive association in at least one analysis (by gender or outcome), and 1 found no |

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| Wood Johnson Foundation, Roche, Sandoz, the US Department of Defence, the US Department of Agriculture, the Wallace Genetics Fund, Wyeth-Ayerst, Merck, Agricultural Research Service and by private contributors.<br><br>**Multifactor review:** Yes | defined in one study, and included breakfast cereals ≤25% whole grain or bran content by weight).<br><br>Children<br>Intake of bread, wheat and rice at age 1.5 or 3 years; assessed via mothers'-report.<br><br>**Outcome(s):**<br>Adults<br>Outcomes varied across studies and included: weight, overweight or obesity, weight gain greater than 25kg over 12 years, mean annual change in WC or BMI.<br><br>Assessment method was reported to included self-report, research team measurement.<br><br>Children<br>Obesity during adolescence; height and weight were measured by the research team.<br><br>Follow up was from the age of 1.5 or 3 up to adolescence (mean follow up 10 years, 11 months) | 0.12 to 1.68, p<0.05). There was no significant association between change in BMI and white-bread consumption compared to healthy diet consumption (regression coefficient 0.05, 95% CI -0.1 to 0.23).<br><br>One study (n=353) reported that consumption of breads and cereals (not further defined) was not predictive of weight change in women (data NR). Comparison of participants who had gained weight over four years vs. those who hadn't revealed no significant difference in bread and cereal intake (OR NR, p=0.606).<br><br>One study (n=17,369) found that bread consumption (included white and whole wheat rolls, bread, croissants and pretzels) was not predictive of large weight loses over 2 years in women (OR 0.93, 95% CI 0.83 to 1.04) or men (OR 1.01, 95% CI 0.90 to 1.14).<br><br>One study (n=17,881) found that consuming one serving/day or more of refined grain breakfast cereal intake was not associated with overweight risk over 13 years, compared to consuming rarely or never (RR 0.81, 95% CI 0.65 to 1.01, p for trend=0.08).<br><br>Children<br>One study (n=737) found that intake of bread and wheat at age 3 was not significantly associated with obesity in adolescents (OR 0.87, 95% CI 0.65 to 1.16). Similarly, there | association (inverse direction of effect).<br><br>In the studies in children it was not clear whether the review ascertained if the grains and grain products were refined or not, although they were described in a section on refined grains, so this has been assumed ot be the case.<br><br>Exposure levels associated with the outcomes was only reported in one study.<br><br>Setting and population weight status not reported across primary studies. |

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| | | was no association between high rice intake (not further defined) at age 3 and obesity in adolescence (OR 1.20, 95% CI 0.78 to 1.84). Average follow-up in this study was 10 years 11 months.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>No review level conclusions were drawn regarding refined grains per se. However, the factor was considered as part of a larger section on cereals and cereal products; the review concluded that there were no associations between the consumption of cereals or cereal products and subsequent excess weight gain or obesity. | |

Sugar sweetened beverages

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| **Kaiser et al. 2013**<br><br>**Quality:** ++<br><br>**Search date:** Oct 2012<br><br>**Review design:**<br>Update of a systematic review of RCTs. Original review by Mattes et al. 2010 [++].<br><br>**Review aim:**<br>To address whether an increase in SSB in take increases body weight or BMI in humans, and whether a reduction in SSB intake reduces body weight or BMI in humans.<br><br>**Review funding:**<br>The article was reported to be supported in part by a US National Institutes of Health grant. In their conflict of interest statement, one author declared receiving consulting fees from Kraft foods in the previous 36 months, while the other authors declared having no competing interests. The University at which the authors work was reported as having received gifts and grants from multiple organisations, including food and beverage manufacturers.<br><br>**Study funding:**<br>Two studies were reported as being funded by companies (Nestlé Waters USA, and | **Study participant inclusion criteria:**<br>As for Mattes et al. 2010 [++] - individuals not pregnant, acutely ill or under severely stressed conditions. Age limits not specified, but included studies included children and adults.<br><br>**Total # studies (# relevant and n=):**<br>RCTs = 6* (2, n=unclear)<br>Cohorts = 0<br>Other = 0<br>* new RCTs added in the update<br><br>**Intervention/exposure description:**<br>As for Mattes et al. 2010 [++].<br><br>SSB groups included: cocoa, regular cola, unspecified SSBs (as usually consumed)<br>Comparators included: sugar free cocoa, milk/diet cola/water, non-caloric beverages.<br><br>Measurement of exposures not reported.<br><br>**Outcome(s):**<br>Weight related outcomes assessed by the studies included weight, BMI, BMI z score, WC, SFT, fat mass, waist to height ratio.<br><br>Methods of assessment unclear (some measurement approaches reported e.g. bioimpedance analysis, MRI but purpose of these measurements not explicitly specified). | **Result(s):**<br>Trials in both children and adults were included, but these were not described separately so are not separated here.<br><br>Trials assessing effect of adding SSBs: 2 RCTs in adults found significant weight gain in the groups consuming added SSBs (90-500 kcal/day) compared to control (0.39 to 1.14 kg), 1 RCT in children found no impact of added SSB (158kcal/day; difference 0.110kg, reported as not significant) compared with control.<br><br>An updated meta-analysis found a significant positive effect of added SSB consumption on weight (7 RCTs, n=NR; SMD 0.28, 95% CI 0.12 to 0.44; I2=48%).<br><br>Trials assessing effect of reduction/elimination of SSBs: 1 trial in adults and 2 in children reported SMDs (calculated using weight loss or BMI reduction) of 0.13 to 0.33 (positive direction indicating reducing SSBs effective at reducing weight).<br><br>The 1 RCT not solely in overweight or obese adults and aiming to reduce SSB showed non-significant effects on weight related outcomes and had differing directions of effect (positive direction of effect indicates that reducing SSB is effective, SMD -0.10, | **Applicable to the UK: Unclear**<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: Set, P<br>Unclear: None<br><br>**Authors' limitations:**<br>The most important areas for risk of bias in the included studies come from lack of participant blinding and selective reporting. Most studies also failed to mention if assessors were blinded. Some studies failed to isolate the treatment effects from the effect of attention paid to some groups. 4/6 studies had no measure of compliance with the intervention, making interpretation difficult.<br><br>The review also noted lmitations relating to individual studies, such as small sample sizes, and unequal gender distribution between the groups.<br><br>**Review team limitations:**<br>The figures in the updated meta-analysis for the RCTs included in the previous publication (Mattes et al. 2010 [++]) in some cases differed slightly from the figures presented in the previous publication, but the reason for this were not clear.<br><br>One review author acknowledged potential |

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| GlaxoSmithKline Consumer Healthcare Ltd.). In 2 other studies products used were reported to be provided by companies (a dairy company and the Hershey Company).<br><br>**Multifactor review:** No | Outcomes were assessed at 6 weeks' to 2 years' follow up. | 95% CI -0.34 to 0.15 in 1 RCT, n=303).<br><br>An updated meta-analysis found a non-significant trend towards reduced SSB consumption being associated with weight loss (8 RCTs, n=NR; SMD +0.06, 95% CI -0.01 to +0.13; I2=59%).<br><br>The review also carried out subgroup analysis in those overweight/obese at baseline (not relevant to the current scope).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Our updated meta-analysis shows that the currently available evidence for the effects of reducing SSB intake on obesity is equivocal. | conflict of interest (COI), as did the authors' University, in the form of fees/grants/gifts from food and drinks manufacturers. These COIs appeared to only cover the previous 3 years, and one of the other authors had also declared potential COIs relating to food and drink manufacturers in an earlier publication (Mattes et al. 2010 [++]).<br><br>The review update was part of a 'Pro vs. Con' debate on the role of SSBs in obesity in which the authors appeared to be offering the 'con/against' argument.<br><br>Most of the new RCTs included in this update were in overweight or obese individuals, and the findings may not apply to the general population.<br><br>Participants in some studies received beverages, and this may not be representative of what could be achieved through individual choice.<br><br>Includes 4 RCTs in overweight or obese individuals, or children selected for being above a specified BMI percentile (85th).<br>For one study the exact groups being compared were unclear, as both<br>At least one study was school based, and beverages were provided in at least some studies. |
| **Malik et al. 2013** | **Study participant inclusion criteria:** | **Result(s):** | **Applicable to the UK:** Yes |

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| **Quality:** ++<br><br>**Search date:** Mar 2013<br><br>**Review design:**<br>Systematic review of RCTs and prospective cohort studies.<br><br>**Review aim:**<br>To provide a comprehensive summary of the literature<br>evaluating sugar sweetened beverages (SSBs) and body weight gain.<br><br>**Review funding:**<br>US National Institutes of Health. The authors reported that they had no conflicts of interest.<br><br>**Study funding:**<br>Not reported for every included study, but reported for RCTs where it was considered source of bias. One RCT had funding from the sugar bureau, and drinks were provided by manufacturers for two RCTs.<br><br>**Multifactor review:** No | NR<br><br>**Total # studies (# relevant and n=):**<br>RCT: 10 (5, n=953)<br>Cohort: 22 (19, n=198,533)<br>Other: 0 (0)<br>(Numbers are for studies included in the meta-analysis)<br><br>**Intervention/exposure description:**<br>SSBs were defined in the introduction as composed of energy-containing sweeteners such as sucrose (50% glucose, 50% fructose), high-fructose corn syrup (most often 45% glucose and 55% fructose), or fruit juice concentrates that are added to the beverage by manufacturers, establishments, or individuals and<br>usually contain >25 kcal per 8 fluid ounces.<br><br>Cohort studies: Servings (12 oz.) of SSB per day. Where 12-oz servings not presented, they were calculated from other SSB intake measures where possible.<br><br>Assessed by FFQs, 24-h recalls, diet and lifestyle questionnaires, and diet records.<br><br>RCTs: Intervention involving SSB consumption versus control (most replaced SSBs with non-caloric/artificially sweetened beverages, one also included semi-skim milk and water, one used a dietary advice control), for between 3 weeks and 18 months. Child RCTs assessed | Children (ages 2 to 16 years):<br>Meta-analysis of cohort studies showed an association between SSB consumption and BMI. Each additional daily 12-oz serving of SSBs was associated with a 0.07 kg/m2 increase in BMI over 1 year (95% CI 0.01 to 0.12; 15 studies, n=25,745; random effects analysis).<br>9/11 cohort studies that could not be pooled in the meta-analyses were reported as supporting a positive association.<br><br>Meta-analysis of RCTs did not find an association between reducing SSB consumption and BMI (5 RCTs, n=2,772; WMD -0.17 kg/m2, 95% CI -0.39 to +0.05; I2=74.6%; random effects model). Fixed effects analysis gave a significant difference between groups (WMD -0.12, 95% CI -0.22 to -0.02; I2=NR). Sensitivity analyses showed greater benefits in preventing weight gain in SSB substitution trials (compared<br>with school-based educational programs) and among overweight children<br>(compared with normal-weight children).<br><br>4/5 trials showed a beneficial effect of SSB reduction or a trend in this direction.<br><br>3 trials not included in the meta-analysis had mixed findings: 1 found an adverse effect of SSBs on body weight, and 2 found NS effects.<br><br>Adults: Meta-analysis of cohort studies | **Alignment to NICE review scope:**<br>Complete: D<br>Partial: Set, P<br>Unclear: None<br><br>**Authors' limitations:**<br>Only 3/22 cohort studies adjusted for total energy intake (all adjusted for some diet and lifestyle risk factors).<br><br>Funnel plots suggested that there may have been publication bias among the adult cohorts (p=0.02), but not other study groupings.<br><br>Included studies varied substantially<br>in study design, exposure assessment, adjustment for covariates, and specific outcomes evaluated. These factors were not identified as significant sources of heterogeneity, but cannot be ruled out.<br><br>Estimates from cohort studies are likely to be underestimated because of random measurement error in SSB assessment.<br><br>The data transformations used to obtain consistent units across studies may limit the validity of estimates by imposing various assumptions. The assumption of a 12-oz serving size for some studies, which is consistent with most cans and glasses, may have introduced some random |

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| | the effect of replacing SSBs in the diet, while adult RCTs assessed the effect of adding SSBs to the diet.<br><br>**Outcome(s):**<br>Weight and BMI assessed at between 6 months' and 20 years' follow up in the cohorts, and between 3 weeks and 18 months for RCTs. (Outcomes estimated where possible e.g. from fat mass differences, if studies did not present these outcomes) | showed an association between SSB consumption and weight gain. Each additional 12-oz daily serving of SSBs was associated with a 0.22kg increase in weight over a year (95% CI 0.09 to 0.34; I2=70.2%; 7 studies, n=170,141). 4/6 cohort studies that could not be pooled in the meta-analyses were reported as supporting a positive association.<br><br>Meta-analysis of RCTs also found that adding SSB consumption to the diet (600mL to 1.1L daily; 310 to 530kcal) was associated with an increase in body weight over 3 weeks to 6 months (5 RCTs, n=292; WMD 0.85 kg, 95% CI 0.50 to 1.20; I2=0%; random effects model).<br><br>2 trials not included in the meta-analysis had mixed findings: 1 found an adverse effect of SSBs on body weight, and 1 addressed a different question relating to weight loss (and found NS effect).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Our systematic review and meta-analysis of prospective cohort studies and RCTs provides evidence that SSB consumption promotes weight gain in children and adults. | misclassification and attenuated estimates.<br><br>A number of studies were not included in the analysis because of difficulty in obtaining consistent units, but they were synthesised qualitatively.<br><br>The search was limited to English language reports, and reports in other languages may exist.<br><br>Although the included cohort studies adjusted for potential confounding, residual confounding by unmeasured or poorly measured factors cannot be dismissed.<br><br>Longitudinal studies evaluating diet and weight may also be prone to reverse causation. Although it is not possible to completely eliminate this issue, studies with longer durations and repeated measures as in our change versus change analyses are less prone to this process.<br><br>**Review team limitations:**<br>Some of the studies included overweight or obese individuals, or were in school settings, but most appeared relevant to the current scope.<br><br>Number of adults in the meta-analysis of RCTs was relatively small (n=292).<br><br>Included 6 studies in overweight or obese |

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| | | | populations, or people with prehypertension. Two RCTs were school-based. One RCT replaced SSBs with artificially sweetened beverages plus semi-skim milk and water. |
| **Mattes et al. 2011**<br><br>**Quality:** ++<br><br>**Search date:** Jan 2009<br><br>**Review design:**<br>Systematic review and meta-analysis of RCTs.<br><br>**Review aim:**<br>Not clearly stated. To carry out a critical review of the published RCTs on nutritively sweetened beverages, and to meta-analysis of two sets of these studies separately that [the authors] believed addressed different hypotheses.<br><br>**Review funding:**<br>Some of the activity in the review was reported to be<br>supported in part by US National Institutes of Health grants. In their conflict of interest statement, some of the authors declared having received grants, honoraria, donations and/or consulting fees from a range of food, beverage, pharmaceutical companies, and other commercial and non-profit entities with interests in obesity. | **Study participant inclusion criteria:**<br>Individuals who were not pregnant, acutely ill, or under severely stressed conditions (e.g. field workers in intense heat etc.)<br><br>**Total # studies (# relevant and n=):**<br>RCTs:= 12 (unclear)<br>Cohorts: 0<br>Other: 0<br><br>**Intervention/exposure description:**<br>The review used the term 'nutritively sweetened beverages' (NSBs) and defined this as something one drinks to which a nutritive sweetener has been added (e.g. regular sodas, fruit punches and chocolate milk) . It did not include alcoholic beverages, or meal replacement/growth promoting beverages.<br><br>It included RCTs comparing two different levels of NSB consumption for at least 3 weeks.<br><br>Trials compared NSB (1880kJ per d) vs. isoenergetic solid carbohydrate; added mandatory NSB (about 150 to 530 kcal) vs. no additional drink or replacement non-caloric drink (water/diet drink); interventions | **Result(s):**<br>Trials in both children (ages 7-18 years) and adults were included but these were not described separately.<br><br>Solid carbohydrate vs. NSB: 1 trial (n=15) found no significant difference between consuming NSB and energy matched solid carbohydrate over 4 weeks.<br><br>Trials of mandatory added NSB consumption: 5 trials were identified, 2 showed significant increases in weight gain with NSBs, 3 showed the same direction of effect but findings were non-significant. Differences ranged from 0.09 to 0.99 kg over 3 weeks to a year. Pooling these studies gave an effect size (SMD) of 0.58, 95% CI 0.29 to 0.88). Meta-regression indicated a dose-response relationship (weighted Pearson's r =0.92, p=0.029).<br><br>Effectiveness of trials aimed at decreasing NSB consumption: 6 RCTs (mainly educational interventions in children and adolescents; total n=2,722; 5 RCTs in children and adolescents, n=2,419; 1 RCT in adults, n=303; possible overlap between 2 RCTs) found effect sizes (SMDs) ranging from | **Applicable to the UK: Unclear**<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: Set, P<br>Unclear: None<br><br>**Authors' limitations:**<br>Sample sizes were small, and study durations short precluding confident inferences. It is not clear if results of the added NSB studies are dependent on the control used ("no NSB" or required consumption of non-NSB replacement). The meta-analytical results should be interpreted with caution as they pool all doses, as should the meta-regression due to the risk of confounding factors across studies.<br><br>The review also highlighted various limitations to individual studies, such as not standardising when and how the NSBs were consumed compared to controls (as snacks or otherwise), relevance to "free-living" behaviour, weight related outcomes were only secondary outcomes of the trials aiming to reduce NSB consumption (NSB consumption being the primary focus). The lack of effect on weight-related outcomes in |

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| **Study funding:**<br>NR.<br><br>**Multifactor review:** No | aiming to reduce NSB consumption vs. controls (e.g. general advice, no intervention); interventions where NSBs were restricted (no NSBs) vs. being allowed (up to one regular soda allowed per day).<br><br>**Outcome(s):**<br>Body weight, BMI, obesity or overweight status, percentage body fat or some other indicator of adiposity. Outcomes were assessed at between 3 weeks and 3 years' follow up. | -0.144 to +0.171 (outcome BMI or z BMI). Pooling the studies gave a non-significant result (5 RCTs, n=2,078; SMD -0.037, 95% CI -0.12- to +0.046; I2=0%; fixed effects analysis).<br><br>Effectiveness trials of energy restricted diets allowing or disallowing NSB consumption: Only 1 RCT (n=38) in overweight and obese girls found. (not relevant to the current scope).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The current evidence does not demonstrate conclusively that NSB consumption has uniquely contributed to obesity or that reducing NSB consumption will reduce BMI levels in general. | these trials may be due to the interventions are not being very effective at getting people to reduce NSB consumption (results for NSB consumption not presented in the review).<br><br>Due to the nature of the intervention it is difficult if not impossible to blind participants, and as such this should not be interpreted as a bias per se.<br><br>Conclusions should not be extrapolated to beverages outside those targeted by the review.<br><br>**Review team limitations:**<br>Unclear if the review included sports drinks.<br><br>The inclusion of different types of controls addressing different questions may complicate interpretation, but they are discussed separately.<br><br>Two included studies were in overweight and obese individuals, populations in other studies were not always clear. Included studies comparing e.g. free snacks versus restricted snacks (with NSB being one of the restricted snacks), NSB versus solid carbohydrate consumption, or swapping with e.g. milk. Weight status of populations in included trials were unclear. Some of the interventions were school-based educational interventions, or provision of beverages, |

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| | | | which may not reflect individual choice. |
| **Te Morenga et al. 2013**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2011<br><br>**Review design:**<br>Systematic review and meta-analysis of RCTs and prospective cohort studies.<br><br>**Review aim:**<br>To summarise evidence on the association between intake of dietary sugars and body weight in adults and children.<br><br>**Review funding:**<br>WHO, University of Otago, and Riddet Institute. In their competing interests statement the authors declare that they had no other financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years; and no other relationships or activities that could appear to have influenced the submitted work.<br><br>**Study funding:**<br>13 of the RCTs were reported to have sugar industry funding, and in 3 RCTs funding was unclear. 14 RCTs did not have sugar industry funding. | **Study participant inclusion criteria:**<br>Adults and children free from acute illness. (Could include those with a non-communicable diseases which were stable, e.g. diabetes).<br><br>**Total # studies (# relevant and n=):**<br>RCT: 30 (0)<br>Cohort: 38 (unclear, n=unclear*)<br>Other: 0<br>* separate tallies not provided for the studies assessing SSB intake specifically; no RCTs in children<br><br>**Intervention/exposure description:**<br>The review focused on dietary free sugar intake (total intake, intake of sugar containing foods or beverages), which included SSB intake. 'Free' sugars were defined as all mono- and di-saccharides added to foods by the manufacturer, cook, or consumer, plus sugars naturally present in honey, syrups, and fruit juices. 'SSB' was not further defined.<br><br>Cohort studies: Exposure was assessed as servings per day, volume of beverage consumed per day, % energy intake, or frequency of consumption, and were scaled to comparable units where possible to allow pooling. One SSB serving was assumed to be equivalent to 8-oz. | **Result(s):**<br>Results were mainly presented for sugars as a whole, although in many cases SSBs were the main sugar intake being assessed or targeted. Results presented here are review level results specifically reported as being for SSBs (which the review presented for children only).<br><br>Children: Meta-analysis of 5 cohort studies found that children consuming about 1 daily serving of SSBs at baseline were more likely to be overweight at follow-up than those consuming little or no SSB (n=NR; OR 1.55, 95% CI 1.32 to 1.82; I2=0%). Among the 23 cohort studies in children (mostly assessing SSB intake), 15 found a positive association between increased sugar intake and adiposity, and 14 of these studies were assessing SSB as the sugar exposure (whether any of the studies with other findings assessed SSBs was not reported).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Among people consuming ad libitum diets, intake of free sugars or sugar sweetened beverages is a determinant of body weight. This seems to be mediated via changes in energy intakes, since isocaloric exchange of | **Applicable to the UK:** Unclear<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P<br>Unclear: Set<br><br>**Authors' limitations:**<br>Failure to conceal treatment allocation was the major potential source of bias in the RCTs. In many trials, it was unclear whether outcome measures were assessed by blinded observers, and whether there was selection bias. There was differential dropout in 3 RCTs, which only reported completer analysis.<br><br>There was a lack of consistency in the covariates used to adjust analyses and a wide range of methods of assessing sugar exposures and adiposity outcomes, which made pooling studies difficult.<br><br>**Review team limitations:**<br>Overall review level results for SSBs were only presented for children. Most of the review's focus was on sugar intake as a whole.<br><br>The review assumes that an SSB serving is 8-oz, and this may introduce some inaccuracies. This contrasts with the review |

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| **Multifactor review:** Yes | RCTs: Interventions aimed at increasing or decreasing sugars, or food and drinks containing sugars. Some studies made no strict attempt at maintaining calorie control (ad libitum studies), while others aimed to achieve isoenergetic replacement of sugars with other forms of carbohydrate.<br><br>**Outcome(s):**<br>BMI z score, BMI, body weight, WC, % body fat, fat mass, % trunk fat (in order of importance for pooling). | sugars with other carbohydrates was not associated with weight change. | by Malik et al. 2013, which assumed a serving size of 12-oz.<br><br>Included at least 17 RCTs in overweight and obese adults or those with health conditions such as diabetes. One cohort study selected adolescents from families with at least one overweight child but this study did not appear to assess SSB intake. |
| **USDA 2010u**<br><br>**Quality:** ++<br><br>**Search date:** Jul 2009<br><br>**Review design:**<br>Systematic review of RCTs and cohort studies.<br><br>**Review aim:**<br>To assess whether intake of sugar-sweetened beverages is associated with adiposity in children.<br><br>**Review funding:**<br>Not explicitly reported, but the review was carried out by the US Department of Agriculture's Nutrition Evidence Library to support their guideline development. | **Study participant inclusion criteria:**<br>Children 0 to 18 years (not populations exclusively <2 years old). Health and weight criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 2 (1, n=103)<br>Cohort: 17 (17, n=38,037)<br>Other: 0<br><br>**Intervention/exposure description:**<br>RCTs: Home delivery of non-caloric beverages (target 4 servings/d) for 25 weeks vs. usual beverage consumption. School based education programme aiming to reduce carbonated drink consumption vs. no intervention.<br><br>Cohorts: SSB (or soda, or 'sweet drinks') consumption as % or MJ energy, g | **Result(s):**<br>Overall, the majority of included studies (12 of 19) found a positive association between sugar-sweetened beverage (SSB) intake and adiposity in all or a subsample of the population studied. Of these studies, two were RCTs (n=677) and 10 were cohort studies. The non-school-based RCT (n=103 adolescents) provided home deliveries of non-caloric drinks for 25 weeks to the intervention group to replace SSBs, while the control group continued their usual beverage consumption. At the end of the intervention there was no significant difference between the groups overall (-0.14 ± 0.21 kg/m2; reported as NS). However, among adolescents with the highest baseline BMIs (upper tertile), the intervention group showed a greater reduction in BMI than the control group (-0.75 ± 0.34 kg/m2; p=0.03). | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D, P<br>Partial: Set<br>Unclear: None<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>The review did not present a summary of limitations of the included research. The underlying quality assessments suggest that studies seemed to meet most of the quality criteria.<br><br>One of the RCTs was school based, therefore not within the current scope. The other RCT provided drinks and may not be |

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| **Study funding:**<br>Bias resulting from funding or sponsorship was reported as unlikely in 17/19 studies, and unclear in 2 studies.<br><br>**Multifactor review:** No | carbohydrate from SSB, regular/high/>16-oz vs. no/low consumption/6-16-oz, servings/d, servings, consumption as part of a late night meal (where reported).<br>Exposures were measured with FFQ, 24-h diet recall, 3-day beverage or diet diaries, parent report and weighed record, questionnaire.<br>The measures were used either single time or multiple times.<br><br>**Outcome(s):**<br>Weight, BMI, % body fat, risk of overweight or obesity.<br><br>Measured by self report (e.g. height and weight), DEXA, SFT, bioelectrical impedance (all for body fat) where specified. Often reported a "measured" - which appeared to imply by someone other than the child, only specified once as programme.<br><br>Assessed at between 1 and 15 years' follow up. | Six cohort studies found no association between SSB intake and adiposity in children.<br><br>(Summary effect sizes not presented by the review).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Strong evidence supports the conclusion that greater intake of sugar-sweetened beverage is associated with increased adiposity in children. | representative of what might be achieved by free choice alone.<br><br>(The RCTs described in this review are also commonly included in other reviews.)<br><br>(Results were not presented separately for different exposures/outcome measures/types of effect size, therefore presentation of a range of effect sizes was not possible).<br><br>One of the RCTs was school based, and the other provided drinks. |

Tea and coffee

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| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 2 (2, n=30,038)<br>Other: 0<br><br>**Intervention/exposure description:**<br>1 study looked at the effect of intake of hot drinks (e.g. coffee and tea) on weight using FFQ, the other looked at just coffee intake using dietary interview.<br><br>**Outcome(s):**<br>Weight gain after 2.2 or 5.7 years.<br><br>Anthropometric data was measured by a trained technician at baseline but self-reported at follow-up in 1 study. | **Result(s):**<br>No studies identified that were specifically in children.<br><br>1 cohort (n=17,369) found no association between intake of hot drinks (such as coffee and tea; not further defined) and subsequent excess weight gain (not further defined) and obesity after 2.2 years (OR in women 1.01, in men 1 for highest vs. lowest consumption in g/day ).<br><br>1 cohort (n=12,669) found a daily consumption of more than 8 cups of coffee was associated with a slightly but statistically significantly increased risk of substantial weight gain (not further defined) in women, but with a reduced risk in men after 5.7 years (figures or p values NR).<br><br>The review found no cohort studies assessing the effect of green or black tea specifically on weight-related outcomes.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>There were no specific conclusions drawn for coffee, tea and hot drinks in the review. Overall it concluded that consumption of any type of beverage is not associated with a subsequent weight gain and obesity, | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>FFQ was used in one study and it is unclear if this was self-administered.<br><br>Overweight was more common among participants who consumed more than 8 cups of coffee daily than in those drinking less, but they report that these differences could be entirely explained by the variance of the other determinants of overweight.<br><br>**Review team limitations:**<br>The cohort study on coffee intake was not reported on in the review's supplementary table. It is not known what the study's definition of "substantial weight gain" was.<br><br>The study of hot drinks adjusted for confounders but this did not appear to include use of milk or sugar in the hot drinks. The study of coffee adjusted for confounders, but these were not specified.<br><br>Conclusion includes beverages as a whole.<br><br>Population: Unclear: it is unclear if |

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| | | although the results are inconsistent. | participants from the 2 studies were overweight, obese or had specific conditions at the start of the studies.<br>Setting: Unclear |

**Vegan / vegetarian**

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| **USDA 2010v**<br><br>**Quality:** +<br><br>**Search date:** June 2009<br><br>**Review design:**<br>Systematic review of mixed study designs (cohorts, case-controls and cross sectional studies)<br><br>**Review aim:**<br>How do the health outcomes of a vegetarian diet compare to that of a diet which customarily includes animal products?<br><br>**Review funding:**<br>Funding not explicitly reported. Reviews written by the US Department of Agriculture to support development of their guidelines'<br><br>**Study funding:**<br>Funding sources not explicitly stated but study funding was considered for quality rating and validity<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Children aged 2 to 18 and adults aged 19 and older. Population inclusion criteria described as healthy or those with elevated chronic disease risk.<br><br>**Total # studies (# relevant and n=):**<br>RCTs: 0<br>Cohort: 7 (3, n=22,365)<br>Other: 11 (9 cross-sectional, 2 case-controls)<br><br>**Intervention/exposure description:**<br>1 cohort divided participants into 6 groups: meat eaters (ate meat at both time points), fish eaters (ate fish but not meat at both time points), vegetarians (did not eat meat or fish but did eat diary or eggs at both time points), vegan (ate no animal products at either time point), reverted (those who changed diet in one or more steps in the direction of vegan to vegetarian to fish-eater to meat-eater) and converted (those who changed diet in one or more steps in the opposite direction). Median follow up 5.3 years. Self-reported FFQ and weight/height.<br><br>2 cohorts looked at the cardiovascular risk profiles of vegetarians (practising for at least 1 year in 1 cohort and at least 5 years in 1 cohort) compared to omnivores (length of follow up NR in either study). | **Result(s):**<br>No studies were identified specifically in children.<br><br>1 cohort (n=21,966) found over 5 years that differences in mean BMI between meat eaters, fish eaters, vegetarians and vegans was similar to those at baseline (figures NR). Compared with meat eaters, mean annual weight gain was significantly reduced in vegans (vegans: 284g in men and 303 g in women vs. meat eaters: 406 g in men and 423 g in women, p<0.05 for both sexes). There was no significant difference between annual weight gain between lacto-ovo vegetarians and meat eaters (vegetarian: 386g for men and 392g for women; not significant, p value NR). People classified as converted (from eating meat to vegan/vegetarian) showed the smallest mean annual weight gain of 242 g, 95% CI 133 to 351 (men) and 301 g, 95% CI 238 to 365 g (women). Highest weight gains were among people that were reverted (from a vegan/vegetarian diet to a meat diet), but mean weight gains were not significantly different than weight gains in meat eaters (figures NR).<br><br>Two studies described as cohort studies looked at the cardiovascular risk profiles including BMI of vegetarians (practising for at least 1 year in 1 cohort and at least 5 | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>Although the review reported that 5 studies were cohort studies in its summary, 7 studies were described as cohort studies in the text and table.<br>Outcomes were self reported in 1 study and NR in 2 studies.<br>Length of follow up of 2 cohorts is unclear as follow up was NR; these analyses appeared to be cross sectional.<br>It is unclear if included populations were representative of the general population.<br>It was unclear whether the studies adjusted for confounders.<br><br>Study design: Partial, included study designs out of scope of the review (cross-sectional and case-controls)<br>Outcome: Not all cohorts reported weight-related outcomes; the cohorts that did not match the scope of this review were focused on fracture risk, cancer incidence or mortality. |

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| | 1 cohort study compared the cardiovascular risk profile of healthy vegetarians (practising at least 1 year) to omnivores, no further exposure or assessment details provided (follow up length NR).<br><br>1 cohort looked at the cardiovascular risk of vegetarians (practising at least 5 years) and omnivores (follow up length NR)<br><br>**Outcome(s):**<br>Weight (self-reported in 1 cohort), BMI (assessment method NR in 2 cohorts) | years in 1 cohort) compared to omnivores. Despite being described as cohort studies, the length of follow up was NR in either study and it seemed that the assessments of BMI could be cross sectional.<br><br>-1 cohort (n= 198 healthy vegetarians and omnivores) found NS difference in BMI between lacto-ovo vegetarians and omnivores (follow up length NR).<br><br>-1 cohort (n=201 mainly lacto-ovo vegetarians and omnivores) found BMI significantly lower in vegetarians (mean 22.6 kg/m2) compared to omnivores (mean 26.7 kg/m2) (follow up length NR).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The evidence suggests that vegetarian, including vegan diets, are associated with lower body mass index. (This conclusion was based on all of the studies included, including cross sectional studies, which are outside the scope of the current review.) | Population: Unclear. 1 cohort reported including a healthy population, but is unclear if this study and the other studies included overweight/obese people and unclear if the other 2 studies had people with specific conditions.<br>Setting: Unclear. |

Water

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Muckelbauer et al. 2013**<br><br>**Quality:** ++<br><br>**Search date:** Apr 2013<br><br>**Review design:**<br>Systematic review of any study type<br><br>**Review aim:**<br>To systematically summarise all existing evidence of the association between dietary water consumption and weight-related outcomes in adults.<br><br>**Review funding:**<br>NR<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Adults > 18 years of any body weight status (underweight, normal weight, overweight or obese) and dieting status (dieting for weight loss or maintenance and not primarily dieting)<br><br>**Total # studies (# relevant and n=):**<br>RCT: 3 (2, n=52)<br>Cohort: 0<br>Other: 8 (1 non-randomised intervention, 1 longitudinal observational, 6 cross-sectional)<br><br>**Intervention/exposure description:**<br>Relevant interventions included additional water consumption (average 685mL daily) for three days; additional tap water (average 2.1L daily, unclear if this was total or additional water)<br><br>Comparators from relevant studies included caffeine free diet cola, and no intervention.<br><br>**Outcome(s):**<br>Body weight; measurement NR. | **Result(s):**<br>In mixed weight populations not primarily dieting for weight loss or maintenance, 2 small short-term RCTs (≤2 weeks, one comparing water versus caffeine-free diet cola and the other versus no intervention) showed no effect of water consumption on body weight, cross sectional studies had inconsistent results.<br><br>One RCT (n=32) compared the effect of additional water consumption (average 685mL daily) versus replacing water with caffeine free diet cola for 3 days (mean difference between intervention and control: 0.1 kg (SD NR), p=0.146). The other RCT (n=20) compared the effect of increased water consumption (average 2.1L daily) versus no intervention for 2 weeks on blood pressure (mean difference between intervention and control: 0.18 kg (SD 1.5), p=0.613). The RCTs showed no effect of increased water consumption on body weight.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Studies of individual dieting for weight loss or maintenance suggest a weight-reducing effect of increased water consumption, whereas studies in mixed-weight populations | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D, P<br>Unclear: Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>The review included mixed study designs including cross sectional studies and non-randomised studies.<br><br>The review included mixed populations including groups which were overweight or obese and dieting for weight loss or maintenance, although these studies were reported separately. Only results for those not dieting are reported here.<br><br>The RCTs in mixed weight populations did not primarily aim to look at the effect of water on body weight (main focus hydration in 1 RCT and blood pressure in the other), and may have been too short to show an effect.<br><br>The RCTs are likely to have been too small and short-term to show an effect on body weight. In addition, one study replaced water with another non-caloric beverage, |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | had inconsistent results. The evidence for this association is low due to the lack of good quality studies. | which may reduce ability to detect an effect of water consumption.<br><br>Participants of any weight status were included, as well as any dieting status (i.e. dieting for weight loss). All study designs were eligible for inclusion |
| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 1 (1, n=1,432)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Water consumption measured by parent report (unweighed diet diaries completed on behalf of their children)<br><br>**Outcome(s):**<br>Fat mass, assessed using objective height and weight measurements | **Result(s):**<br>Adults<br>No studies identified<br><br>Children<br>One prospective cohort found no significant association between water consumption at the ages of 5 or 7 years and a fat mass at the age of 9 years (regression coefficient 0.25 [p=0.22] and 0.06 [p=0.58] respectively; fat mass units NR).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>No significant association was found between water consumption and fat mass amongst children. | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D, P<br>Partial: None<br>Unclear: Set<br><br>**Authors' limitations:**<br>Adjustments were made for some potential confounders but not for physical activity levels.<br><br>**Review team limitations:**<br>Did not search for/include RCTs, only included prospective cohort studies in individuals aged >5 years, results may not apply to younger children.<br><br>It is unclear if the study adjusted for total energy intake or intake of calorie containing beverages that might substitute for water<br><br>Unclear: population - not reported if children were sampled from the general population or selected based on weight or health status; setting - not reported. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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**Whole grain consumption**

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Bautista-Castano and Serra-Majem 2012**<br><br>**Quality:** ++<br><br>**Search date:** 2008 (month NR)<br><br>**Review design:**<br>Systematic review of studies that assessed bread consumption and ponderal status (all study designs).<br><br>**Review aim:**<br>To assess the influence eating patterns that include refined and whole-grain bread are associated with overall obesity or excess abdominal adiposity in the general population and in people undergoing obesity management<br><br>**Review funding:**<br>INCERPAN (The Spanish Association of Bread Producers and Retailers)<br><br>**Study funding:**<br>Funding for the individual studies included in the review was not reported<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>None reported.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 3* (0)<br>Cohort: 11* (6, n=171,714)<br>Other: 24*<br>*Includes whole grain and refined grain studies and general studies on bread; relevant study number refers to solely whole grain<br><br>**Intervention/exposure description:**<br>Dietary patterns rich in whole grain bread (sometimes in combination with a high fibre, low fat diet; or analysed in a cluster with 'healthy' characteristics), intake of whole grain bread, intake of whole grain products and cereals assessed used food frequency questionnaires or dietary recalls.<br><br>**Outcome(s):**<br>Ponderal status including body weight/weight change, BMI, and waist circumference after between 4 and 12 years. How these were measured was not reported. | **Result(s):**<br>Groups of food items that included whole-grain bread were not associated with unfavourable effects on weight related outcomes (ponderal status) in any of the studies. (Effect sizes were not reported by the review)<br><br>One study (n=24,950) found that people with a dietary pattern rich in whole-grain bread generally maintained weight; people without this pattern were more likely to weight gain.<br>One study (n=74,091) found that weight gain was inversely associated with intake of whole-grain products.<br>One study (n=459) found that the dietary pattern including whole-grain bread was associated with lower increases in BMI and waist circumference.<br>One study (n=2,436) found that no dietary pattern (including a whole grain bread containing pattern) was consistently associated with changes in BMI or the development of obesity.<br>One study (n=27,082) found that consumption of whole-grain products and cereals prevented weight gain.<br>One study (n=42,696) found that whole grain cereals did not influence waist circumference changes.<br><br>**Adverse Effects:**<br>NR | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D, P<br>Unclear: Set<br><br>**Authors' limitations:**<br>Variations in sample size, quality of study design, length of follow-up make it difficult to compare results of studies.<br>Measurement of dietary intake is less precise that, for example, measurement of blood analytes.<br>Some of the included studies evaluated groups of food items that included bread, but the resulting data did not indicate the proportion with which bread consumption influenced the effect studied.<br>Heterogenity of methods used (for example diet index, factor analysis, cluster analysis).<br><br>**Review team limitations:**<br>Although whole grain (and refined grain) bread consumption were the focus of the review, often the studies analysed whole grain bread as part of a dietary pattern or cluster of whole grain food. The results may therefore be more representative of the effect if these dietary patterns rather than the effects of whole grain breads alone, and also may not apply to other forms of whole grain (other than bread). |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | **Conclusions:**<br>The review concluded, dietary patterns that include whole-grain bread do not increase weight gain and may be beneficial (i.e. inversely associated) with weight related outcomes. | All RCTs were performed in overweight/obese populations and therefore were not extracted here.<br>All extracted studies were in adults.<br><br>The review was funded by The Spanish Association of Bread Producers and Retailers<br><br>Study design: cross-sectional studies also included<br>Population: all RCTs were performed in overweight/obese populations. Cohort studies did not have weight status as a reported entry criteria<br>Setting: Not a reported inclusion/exclusion criterion. |
| **Pol et al. 2013**<br><br>**Quality:** ++<br><br>**Search date:** Mar 2012<br><br>**Review design:**<br>Systematic review of RCTs of whole grain compared with a non-whole grain control in adults<br><br>**Review aim:**<br>To review aimed to assess the effects of whole-grain compared with non-whole grain foods on changes in body weight, percentage of body fat, and waist circumference | **Study participant inclusion criteria:**<br>Apparently healthy adults, including normal weight, overweight and obese adults without diabetes mellitus or cardiovascular diseases.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 26 (unclear)<br>Cohort: 0 (0)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Whole grain food or diets rich in whole grain. The intervention was a mixed whole-grain diet in 9 studies, oat products in 7 studies, whole-grain wheat in 7 studies, whole grain barley in 2 studies, whole grain rye in 2 | **Result(s):**<br>Data from 26 RCTs (31 comparisons) involving 2,060 participants were included in the meta-analysis.<br><br>Whole grain intake did not show any effect on body weight (weighted mean difference [WMD] 0.06kg, 95% CI -0.09 to 0.20kg; p=0.45) compared with control. Stratification by background diet (calorie restricted or not) did not change the result. Meta-regression found no linear dose-response effect.<br><br>A subgroup analysis for individual grains showed that only whole-grain rice decreased | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P<br>Unclear: Set<br><br>**Authors' limitations:**<br>One study strongly influenced the body fat and weight analyses, this study was overweight Korean women. It reported a very low daily energy intake of 260kJ/day, and the wholegrain rice was provided in a powdered form as meal replacements in a relatively low dose. (Reviewers' note: This study is not relevant to the current review |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Review funding:**<br>The 3G Centre (GUT, GRAIN & GREENS) under the Danish Council for Strategic Research and the OAK foundation. The OAK Foundation is a group of philanthropic organisations.<br><br>**Study funding:**<br>Funding for the individual studies included in the review was not reported.<br><br>**Multifactor review: No** | studies, and whole grain rice in 2 studies. (NB some studies had more than one intervention arm) Whole grain dose ranged between 18.2g/day to 150g/day.<br><br>In some cases the study foods were provided. Controls were the same background diets without whole grains, although it was unclear if this meant removing whole grains entirely from comparator diets. In some studies the diets were calorie restricted, in others the background diet was usual diet.<br><br>**Outcome(s):**<br>Body weight, percentage body fat (measured using bioelectric impedance, dual-energy X-ray absorptiometry, or method of measurement not reported), waist circumference. Studies varied between 2 weeks and 16 weeks in length, with the majority of studies lasting between 4 and 6 weeks. | body weight compared to a control (based on 2 studies; WMD -1.10kg, 95% CI -20.6 to -0.14kg, p=0.02).<br><br>Seven RCTs (9 comparisons) reported on changes in the percentage of body fat. A small effect on the percentage of body fat was seen (weighted mean difference -0.48%, 95% CI -0.95% to -0.01%; p=0.04) compared to control.<br><br>When stratified by background diet, the reduction in body fat percentage with whole grains compared with a control was greater in studies that applied calorie restriction. This suggests that effects may be greatest in those on weight loss diets.<br><br>A subgroup analysis of individual grains found that whole grain rice decreased the percentage of body fat more than control (1 RCT, weighted mean difference -1.2%, 95% CI -2.36% to -0.04%; p=0.04).<br><br>Nine RCTs (11 comparisons) reported changes in waist circumference. There was no difference in change in waist circumference with whole grains compared with a control (WMD -0.15 cm, 95% CI -0.51 to 0.22 cm, p=0.43). Stratifying by background diet did not change this result. A subgroup analysis for individual grains found that whole-grain oat reduced waist circumference more than control (1 RCT; | scope, and may also have limited applicability to the UK).<br><br>All but one of the studies included in the meta-analysis used doses of whole grain exceeding the highest whole grain consumption (quintile) in the population (Reviewers' note: Unclear if this referred to the control groups of the studies or the general population). Doses reflected the amounts intended for consumption, and actual intake was not measured with daries of food frequency questionnaires in most studies). In many studies it was unclear whether participants substituted their usual grain product consumption with whole grain foods or whether they added whole grain foods to their usual diet. None of the studies were more than 16 weeks long.<br><br>The majority of included studies did not have changes in body weight and fat as primary endpoints.<br><br>**Review team limitations:**<br>Included trials could be in healthy normal weight, overweight or obese participants. Inclusion criteria for each trial was not reported, so discussion of solely trials in general population samples was not possible. However, average BMI was 25 or higher in 19/26 studies.<br><br>Seven of the included studies evaluated |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | WMD -1.20cm, 95% CI -1.66 to -0.74cm; p<0.001).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>"Whole-grain consumption does not decrease body weight compared with control consumption, but a small beneficial effect on body fat may be present." | whole-grain diet in a calorie-restricted background diet, the other 19 were in a non-calorie restricted background diet. The former ma indicate that these were weigth loss diets. The researchers performed stratified analyses to see whether background diet influenced the results.<br><br>Population: included studies in healthy normal weight, overweight or obese participants. |
| **WCRF 2006**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2005<br><br>**Review design:**<br>Systematic review of prospective cohorts of more than 1 year, RCTs of any length and systematic reviews for the area of TV viewing.<br><br>**Review aim:**<br>What are the food, nutrition and physical activity related causes of weight gain, overweight and obesity in humans?<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>Funding is reported for some but not all | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCTs: 0 (0)<br>Cohorts: 4 (4, n=121,209)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Whole grain cereal and cereal product intake assessed using food frequency questionnaires. The exposures were whole grain foods in 2 studies, whole grain bread in 1 study, and whole grain breakfast cereal in 1 study.<br><br>**Outcome(s):**<br>Change in weight, BMI, and waist circumference over between 6 years and 13 years of follow-up. Weight was self-reported | **Result(s):**<br>Results of the cohort studies were mixed. Two cohort studies found an inverse association between whole grain intake and change in weight/BMI, while the other two studies found no significant association (small inverse direction of effect):<br><br>-One study (n=74,091 women) that found an association between whole grain consumption and weight/BMI found that compared with the lowest quintile of whole grain intake, the highest quintile had an adjusted odds ratio (OR) for BMI≥30kg/m2 of 0.81 (95% CI 0.73 to 0.91, p for trend 0.0002) and an adjusted OR for weight gain of >25kg of 0.77 (95% CI 0.59 to 1.01, p for trend 0.03) over 12 years.<br>-The other cohort study (n=27,082 men) that reported an association found a significant difference in mean weight change between the lowest and highest quintile (Q) of whole | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Exposures varied greatly between individual studies. Two cohort studies used a comprehensive definition of whole grain foods, one assessed whole grain bread, and one assessed whole grain breakfast cereal consumption.<br><br>**Review team limitations:**<br>All 4 cohort studies were in adults (none identified in children).<br><br>Funding sources for the individual studies was reported to include food manufacturers, food industry-related organisations, |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| included studies e.g. international governmental bodies, charities, industry, pharmaceutical companies.<br><br>**Multifactor review:** Yes | in 3 cohorts, but confirmed in a sub-sample in 2 studies. Waist circumference was measured in the one study that reported this outcome. | grain intake (p for trend <0.0001, mean weight change ± SD: Q1 1.24kg± 0.23 vs. Q5 0.75kg ± 0.22). A 40g/day increase in wholegrain from all foods lead to a reduction in weight gain of 0.49kg (not explicitly reported, but appears to be based on the difference between the quintiles).<br>-One cohort study (n=2,155) found no association between wholegrain bread consumption and waist circumference over 6 years (regression coefficient -0.07 for men [95% CI -0.30 to 0.17], -0.20 for women [95% CI -0.49 to 0.09], exposure and outcomes units NR )<br>-One cohort study (n=17,881 men) found no association between whole grain breakfast cereal consumption and overweight over 13 years (≥1 serving/day vs. rarely or never consumed: OR 0.91, 95% CI 0.79 to 1.05, p for trend = 0.13).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The conclusions state that there is "a shortage of studies investigating the relationship between wholegrain consumption and obesity" | pharmaceutical companies as well as non-food related funding organisations and governmental organisations (e.g. the US Department of Agriculture).<br><br>Population: Unclear.<br>Setting: Not reported |

## Energy and nutrients

**Non-nutritive sweeteners**

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Brown et al. 2010**<br><br>**Quality:** -<br><br>**Search date:** NR<br><br>**Review design:**<br>Systematic review of studies (all study types) that specifically address artificial sweetener consumption in association with metabolic health effects in children aged between 0 and 18 years old.<br><br>**Review aim:**<br>The review aimed to systematically review the effects of artificial sweeteners on food intake, weight and metabolic health in children.<br><br>**Review funding:**<br>National Institute of Diabetes, Digestive and Kidney Diseases<br><br>**Study funding:**<br>Funding for individual studies included in the review was not reported.<br><br>**Multifactor review:** | **Study participant inclusion criteria:**<br>Children aged between 0 and 18 years old<br><br>**Total # studies (# relevant and n=):**<br>RCT: 3 (1, n=103)<br>Cohort: 6 (6, n=16,119)<br>Other: 9* (0)<br>*This includes 3 cross-sectional studies and 6 studies that had looked at the acute effects on food intake, study design not reported.<br><br>**Intervention/exposure description:**<br>RCT: One RCT replaced sugar-sweetened beverages (SSB) with artificially sweetened beverages (ASB) or water.<br>Cohort studies: Sugar sweetened beverage intake, artificially sweetened beverage intake/diet soda intake. How these exposures were measured was not reported.<br><br>**Outcome(s):**<br>RCT: BMI (after 25 weeks)<br>Cohort studies: obesity, weight gain, BMI z-score, BMI, fat mass, obesity risk status (follow-up between 1 and 10 years).<br><br>How outcomes were measured was not reported. | **Result(s):**<br>RCTs: The relevant RCT found no significant effect on BMI overall (replacing sugar sweetened beverages with ASB or water vs. control group; p value NR). The effect was greatest amongst the heaviest participants (-0.63 ± 0.23 kg/m2 with intervention vs. 0.12 ± 0.26 kg/m2 with control; significance NR). It did not separately report consumption of water versus artificially-sweetened beverages, therefore the effect of artificial sweeteners could not be isolated.<br><br>Cohort studies:<br>-3 cohort studies (n=13,023) found a positive association between diet soda consumption and BMI z-scores, fat mass, or weight gain at 1 to 4 years (figures NR), although one of these studies found an association only in boys and not in girls.<br><br>-2 studies (n=2,548) found no association between artificially-sweetened soda consumption and BMI or risk of obesity over 3 to 10 years (figures NR).<br><br>-1 cohort study found that increased diet soda consumption was associated with decreased incidence of obesity over 19 months (figures NR)<br><br>**Adverse Effects:**<br>The effect of artificial sweeteners on the metabolic syndrome was assessed in 2 | **Applicable to the UK:** Unclear<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D, P<br>Unclear: Set<br><br>**Authors' limitations:**<br>The RCTs included were not specifically designed to look for effects of artificial sweeteners on weight change, and were presumably underpowered to do so.<br><br>**Review team limitations:**<br>The included RCT replaced SSB with ASB or water, therefore the effect of ASB alone cannot not be isolated. The RCT was small and may be underpowered to detect an effect.<br><br>How exposures and outcomes were measured was not reported.<br><br>All of the included studies focused on artificially sweetened beverage consumption rather than total sweetener consumption.<br><br>Population: at least 2 RCTs in overweight children and adolescents. Weight status of participants in the included trial not reported.<br>D: all study designs included.<br>O: reported additional outcomes, such as food intake, diabetes, and metabolic |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | studies. Neither met the inclusion criteria for this review (both in overweight/obese populations), but found no difference in blood pressure, glucose, or lipid profile.<br><br>**Conclusions:**<br>"Data from large, epidemiologic studies support the existence of an association between artificially sweetened beverage consumption and weight gain in children. Randomised controlled trials in children are very limited, and do not clearly demonstrate either beneficial or adverse metabolic effects of artificial sweeteners." | syndrome components.<br>Setting: not explicitly reported. |
| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:** | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 3 (3, n=111,190)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Exposures included: artificial sweetener use (not otherwise define), saccharin intake.<br><br>Assessment methods included self-administered FFQ, semi-quantitative FFQ, interview, and questionnaire.<br><br>**Outcome(s):**<br>Outcomes included 1 and 4 year change in | **Result(s):**<br>Adults<br>One study in women aged 50 to 69 years (n=78,694) reported that weight gain was significantly more likely in women who used artificial sweeteners (AS) than non-users; the association was particularly pronounced among women with a very high initial relative weight (mean weight gain for non-AS users +6.71lbs vs. +8.19lbs for AS-users, $p<0.001$).<br><br>One study in non-smoking women (n=31,940) reported that saccharin intake was significantly associated with four year change in weight (r=0.0024, 95% CI 0.00176 to 0.0030.<br><br>One study (n=556) reported that saccharin consumption was significantly associated | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Outcomes were self-report in two studies.<br><br>Two studies adjusted for potential confounders, and the third study did not.<br><br>**Review team limitations:**<br>The amount of non-caloric artificial sweeteners associated with the outcomes in each case was not reported.<br><br>Population weight and health status, and setting were unclear. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| NR<br><br>**Multifactor review:** Yes | weight; height and weight were measured by research team in one study, and self-reported in two studies. | with tertiles of weight gain over 4 years in initial analyses, this association was no longer significant after adjusting for age, smoking, baseline BMI and total energy (regression coefficient 0.3731, p=0.13).<br><br>Children<br>No studies<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Epidemiological evidence suggests that consumption of high levels of non-caloric sweeteners is associated with subsequent weight gain and obesity. However, other evidence strongly suggests that this relationship is an artefact. People who know they are predisposed to gaining excess weight are more likely to consume artificial sweeteners, as part of habitually trying to prevent further weight gain/lose weight ('habitual dieters'). Habitual dieters are more likely gain excess weight over time compared with those who do not habitually diet. | |
| **USDA 2010c**<br><br>**Quality:** +<br><br>**Search date:** Jan 2010<br><br>**Review design:** | **Study participant inclusion criteria:**<br>Population inclusion criteria were healthy children, young people (2 to 18 years) or adults (19 years and older) and those with elevated chronic disease risk<br><br>**Total # studies (# relevant and n=):** | **Result(s):**<br>One prospective cohort (n=3,371) found a significant positive association between baseline artificially sweetened beverage consumption and all outcome measures (incidence of overweight/obesity, incidence of obese, and BMI change), adjusted for | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D, P<br>Unclear: Set |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| Systematic review. Cross-sectional studies excluded.<br><br>**Review aim:**<br>The review aimed to determine how non-caloric sweeteners are related to energy intake and body weight.<br><br>**Review funding:**<br>NR. Reviews written by the US Department of Agriculture to support development of their guidelines.<br><br>**Study funding:**<br>Funding for individual studies included in the review was not reported, however, the quality appraisal for the included study reported that the sources of funding and investigators' affiliations were described and the study was free from apparent conflicts of interest.<br><br>**Multifactor review:** No | RCT: 1 (0)<br>Cohort: 1 (1, n=3,371)<br>Other: 1 (0) [systematic review and meta-analysis]<br><br>**Intervention/exposure description:**<br>Artificially sweetened beverage consumption (soft drinks, tea, coffee). Consumption was self-reported. Participants were also asked whether they "usually" used sugar or sugar substitutes.<br><br>**Outcome(s):**<br>Incidence of overweight and or obesity (BMI 25kg/m2 or more), incidence of obesity (BMI 30kg/m2 or more) and BMI change. Height and weight were measured at baseline and 7 or 8 years later, how these were measured was not reported. | baseline BMI and demographic/behavioural characteristics.<br><br>Consuming more than 21 artificially sweetened beverages per week (vs. none) was associated with almost-doubled risk of overweight/obesity (OR=1.93, CI NR; p=0.007) among 1,250 baseline normal-weight individuals, and doubled risk of obesity (OR=2.03, CI NR ; p=0.0005) among 2,571 individuals with baseline BMIs less than 30kg/m2.<br>Compared with nonusers (BMI change +1.01kg/m2), change in BMI was significantly higher for people reporting artificially sweetened beverage consumption in quartiles two to four: quartile 2 +1.46 (p=0.003), quartile 3 +1.50 (p=0.002), and quartile 4 +1.78kg/m2 (p<0.0001). Overall, adjusted change in BMI was 47% greater among artificial sweetener users than non-users (+1.48kg/m2 vs. +1.01kg/m2, respectively, P<0.0001).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>"Moderate evidence shows that using non-caloric sweeteners will affect energy intake only if they are substituted for higher calorie foods and beverages. A few observational studies report that individuals who use non-caloric sweeteners are more likely to gain | **Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>Only one relevant cohort study was included in the systematic review. This study was in adults (aged 25 to 64).<br><br>The analyses in the cohort study were adjusted for baseline BMI and demographic and behavioural characteristics.<br>Artificially sweetened beverage consumption was self-reported. How height and weight were measured was not reported.<br><br>Study design: Also included systematic reviews and meta-analyses. The RCT did not include weight outcomes.<br>Population: Healthy, could include those with elevated chronic disease risk<br>Setting: Not an inclusion/exclusion criterion<br>Outcome: also reported on energy intake. |

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| | | weight or be heavier. This does not mean that non-caloric sweeteners cause weight gain, rather that they are more likely to be consumed by overweight and obese individuals." (conclusions based on all included studies and relates to the energy intake outcome as well as body weight). | |
| **Wiebe et al. 2011**<br><br>**Quality:** ++<br><br>**Search date:** Jan 2011<br><br>**Review design:**<br>Systematic review of RCTs that compared different sweeteners and that were at least 1 week long and reported weight change, energy intake, lipids, glycated haemoglobin, or insulin resistance, or measured 2-hour blood glucose responses. Trials had to have at least 10 participants per group.<br><br>**Review aim:**<br>The review aimed to systematically summarise the available RCT evidence to determine the comparative effectiveness of sweetener additives (non-caloric, sugar alcohols, and saccharides).<br><br>**Review funding:**<br>Alberta Heritage Foundation for Medical Research<br><br>**Study funding:** | **Study participant inclusion criteria:**<br>Obese, diabetic and healthy adult (16 years or older) populations.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 53 (1, n=133)<br>Cohort: 0<br>Other: 0<br><br>**Intervention/exposure description:**<br>3.56g aspartame/day vs. sucrose 42g/d in the relevant RCT<br><br>**Outcome(s):**<br>Change in BMI after 4-weeks. How this was measured was not reported. | **Result(s):**<br>The single relevant RCT compared aspartame (3.56g/d) to the natural sweetener sucrose (42g/d) and did not find a significant difference in change in BMI after 4 weeks (mean difference -0.3kg/m2, 95% CI -1.1 to 0.5). Average age of the participants was 32 years, all were female.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The review concluded that "little high-quality clinical research has been done to identify the potential harms and benefits of hypocaloric sweeteners" (Conclusion based on all studies in review, which included studies in overweight/obese populations and/or diabetic populations as well as healthy populations, and assessed outcomes in addition to BMI/weight change). | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P<br>Unclear: Set<br><br>**Authors' limitations:**<br>Author identified limitations relevant to the current review were that the RCTs had unclear allocation concealment prior to blinding.<br><br>**Review team limitations:**<br>Follow up in the included and relevant RCT was just 4 weeks, sample size was relatively small (n=133) and it only included women. How outcomes were measured was also not reported.<br><br>Outcome: energy intake, lipids, glycerated haemoglobin, insulin resistance and blood glucose responses were also assessed as outcomes.<br>Population: trials in healthy, overweight/obese and/or diabetic adults included. The non-relevant RCTs were in |

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| Funding for RCTs that meet scope extracted. Sucrose: 3 of the trials had private funding, 1 had public funding. Fructose: 1 mixed funding, 1 public funding. Glucose: 1 mixed funding, 1 public funding. Artificial sweetener: the trial received public funding.<br><br>**Multifactor review:** Yes | | | overweight or obese individuals, or people with health conditions such as type 2 diabetes, addressed caloric sweeteners, or did not assess weight related outcomes. Setting: setting not reported. |

Catechins

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Phung et al. 2010**<br><br>**Quality:** ++<br><br>**Search date:** Apr 2009<br><br>**Review design:**<br>Systematic review of RCTs.<br><br>**Review aim:**<br>The objective was to perform a systematic review and<br>meta-analysis of RCTs of Green Tea Catechins on anthropometric variables, including body mass index (BMI), body weight, waist circumference (WC), and waist-to-hip ratio (WHR).<br><br>**Review funding:**<br>The study reported it was not funded.<br><br>**Study funding:**<br>Funding sources were not reported.<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Age, body weight status and health status inclusion criteria.<br><br>**Total # studies (# relevant and n=):**<br>RCT:15 (4, n=388)<br>Cohort: 0<br>Other: 0<br><br>**Intervention/exposure description:**<br>The relevant studies assessed green tea catechins (583mg - 714mg/day) with caffeine (70mg - 114mg/day) compared with caffeine-matched control (0-126mg catechins and 70 - 114mg caffeine/day).<br><br>Interventions and control were mainly green teas with differing levels of catechins, with one study using green tea extract capsules and placebo capsules. The studies varied in whether tea and coffee was allowed to be consumed alongside the intervention green tea, and in what quantity.<br><br>Study periods were between 3 to 12 weeks.<br><br>**Outcome(s):**<br>Weighted mean difference in BMI weight (kg), waist circumference and waist to hip ratio. | **Result(s):**<br>The meta-analysis showed green tea catechins with caffeine decreased BMI (-0.55; 95% CI: -0.65, -0.40; 6 RCTs, n=471), body weight (-1.38 kg; 95% CI: -1.70,-1.06; 6 RCTs, n=567), and WC (-1.93 cm; 95% CI: -2.82, -1.04; 5 RCTs, n=438) but not WHR compared with caffeine alone (-0.02, 95% CI -0.05, 0.0008; 3 RCTs, n=163). The meta-analysis included all 4 studies relevant to the current scope for BMI outcome, 3 of 4 for body weight and WC, and 1 of 4 for WHR.<br><br>Study level results from the four RCTs most relevant to the current review include: There was a slight increase in BMI in the first study 0.20 (-2.05, 2.45), but a small reduction in the other three -0.60 (-0.75,-0.45), -0.40 (-0.83, 0.03), -0.49 (-0.81, -0.17).<br><br>Weight (kg) was slightly reduced in the three studies that assessed this outcome: -1.60 (-2.00, -1.19), -1.10 (-2.23, -0.03), -1.25 (-2.17, -0.33).<br><br>Waist circumference (cm) was also slightly reduced in these three studies, with varying significance: -2.5 (-3.10, -1.90), -1.80 (-3.05, -0.55), -0.54 (-1.91, 0.83).<br><br>Waist to hip ratio did not differ in the 1 study 0.008 (-0.09, 0.11). | **Applicable to the UK: Unclear**<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P<br>Unclear: Set<br><br>**Authors' limitations:**<br>Inclusion of heterogenous populations including children, healthy adults, and adults with comorbidities such as overweight or obesity, hyperlipidaemia or diabetes mellitus.<br><br>Dose response could not be assessed due to the small number of studies and the variation in catechin composition among the trials.<br><br>**Review team limitations:**<br>The studies varied on whether tea and coffee could be consumed as well, and how much.<br><br>Partial: Population included BMI between 24-30 in two of the studies.<br>Unclear: Setting |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | The review did not find benefits in trials looking at catechins alone (without caffeine, mainly given as capsules); none of these trials matched the scope of the current review.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The meta-analysis of green tea catechins with caffeine compared with a caffeine-matched control showed statistically significant reductions in BMI, body weight, and WC. However, the clinical significance of these reductions is modest at best. Current data do not suggest that green tea catechins alone affect anthropometric measurements. | |

Caffeine

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 3 (3, n=32,612)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Caffeine intake was assessed using a FFQ with or without an interview. The sources of the caffeine consumed (i.e. tea or coffee or other sources) in the individual studies was not reported.<br><br>**Outcome(s):**<br>Weight gain after 1, 4 or 12 years. Weight was self-reported in 1 study, and method of assessment in the other two studies was unclear. | **Result(s):**<br>In the first study (n=556) caffeine intake was not associated with change in weight over 12 years (regression coefficient 0.143, p=0.88).<br><br>In the second study of non-smoking nurses (n=31,940), caffeine intake was not associated with weight gain over 4 years (regression coefficient 0.0003, p value NR).<br><br>In the third study of students (n=116), caffeine was not a significant predictor for weight gain over 1 year in men but women in the 'BMI-gain' group were more likely to consume caffeine (OR 0.2, 95% CI 0.04, 0.94, p=0.04; exact comparison this data refers to unclear).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The limited epidemiological evidence reviewed (three studies) suggests that levels of caffeine intake, regardless of source, are not associated with subsequent excess weight gain or obesity. | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>The method of assessment of dietary intake varied. Body weight and height were self-reported in the large study. All studies were from the United States. Although all studies adjusted for some confounders, none adjusted for physical activity levels.<br><br>**Review team limitations:**<br>The frequency and amount of caffeine consumption compared in each study was unclear. The review did not specify exact exposure levels involved in the comparisons described.<br><br>Population: is unclear if participants from the 3 studies were overweight, obese or had specific conditions at the start of the studies.<br>Setting: Unclear |

**Energy density**

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| **Fogelholm et al. 2012**<br><br>**Quality:** +<br><br>**Search date:** NR<br><br>**Review design:**<br>Systematic review of cohorts with a follow up of more than 1 year and RCTs.<br><br>**Review aim:**<br>The purpose was to examine the associations of dietary macronutrient composition, food consumption and dietary patterns in prevention of weight or waist circumference gain, with and without prior weight reduction.<br><br>**Review funding:**<br>Nordic Council of Ministers<br><br>**Study funding:**<br>Funding sources were not reported<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>Adults aged 17 to 80 years. No inclusion criteria for body weight status.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 4 (4, n=189,851)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Change in dietary energy density (defined as the amount of energy in a given weight of food) using FFQ. No further details provided. 1 cohort weighed 7 day food record at baseline. Water content was only included in calculations in 1 cohort, it was unclear whether this referred to water contained in food or drinks or both.<br><br>**Outcome(s):**<br>Self-reported or measured change in weight and/or WC after 5 to 8 years. | **Result(s):**<br>Two studies (n=138,063) found that energy density was positively associated with WC. The results of the 3 studies (n=141,220) assessing the relationship between energy density and weight change were less consistent. One study reported that an increase in energy density was associated with a simultaneous increase in weight among women, while 2 other studies did not find a significant association.<br><br>In 1 cohort (n=48,631, median follow up 5.5 years), 1 kcal/g increase in energy density (food only) predicted an increase in WC of 0.09cm in men (95%CI 0.05 to 0.13) and 0.15cm (0.09, 0.21) in women, p values NR.<br><br>In 1 cohort (n=89,432, follow up 6.5 years) eeach 1kcal/g increase in energy density (food only) predicted an annual WC increase of 0.09 cm/year (95% CI 0.01 to 0.18), p value NR. Energy density was not associated with weight change (figures NR).<br><br>In another cohort (n=1,762, follow up 5 years) energy density (including water content) was not associated weight change for either sex, figures and p value NR.<br><br>In a cohort of women (n=50,026, follow up 8 years) who increased dietary energy density (for food only) during follow-up the most | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: P<br>Unclear: D, Set<br><br>**Authors' limitations:**<br>The studies mostly relied on FFQ but the authors were not aware of a validated FFQ to assess dietary density.<br><br>**Review team limitations:**<br>The only study to show an association with weight gain was conducted using female nurses, limiting its generalisablility to the general population of men and women. Similarly, it had high levels of loss to follow up over the 8 year follow up period, reporting a 57% dropout rate. This means the final group is a highly select and streamlined version of the original group and may not have the same characteristics potentially biasing the results observed.<br><br>Partial: population in 1 RCT included average male baseline BMI of 25.1.<br>Unclear: Study design of 1 cohort selected participants from a larger study. It is unclear how they were selected.<br>Unclear: setting |

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| | | (not further defined) had a significantly greater weight gain than those who decreased dietary energy density the most (6.42kg vs. 4.57kg; p for trend <0.001).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>There is suggestive evidence that higher energy density of the diet is associated with larger increases in WC. However, the evidence regarding the association between energy density and weight change was inconclusive. | |
| **Johnson et al. 2009**<br><br>**Quality:** +<br><br>**Search date:** Sept 2008<br><br>**Review design:**<br>Systematic review of cross-sectional and longitudinal studies.<br><br>**Review aim:**<br>To demonstrate that current variation in the method for calculating energy density hampers the interpretation of results.<br><br>**Review funding:**<br>The authors were funded by Cancer Research UK and the Medical Research Council but they report that the funding bodies had no | **Study participant inclusion criteria:**<br>"Free-living" adults and children, excluding those actively participating in weight loss or samples limited to clinically ill participants.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 8 (3, n= n=51,974 adults/3, n=1,889 children)<br>Other: 16<br><br>In total, the review identified 8 cohort studies and 16 cross-sectional studies. Of these 6 of the cohort studies (n=53,863) matched the scope of this review, 3 (n=1,889) were in children, 3 in adults (n=51,974).<br><br>**Intervention/exposure description:** | **Result(s):**<br>Across adults and children, all 4 studies that measured food alone found a positive association.<br><br>Out of 5 studies that measured food and drink to some extent, 4 found no evidence of an association.<br><br>Children:<br>Both studies measuring FO energy density found an association. All 3 studies that measured FD energy density (all drinks or just energy containing drinks) found no evidence of an association. The review publication reported significant and non-significant results but did not provide p-values alongside 95% confidence intervals for most findings. | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: P<br>Unclear: D, Set<br><br>**Authors' limitations:**<br>The cohort of nurses (n=50,026) was not truly prospective as the exposure is change in dietary energy density and the outcome is change In body weight, so it is impossible to establish which changed first; therefore, the findings are equivalent to a cross-sectional study.<br><br>**Review team limitations:**<br>The review publication reported results as significant or non-significant, but did not |

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| role in the decision to publish the paper.<br><br>**Study funding:**<br>Funding was recorded for 1 study, the Avon Longitudinal Study of Parents and Children. It was funded by the UK Medical Research Council, the Wellcome Trust and the University of Bristol.<br><br>**Multifactor review:** No | Dietary energy density was assessed in children using a diary (2 studies, not further defined), or 24-hour food recall (1 study). Two studies measured energy density in food only (FO) and food and drinks (FD). The other measured food and energy-containing drinks (FCD)<br><br>3 studies measured energy density in food only (FO) and food and drinks (FD). Of the others, 1 measured FO, 1 measured FD and 1 measured food and energy-containing drinks (FCD).<br><br>Dietary energy density in adults was assessed using a diary (not further defined), 24-hour food recall and a FFQ, a different method in each of the three included studies. One study measured energy density in food only (FO) and 1 food and drinks (FD). The third study measured FO and FD.<br><br>**Outcome(s):**<br>Weight change or increased adiposity over between 1 and 8 years. Follow-up in all but one study was after at least 4 years.<br><br>Outcomes in children included weight change and increased adiposity between 1 and 8 years follow up<br><br>Outcomes in adults were weight change over 8 years (1 study), 6 years (1 study) and 5 years (1 study). | 1 cohort (n=798, ages NR) found no significant association between FCD energy density and weight gain over 1 year (beta=0.23 (SD 0.35) kg/year per kJg)<br><br>1 cohort (n=1,043) found a significant increase in the odds of excess adiposity at age 9 years per kJ/g FO energy density measured at 7 years OR=1.36 (95%CI 1.09-1.69) but not at age 5 years OR=1.12 (95%CI 0.90-1.40). It found no significant effect on the odds of excess adiposity at age 9 years per kJ/g dietary FD energy density at age 5 or 7 (OR=0.97, 95% CI 0.61-1.15; OR=0.97, 95% CI 0.75-1.24 respectively).<br><br>1 small cohort study (n=48) found significant increase in the odds of gaining the most fat vs. gaining the least fat between 7 and 15 years when looking at FO energy density OR=1.9 (95% CI 1.1-3.6). It found no significant effect when using FD energy density OR=2.6 (95%CI 1.1-4.3).<br><br>Adults:<br>Both studies measuring FO energy density found a significant positive association with weight gain. Of the 2 studies that measured FD energy density, 1 found no evidence of an association, 1 found a significant positive association with weight gain.<br><br>1 cohort (n=50,026; also included in | provide p-values or 95% CIs.<br><br>The review aimed to see if the association between energy density and weight related outcomes differed depending on whether drinks were taken into account in the calculation of energy density. No overall conclusions on the association between energy density and weight related outcomes was drawn.<br><br>Partial: Population included children of Hispanic families where at least one of the children was overweight. 1 cohort was in pregnant women and 1 was post-weight loss, so are not relevant to the current review scope<br>Unclear: study design<br>Unclear: Setting |

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| | | Fogelholm et al. 2012 [++]) found weight gain across all quintiles of change in FO energy density over 8 years (Q1=4.4kg; Q2=4.9kg; Q3=5.3kg; Q4=5.9kg; Q5=6.7kg; difference significant). It also found weight gain when FD energy density was used (Q1=4.7kg; Q2=5.1 kg; Q3=5.4kg; Q4=5.7kg; Q5=6.3kg; difference significant).<br><br>1 cohort (n=1,762; also included in Fogelholm et al. 2012 [++]) found no significant association between FD energy density and weight change (beta: women -24 kg per MJ/g [SE 47]; men -71 [SE 58] kg per MJ/g; p value NR).<br><br>1 cohort (n=186) of women found significant weight gain over 6 years across low, intermediate and high FO energy density groups (low=2.5kg; intermediate=4.8kg; high=6.4kg).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The association between dietary energy density, increased energy intake and weight gain is supported by experimental evidence but confirmation is limited.<br><br>Focusing on studies with energy density measured using food only reduces the variability in the results obtained. Energy | |

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| | | from drinks consumed should be calculated separately. These overall conclusions were based on the results from all cohort studies. | |

Fat / protein / carbohydrate intake

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| **Hooper et al. 2012**<br><br>**Quality:** ++<br><br>**Search date:** Jun 2010<br><br>**Review design:**<br>Systematic review and meta-analysis of randomised controlled trials (at least 26 weeks in duration) and prospective cohort studies (at least one year in duration).<br><br>**Review aim:**<br>To investigate the relation between total fat intake and body weight in adults and children.<br><br>**Review funding:**<br>WHO (the review was performed to support development of WHO guidance).<br><br>**Study funding:**<br>Adults: The cohort studies in adults were funded by non-commercial bodies, except for one study where funding was unclear; one study which was part funded by the Association of Danish Pharmacies (a professional trade association). Children: The cohort studies in children were funded by non-commercial bodies.<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Studies in apparently healthy children or adults from any country were reported to be included. Although populations were reported as healthy, some studies were specifically in populations with health conditions e.g. type 2 diabetes, hypercholesterolemia. Studies aiming for weight loss and populations recruited for these studies were excluded.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 33 (3, n=1,131)<br>Cohort: 13 (10, n=107,624 adults; 3, n=1,337 children)<br>Other: 0<br><br>**Intervention/exposure description:**<br>RCTs: Interventions aimed to reduce total fat intake (% energy from fat or g/day) compared with usual diet (control) for 26 weeks or longer. The difference between intervention and control ranged from <5% to >15% energy from fat. Control group fat intake ranged from 28% to 43% energy from fat. During the intervention periods energy intake was reported as usually lower in the low fat group than in the control groups (figures not reported). How intake was measured NR.<br>Interventions could be multicomponent, but the non-fat related components had to be the same in both groups. | **Result(s):**<br>Children (1 RCT, 3 cohort studies):<br>In the RCT (n=191, age 12-13 years) found that mean BMI (adjusted for age and gender) decreased significantly from baseline in the intervention (23.3 (SD 2.8) vs. 24.0 (SD 3.1), p<0.001) but not control group (24.8 (SD 3.8) vs. 24.3 (SD 3.3), p=0.355). The review calculated the between group difference as significant (−1.50, 95% CI −2.45 to −0.55). The 3 cohort studies (n=1,337, age 3-19 years) all found a significant association between % energy from fat at baseline and change in body mass index or weight (p≤0.05). Analyses of change in energy intake from fat over time had mixed findings in 1 study. One study found that every 5% more energy from fat at baseline was associated with 0.17k/m2 higher BMI at 2 year follow up (p=0.05 for regression).<br><br>The evidence in children was given a GRADE assessment of moderate quality.<br><br>Adults (33 RCTs, 10 cohort studies):<br>Meta-analysis found that diets lower in total fat were associated with lower body weight (27 comparisons, n=57,735; -1.6 kg, 95% CI −2.0 to −1.2 kg, I2=75%), lower BMI (9 RCTs; −0.51 kg/m2, 95% CI −0.76 to −0.26, I2=77%), and lower waist circumference (1 RCT, n=15,671 women; -0.3 cm, 95% CI −0.58 to −0.02). The effect on weight (main analysis) | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P, Set<br>Unclear: None<br><br>**Authors' limitations:**<br>Risk of bias in RCTs was variable. The RCTs were not blinded (due to the nature of the intervention) and allocation concealment was rarely clearly reported. The cohort studies were mostly assessed as being at high risk of bias (11/13 studies).<br>There were too few studies in children to assess small study bias, heterogeneity, publication bias, or the possibility of a dose response gradient. Imprecision was high in the data from child studies (but not quantifiable).<br><br>**Review team limitations:**<br>Some of the trials (8 RCTs) provided food, which may reduce the applicability of their results to individual choices in a day to day environment. Although the RCT findings were in apparently healthy individuals, most participants had health conditions (e.g. type 2 diabetes, recent breast cancer) and this may limit applicability of the findings to the general population. However, subgroup analysis in healthy populations did suggest that the results did apply to this group (8 |

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| | Cohorts: Differences in fat consumption groups being compared in cohort studies not reported at a summary level. Exposure measured in varying ways including FFQ, weighed 7-day food record, 24-hour or 7 day dietary recall, interview. All except 1 cohort appeared to be using exposure data from a single dietary assessment in their analyses.<br><br>**Outcome(s):**<br>Weight, BMI, waist circumference. (Also serum lipid levels and blood pressure for adverse effect assessment). Follow up was between 6 months and over 8 years. Range of follow up in adult cohort studies not reported (average 6.2 years of follow up per person). | was retained in sensitivity analyses (not carried out on other outcomes).<br><br>Subgroup analysis showed that reduced fat intake was also associated with lower body weight at follow up in populations without risk factors or illnesses (3 comparisons, n=NR; -0.98 kg, 95% CI -1.56 to -0.41) and those who were not overweight or obese (8 comparisons, n=NR; -0.96 kg, 95% CI -1.69 to -0.22, I2=87%).<br>The evidence from RCTs was given a GRADE rating of high.<br><br>Metaregression suggested that greater reduction in total fat intake and lower baseline fat intake were associated with greater weight loss, and these factors accounted for most of the heterogeneity in the meta-analysis. It found that for every 1% energy from total fat reduction weight was reduced by 0.19 kg (95% CI −0.33 to −0.06, p=0.006).<br><br>During the diet periods energy intake was usually lower in the low fat group than in the control groups; sugar intake was not measured often but where reported usually seemed to be higher in the low fat arms. Carbohydrate intakes were mostly higher in the low fat arms than in the usual fat arms; protein intakes were sometimes higher and sometimes similar. Subgroup analysis suggested that greater reduction in energy | comparisons, n=NR; -0.98 kg, 95% CI -1.69 to -0.22, I2=87%).<br><br>Most of the RCTs (29 RCTs) were in specific populations with health conditions, and one included only people who were overweight or obese.<br><br>All adult RCTs were community based, but some provided a "trial shop" where foods were supplied i.e. an environmental modification. The RCT in children was school-based. |

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| | | intake in the reduced fat group was associated with greater weight reduction (p=0.04).<br><br>In the 10 cohort studies: 5/16 analyses showed a significant positive effect of lower fat intake on weight change (11/16 analyses NS effect); 1/4 analyses showed a significant inverse effect of lower fat intake on waist circumference change (3/4 analyses NS effect); 1 study found that lower total fat intake was associated with lower body weight 10 years later in black individuals but not white individuals; and 1 study found NS effect of total fat intake on BMI. (Direction of NS effects varied).<br><br>There was no suggestion of inverse effects of the interventions on other cardiovascular risk factors (lipid levels or blood pressure).<br><br>**Adverse Effects:**<br>There was no suggestion of inverse effects of the interventions on other cardiovascular risk factors (lipid levels or blood pressure).<br><br>**Conclusions:**<br>Lower total fat intake leads to small but statistically significant and clinically meaningful, sustained reductions in body weight in adults in studies with baseline fat intakes of 28-43% of energy intake and durations from six months to over eight years. Evidence supports a similar effect in | |

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| | | children and young people. | |
| **Santesso et al. 2012**<br><br>**Quality:** ++<br><br>**Search date:** Jul 2011<br><br>**Review design:**<br>Systematic review of randomised controlled trials.<br><br>**Review aim:**<br>To assess the benefits and harms of higher-protein<br>compared with lower-protein diets in the general population.<br><br>**Review funding:**<br>Barilla (an Italian food company). The review reported that the funding organisation was not involved in the analysis of the study and the final decision to submit for publication. One author was an employee of the sponsor and was involved in the review and interpretation of the data in the manuscript. However, the final decision about interpretation rested with the first and corresponding author.<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Studies in adults where ≥80% did not have medically indicated diets (e.g. due to diabetes of CKD) or where results were reported separately for these groups. Studies aimed at weight loss could be included, as were studies in people with hypertension, hyperlipidaemia, or metabolic syndrome.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 74 (6, n=143)<br>Cohort: 0<br>Other: 0<br><br>**Intervention/exposure description:**<br>Trials had to compare groups with higher versus lower protein diets, for ≥28 days. The difference between the two groups had to be at least 5% energy from protein (based on mean reported intakes at time nearest to follow up). The aim of the study did not have to be to assess the effect of a change in protein intake, as long as the intake was different between the groups.<br>The groups had median (range) energy intake from protein: 27% ( 16% to 45%) for higher protein group; 18% (5% to 23%) in the lower protein group. The 6 studies in healthy individuals generally had lower % energy consumption from protein (range 12% to 29%) than trials in overweight/obese individuals.<br><br>The review reported that co-interventions | **Result(s):**<br>Pooled effect sizes using standardised mean differences (SMDs) were<br>small to moderate and favoured higher-protein diets for weight loss (38 RCTs, n=2,326; SMD -0.36, 95% CI -0.56 to -0.17; I2=77%), BMI reduction (16 RCTs, n=887; SMD -0.37, 95% CI -0.56 to -0.19; I2=42%), and waist circumference (15 RCTs, n=1,214; -0.43, 95% CI -0.69 to -0.16; I2=75%).<br><br>Meta-regression suggested that a higher BMI at the start of a study was associated with greater weight loss in people in the higher-protein diet arms. Other variables including % energy intake from carbohydrates and trial duration did not have an effect in the fully adjusted model.<br><br>The review translated findings to an effect of a higher protein diet at 3 months, which would be: greater weight loss of 1.21 kg (95% CI -1.88 to -0.57), a 0.51 kg/m2 greater decrease in BMI (95% CI -0.77 to -0.26) and a 1.66 cm greater reduction in waist circumference (95% CI -2.66 to -0.62)<br><br>The evidence was rated as moderate-quality using the GRADE system for all three outcomes.<br><br>Secondary analyses of end of study values (rather than change values) did not find | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P<br>Unclear: Set<br><br>**Authors' limitations:**<br>The authors report that every attempt was made to avoid double counting of participants (implying that this may still not have removed the issue entirely).<br><br>**Review team limitations:**<br>The majority of the studies were in people who were overweight or obese, and/or had a specific health problem. They could include RCTs aimed at weight loss, and provide food, as long as the diet could be replicated by the general population.<br><br>The results may not be applicable to the general population. The 6 RCTs in healthy individuals were small (n=143).<br><br>The RCTs were mostly <6 months in duration, and may not be representative of the longer-term effects of high protein diets.<br><br>Unclear if all groups were received a new diet, or if some control groups were "usual diet". |

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| | were allowed if they were the same in both groups. How protein intake was measured was not reported.<br><br>The median daily energy intake was the same in higher protein and lower protein groups (1,500 kcal). 58% of trials a difference in kcal intakes within 100 kcal/day between the two groups. Median carbohydrate intake was higher in the lower protein groups (55% vs. 38% total daily energy intake), and median fat intake was slightly higher in the higher protein diet groups (32% vs. 26% total daily energy intake), but in both cases ranges showed considerable overlap.<br><br>**Outcome(s):**<br>Weight, BMI, waist circumference, adverse effects. The primary analysis looked at change values, and the secondary analysis at end of study scores. Methods of measurement NR.<br><br>Most studies (80%) measured outcomes at <6 months' follow up (range 28 days to 1 year). | significant differences between the higher and lower protein diets, but these analyses included fewer participants and the direction of effect was still towards benefit with a higher protein diet.<br><br>22 RCTs measured and reported adverse effects.<br><br>5 RCTs found no difference in overall adverse events, and 2 different RCTs found more adverse gastrointestinal events with high-protein diets. These 7 RCTs included 581 participants.<br><br>The GRADE rating of this evidence was low, in part due to likely selective reporting bias.<br><br>The review reported that effects on surrogate measures of kidney health were non-significant. Six RCTs assessed kidney function (serum creatinine): 4 RCTs that could not be pooled found non-significant effects, and 2 that could be pooled showed an increase in serum creatinine (MD 6.14 micromol/L, 95% CI 2.49 to 9.79) but this evidence was very low quality.<br><br>**Adverse Effects:**<br>22 RCTs measured and reported adverse effects.<br><br>5 RCTs found no difference in overall adverse events, and 2 different RCTs found | Included studies in people aiming to lose weight. Most of the RCTs (67/74) were in people who were overweight or obese, and/or had a specific health problem such as hyperlipidaemia; 1 RCT was specifically in vegans. The review looked at a wide range of patient-important outcomes and surrogate outcomes, including weight-related outcomes (analyses were performed separately). |

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| | | more adverse gastrointestinal events with high-protein diets. These 7 RCTs included 581 participants.<br><br>The GRADE rating of this evidence was low, in part due to likely selective reporting bias.<br><br>The review reported that effects on surrogate measures of kidney health were non-significant. Six RCTs assessed kidney function (serum creatinine): 4 RCTs that could not be pooled found non-significant effects, and 2 that could be pooled showed an increase in serum creatinine (MD 6.14 micromol/L, 95% CI 2.49 to 9.79) but this evidence was very low quality.<br><br>**Conclusions:**<br>Higher-protein diets probably improve adiposity, but the effects are small and need to be weighed against the potential for harms. | |
| **Schwingshackl and Hoffmann 2013**<br><br>**Quality:** ++<br><br>**Search date:** Aug 2012<br><br>**Review design:**<br>Systematic review of RCTs lasting 1 year or longer.<br><br>**Review aim:**<br>To compare the long term effects of high | **Study participant inclusion criteria:**<br>NR<br><br>**Total # studies (# relevant and n=):**<br>RCT: 15 (unclear, maximum 3, n=107)<br>Cohort: 0<br>Other: 0<br><br>**Intervention/exposure description:**<br>High protein (25-40% of energy) vs. low protein (10-20% of energy). All diets were low fat (10-30% of energy). In most trials | **Result(s):**<br>There were no significant differences between high and low protein groups in any of the weight related outcomes.<br><br>Weight (13 RCTs, n=971): WMD -0.39kg, 95% CI -1.43 to +0.65; I2=0%<br>WC (8 RCTs, n=727): WMD -0.98 cm, 95% CI -3.32 to +1.37; I2=72%<br>Fat mass (10 RCTs, n=913): WMD -0.59 kg, 95% CI -1.32 to +0.13; I2=0% | **Applicable to the UK: Unclear**<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P, O<br>Unclear: Set<br><br>**Authors' limitations:**<br>The authors note that their results are different to those of Santesso et al. 2012 [++], and suggest that this may be due to excluding trials shorter than 1 year, and |

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| protein versus low protein diets on biomarkers of obesity, cardiovascular complications as well as adverse effects of high protein.<br><br>**Review funding:**<br>NR<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | (11/15) fat intakes were the same in both groups, with the low protein groups consuming more energy from carbohydrate (55%->65%) than the high protein groups (33%-55%). In 9/15 trials both groups had the same target energy intake (1340 to 1960 kcal where stated, in some trials a deficit was the target), 4 trials had no restrictions, 1 trial had a small difference in calorie intake (60 kcal lower in the high protein group), and in 1 trial differences were not clear.<br><br>How nutrient intake was assessed/confirmed NR.<br><br>**Outcome(s):**<br>Weight, waist circumference, fat mass, adverse effects. How measured not reported. Trials lasted 1-2 years. | Sensitivity analysis of only higher quality trials (Jadad score ≥3; 8 RCTs), or trials not in people with T2D supported the primary analysis findings.<br><br>Adverse effects: 3 RCTs assessed the effects on biomarkers of kidney function in people with T2D. These trials did not find an effect on renal function as measured by serum creatinine and microalbuminuria (figures NR).<br><br>**Adverse Effects:**<br>3 RCTs assessed the effects on biomarkers of kidney function in people with T2D. These trials did not find an effect on renal function as measured by serum creatinine and microalbuminuria (figures NR).<br><br>**Conclusions:**<br>According to the present analysis of long-term RCTs, high protein diets exerted neither specific beneficial not detrimental effects on outcome markers of obesity. Therefore it seems premature to recommend high-protein diets in the management of overweight and obesity. | inclusion of both change values and end of trial values in their meta-analysis (Santesso analysed these separately). They note that this approach is considered as a legitimate procedure by the Cochrane Collaboration and should not be considered a limitation.<br><br>The review did not included unpublished data, and funnel plots suggested that some publication bias could not be ruled out that could have an impact on the results.<br><br>The RCTs included were heterogeneous in terms of diets used, definition of high and low protein, study populations, intervention and follow up duration, nutritional assessment, and whether the diets were hypocaloric or isocaloric.<br><br>**Review team limitations:**<br>The studies were generally small, with 9/15 having <100 participants, and the meta-analyses including <1000 participants. Therefore they may be underpowered to detect an effect.<br><br>The majority of trials were overweight/obese individuals (either selected on this basis or average BMI in this range), or those with insulin resistance.<br><br>It was unclear if in any cases the participants in the control groups were eating their usual diet. |

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| | | | Also, the countries in which the studies were performed were not reported. The results may not apply to general populations in the UK aiming to maintain weight/prevent excess weight gain.<br><br>Funding sources of the review and included studies were not reported, although the review authors reported no conflicts of interest.<br><br>Included outcomes other than weight related outcomes (e.g. serum lipids) but analysed separately. Included 12/15 studies specifically in overweight and obese individuals, those aiming to losing weight, or those with insulin resistance. Populations in the remaining 3 trials all had average BMIs in the overweight/obese range, but unclear if they were selected on this basis. |
| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohorts:<br>Total fat intake: 27 (15, n=126,891 adults/ 11, n=3,962 children)<br>Total protein intake: 19 (8, n=81,286 adults/11, n=2,396 children)<br>Total carbohydrate intake: 16 (7, n=79,083 | **Result(s):**<br>Total fat intake (TFI):<br>Children (TFI): Ten cohorts (0 to 19 years of age; n=3,781) analysed exposure and outcome in childhood, and 1 (n=181) analysed exposure in childhood and outcome in adulthood. Five studies found no significant associations (2 direction of effect NR, 1 positive, 1 inverse, 1 mixed directions); results in the other 6 studies were mixed, with variation in direction of effect (mainly positive, 5/6), and in findings across different exposure and outcome | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P<br>Unclear: Set<br><br>**Authors' limitations:**<br>Reporting and measurement of exposures varied (advantages and disadvantages of methods vary).<br><br>Fat intake studies: One adult study used self |

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| subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | adults/9, n=2,625 children)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Total fat intake: % energy from fat, change in fat intake, g/day, servings/day.<br>Total protein intake: % or MJ energy from protein, g/day, g/kg body weight/day, servings/d, 'low' or 'high' intake, kJ/g<br>Total carbohydrate intake: % energy from carbohydrates and other methods (g, g/day, MJ/day).<br><br>Exposures measured by various methods: 24-hour or 7-day dietary recall, 1 to 7 day food records (some weighed), FFQ, diet history record, interview, questionnaire, parental report. (Some child studies reported using parental report of these measures, one study reported dietician measurement.)<br><br>**Outcome(s):**<br>Total fat studies: weight, BMI, WC, SFT, WHR. Measured by self report in one adult study, measured by researchers in all child studies. Outcomes measured at 3 months' to 12 years' (adults) and 1 to 15 years' (children) follow up.<br><br>Total protein studies: weight, body fat (% or g), BMI, WC, SFT, WHR, overweight. Measurement not reported in all cases, DEXA reported as used for some body fat analyses, and height and weight always measured (by | measures or methods of analysis in some studies.<br><br>Across studies, correlation coefficients ranged from -0.09 (for the relationship between % energy as fat at age 2 years and triceps skinfold at age 8 years) to +0.314 (for % energy from fat intake at age 15 years and BMI at age 18 among girls; p values for these figures appeared to be repeats of the correlation coefficients). Regression coefficients ranged from -0.07 (for the relationship between % energy from total fat intake and BMI, p=0.044) to +178.7 (fat intake in g/day and g body fat after 70 months, p=0.01).<br><br>Adults (TFI): Meta-analysis of 4 cohorts found no association between total fat intake (% energy from fat) and change in weight (n=9,753; regression slope +0.07, 95% CI -0.03 to +0.16; heterogeneity present).<br><br>Across the 16 adult cohorts included, results were mixed, with 7 studies not finding a significant association between total fat intake and weight-related outcomes at follow up of a year or longer. The other studies found a mix of positive and inverse associations, and results were not always consistent across genders.<br><br>Total protein intake (TPI):<br>Children (TPI): | reported weight and height. Many studies (11/16 in adults) did not adjust for baseline BMI, and other studies had unclear reporting of this aspect of analysis.<br><br>Protein intake studies: The method of assessment of dietary intake varied . All studies adjusted for some potential confounders, but few adjusted for PA levels.<br><br>Carbohydrate intake studies: All studies adjusted for some potential confounders, but few adjusted for PA levels.<br><br>**Review team limitations:**<br>The use of different exposure and outcome measurements complicates interpretation of findings. Summaries of effect sizes are derived from ranges presented in study inclusion tables, as were total study participant numbers, as these were not clearly reported as summaries in the review.<br><br>Total fat intake: Included one cohort in adults with previous weight loss on a VLCD. |

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| | whom NR) except in 1 adult study where it was self reported. Outcomes measured at 1 to 12 years' (adults) and 1 to 9 years' (children) follow up.<br><br>Total carbohydrate intake: weight, BMI, WC, SFT, WHR, fat mass, lean mass. Measurement not reported in all cases, DEXA. Outcomes measured at 3 months' to 12 years' (adults) and 1 to 15 years' (children) follow up. | The 11 prospective cohorts in children (n=2,538; possible overlap of 3 small cohorts) found mixed results. 6/11 cohorts (n=942) showed a positive association between protein intake and at least 1 weight-related outcome in at least 1 of the groups analysed.<br>-1 study (n=72) found change in protein intake (g/day) at 2 years of age was positively associated with change in % body fat (r=0.163, 95% CI 0.07 to 0.32, p=0.04; regression coefficient 0.25%, p=0.01) and grams of body fat (r=38.36, 95% CI −3.4 to 80.2, p=0.08; regression coefficient 61.08, p=0.01) at age 5 years (model included dairy product intake). In another publication of what appeared to be longer term follow up of this sample (n=52), there was no association with body fat at age 8 years (figures NR). A third publication from similar authors that may also be the same cohort (n=70) protein intake (g) at 2 years of age was not significantly associated with change in BMI at age 8 (regression coefficient 0.01, 95% CI −0.01 to 0.03).<br>-1 study (n=142) found that protein intake (g/day or % energy) at 9 months of age was positively associated with body weight at age 10 years (regression coefficient for g/day 0.16, 95% CI 0.29 to 0.37, p<0.012; for % energy 0.44, 95% CI 0.12 to 0.76, p<0.01). Protein intake (g/day or % energy) at 9 months of age was not associated with BMI or % body fat at 10 years of age. | |

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| | | -1 study (n=278) found that protein intake (% energy) at 2 years of age was positively correlated with change in BMI (r=0.22, p=0.03) and subscapular skinfold (r=0.20, p=0.04), but not with tricep skinfold, over 6 years' follow up.<br>-1 study (n=100) found a positive relationship in boys between protein intake (% energy) at 2 months and BMI at 6 years (regression coefficient 1.2, 95% CI 0.61 to 1.79, p=0.003), there were also positive findings for protein intake at 4, 9 and 12 months (regression coefficients 0.2 to 0.3). Protein intake (% energy) at 9-12 months of age explained the 50% variance in BMI among 6-year-old boys. Results for girls were not reported.<br>-1 study (n=147) found that protein intake at the age of 1 year was associated with overweight at 5 years (figures NR, p=0.05).<br>-1 study (n=203) found that high protein intake at 12 months was significantly associated with a higher risk of having a BMI or percentage body fat above the 75th percentile at 7 years (BMI OR 2.39, 95% CI 1.14 to 4.99, p=0.02; % body fat OR 2.28, 95% CI 1.06 to 4.88, p=0.03).<br><br>The other 5 cohorts (n=1,454) had findings that were non-significant (direction of effect positive in 2, mixture of inverse and positive associations in 1, NR in 2 studies). Two of these are described above as they appeared to represent longer term follow up of one of | |

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| | | the studies finding a positive association, participants in these studies may be double counted in the overall study totals if this is the case.<br><br>As an illustration of the range of effects seen, regression coefficients for relationship of weight gain with % energy intake from protein ranged from a small non-significant positive effect in the largest cohort (n=1,030; regression coefficient 0.005, p=0.89) to a significant positive effect (0.44, 95% CI 0.12 to 0.76, p<0.01).<br><br>Adults (TPI): The 8 prospective cohorts in adults (n=81,286) had mainly non-significant findings (6/8, n=35,681; direction of effect positive in 3, NR in 3). The 2 studies with reported as showing associations found mixed directions of effect, and one appeared non-significant:<br>- one (n=2,909) found a positive association between TPI and weight gain over 10 years (mean weight: white individuals 75.2 in lowest intake quintile [Q1, quintiles not quantified] vs. 77.2 in highest intake quintile [Q5], units NR, p<0.01; black individuals 81.8 Q1 vs. 83.4 Q5, p=0.25); and also found an association with change in WHR, but the reported direction of this effect appeared to conflict between text (inverse) and tables (positive; mean WHR in white individuals 0.805 in Q1 vs. 0.811 in Q5; p=0.02); both associations were found in white but not | |

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| | | black individuals.<br>-the other large cohort (n=42,696) was reported as finding an inverse association between TPI and WC over 5 years but the differences were small and appeared non-significant (men -0.20cm, 95% CI -0.48 to 0.07; women -0.4cm, 95% CI -0.81 to 0.003; p values NR).<br><br>Summaries of the range of effect sizes or directions of effect were not reported in the review, potentially due to the heterogeneity of exposures and outcomes. To give an indication of direction and size of effect seen, a summary is presented here for the most commonly reported outcome (weight or weight change) results presented in the review tables (regression coefficients). Across the studies, effects on weight were all positive where reported, although not all were significant. These ranged from a regression coefficients indicating small non-significant changes (0.014 unit increase in change in body weight [units NR] per g/day increase in protein intake over 4 years in women, p value NR) to the significant difference in mean weight reported above (2 kg difference in mean weight between highest and lowest quintiles over 10 years [reviewer calculated], units NR, based on values likely to be kg).<br><br>Total carbohydrate intake (TCI):<br>Children: | |

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| | | Nine prospective cohort studies (n=2,625) assessed total carbohydrate intake in children and young people aged 10 months to 19 years, with 1 to 15 years' follow up.<br><br>7 prospective cohort studies assessed carbohydrates as % energy. Most studies (5/7 n=1,230) found no association between total carbohydrate intake (% of energy) and various weight related outcomes in children and young people (regression coefficients -0.01 kg/m2 change in BMI per % change in carbohydrate intake, p=0.53; correlation coefficient -0.01 for BMI; NR for 3 studies). Two studies (n=1,100) found a significant inverse relationship between total carbohydrate intake (% of energy) and a weight related outcome (regression coefficients: −0.044 kg/year weight per unit change in % energy from carbohydrates, p=0.007; −11.70 kg/m2 [95% CI −20.5 to −2.9] BMI change per unit change in % energy from carbohydrates over 6 years).<br><br>3 cohort studies (n=476, overlaps with % energy studies) carried out analyses for exposure measures other than % energy intake. Two out of 3 studies (n=233) found no association over 7.8 to 15 years (regression coefficient 0.02 kg/m2 BMI change for 1 g change in carbohydrate intake, p=0.33; 1 study NR), 1 (n=243) found a significant inverse association with one weight related measure (subscapular | |

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| | | skinfold, regression coefficient for change of 1 kJ/g carbohydrate intake -0.003, units NR, p<0.006) but not other measures (BMI regression coefficient 0, p=0.77) over 13 years.<br><br>Adults (TCI):<br>The review included 7 prospective cohorts (n=79,083) in adults. The studies found mixed results at 1 to 12 years' follow up.<br>3 cohort studies (n=982) assessed carbohydrates as % energy intake. 2/3 studies (n=928) found no association with BMI or weight over 1 year (regression coefficient for weight [units NR] in women 0.208 [p=0.33], in men -0.07 [p=0.568] in 1 study; NR for BMI in other study), and 1 small study (n=54) found a significant positive association with change in body weight (correlation coefficient r=0.33, p<0.05) and body fat (r=0.35, p<0.05), but not lean mass over 2 years.<br><br>6 cohort studies (n=78,796; overlapping with % energy studies) assessed carbohydrates using methods other than % energy: 3/6 studies (n=43,893) found no significant associations over 1 to 12 years (regression coefficient for g carbohydrate and change in body weight [units NR] over 12 years 0.599, p=0.94; NR for BMI and WC for 2 studies), 2 studies (n=34,849) found inverse associations with weight gain over 4 to 10 years (regression coefficient −0.001, 95% CI 0.0024 | |

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| | | to 0.0004; higher weight gain in lowest quintile vs. highest quintile of intake [figures NR] in white participants p=0.04 and in black participants p=0.03), and 1 small study (n=54) found a positive association with change in body weight (r=0.30, p<0.05) and fat mass (r=0.34, p<0.05) but not lean mass over 2 years.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The substantial evidence reviewed suggests that levels of lipid (fat), carbohydrate, and protein intake are not associated with subsequent excess weight gain or obesity (regardless of sources of these nutrients), although the results were inconsistent. (Conclusions based on both total intakes and intakes from specific sources of the individual nutrients e.g. starch, saturated fatty acids, plant protein. Only total nutrient consumption is dealt with here.) | |
| **USDA 2010y**<br><br>**Quality:** ++<br><br>**Search date:** Jun 2009<br><br>**Review design:**<br>Systematic review of RCTs and cohort studies. | **Study participant inclusion criteria:**<br>Children aged up to 18 years, not in developing countries.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 3* (1, n=1,062)<br>Cohorts: 23 (20, n= 14,186)<br>Other: 1 | **Result(s):**<br>The RCT most relevant to the current scope reported less obesity among intervention girls than among control girls at age 10 years (10.2% vs. 18.8%, p=0.0439), but no differences for boys (11.6% vs. 12.1%, p=1.0); but no difference in between groups at 14 years (reported in a separate publication; body weight: p=0.27, BMI | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: Set, P<br>Unclear: None<br><br>**Authors' limitations:**<br>There were no studies conducted under |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| **Review aim:**<br>To assess whether intake of dietary fat is associated with adiposity in children.<br><br>**Review funding:**<br>Funding not explicitly reported. Reviews carried out by the US Department of Agriculture Nutrition Evidence Library to support development of their guidelines.<br><br>**Study funding:**<br>Study funding assessed and judged not to be likely to be a source of bias in all but 2 studies, where funding was unclear.<br><br>**Multifactor review:** No | (*reported as 4 but appears to be 4 publications from 3 RCTs)<br><br>**Intervention/exposure description:**<br>RCTs: In the most relevant RCT the intervention aimed to achieve 30-35% of energy from fat at age 1-2 years and 30% afterwards (ratio 2:1 unsaturated: saturated fat), and the control was no specific fat related dietary advice. It was not clear whether the intention was to reduce total energy intake from fat, or just to reduce intake of saturated fat relative to other fats.<br><br>Cohort studies: Fat intake was mostly reported as measured as % total energy intake (range in studies 27-40% on average or among the groups being compared). One study appeared to look at dietary pattern rather than fat intake specifically, and another looked only at fat intake from energy dense snacks.<br>Intake measured in various ways including self report, FFQ, 24-hour recall, 3 day diet records (some weighed), interview, parental report, or direct observation. Some studies used multiple assessments, either over a short period (days) or longer (months to years).<br><br>**Outcome(s):**<br>Adiposity (e.g. body weight, body mass index, skinfold thickness, percent body fat). Assessment method not always reported, but | p=0.28; further figures NR). Intervention children were reported to have lower fat and saturated intakes than controls (p<0.001).<br><br>Of the 20 relevant cohort studies, 11 found a positive association between total fat intake or intake of high-fat foods and adiposity in all or a sub-sample of the population studied (14/23 for all included cohorts). The direction of effect in the 9 studies with non-significant findings was not reported.<br>Few studies were reported in the review a way that allowed extraction of a range of effect sizes. One study (also reported in Hooper et al. 2012 [++]) found that a 5% recent increase in fat intake [not further defined] predicted a 0.201 kg/m2 increase in BMI.<br><br>The varied results were reported to be as a result of using multiple measures of adiposity within the same study, carrying out multiple analyses stratified by different variables (e.g., sex, weight status), or dietary fat measured in varying ways (total grams or % of energy intake). More of the studies that found a positive association between dietary fat and adiposity, used multiple measures of adiposity (e.g. skinfold measures, and body composition by DEXA), rather than only BMI.<br><br>**Adverse Effects:**<br>NR | isocaloric conditions. Methodological differences between studies were significant, especially with respect to dietary assessment procedures, identification of implausible energy intake reports, choice of anthropometrics, and statistical approaches. Additional prospective studies that assess both the amount and type of fat in relation to changes in childhood adiposity are warranted.<br><br>**Review team limitations:**<br>One RCT appeared to include physical activity component as well as diet changes (in fat and fruit and vegetable intake), and the whether this was also provided to the comparator group was unclear. This may confound results.<br><br>One RCT was school-based. Three studies (1 RCT, 2 cohorts) selected participants on the basis of being in higher percentiles of body weight or having elevated LDL cholesterol. Comparator in some RCTs unclear. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | included self report, trained parental measurement, as well as objective measurement (e.g. electronic scales, stadiometer, bioelectrical impedance, DEXA, skinfold thickness) | **Conclusions:**<br>Moderate evidence from prospective cohort studies suggests that increased intake of dietary fat is associated with greater adiposity in children. However, there were no studies conducted under isocaloric conditions. | |

Fibre

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 5 (3, n=108,940 adults/ 2, n=11,506 children)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Adult exposure: ranged from crude fibre (g/day), dietary fibre (not further defined), total fibre intake, fibre foods (vegetables, fruits, seaweeds and pickled foods), and fibre intake (not otherwise defined).<br><br>Children exposure: fibre (g/day) and relationship between intake of fibre foods (not further defined) at age 3 and obesity (not further defined) in adolescence.<br><br>All studies used a self- or parent-completed FFQ to assess fibre intake.<br><br>**Outcome(s):**<br>Adults: change in body weight, weight gain of equal to or greater than 25 kg, BMI equal or greater than 30 and weight (not further defined)<br><br>Children: obesity (not further defined), | **Result(s):**<br>Adults<br>Three cohort studies assessed the association between fibre intake and weight related outcomes in adults. Follow-up ranged from 4 to 12 years. The findings were mixed in direction.<br><br>One study (reported as n=74,091 women in evidence table but n=16,587 in the text) found significantly lower odds of obesity at 12 year follow-up in the highest vs. lowest quintile of dietary fibre intake (adjusted OR 0.66, 95% CI 0.58 to 0.74; p for trend<0.001) and overweight (adjusted OR 0.51, 95% CI 0.39 to 0.67; p for trend<0.001).<br><br>Another publication based on the same cohort (n=31,940 women) reported significant positive associations between 4 year weight gain and crude fibre intake (regression coefficient 0.029, 95% CI 0.004 to 0.062) and dietary fibre intake (regression coefficient 0.006, 95% CI 0.002 to 0.01).<br><br>A third study (n=2,909) found significant inverse associations: in all subgroups (white and black) the lowest quintile of total fibre intake had higher 10 year weight gain than those in the highest quintile (quintiles not quantified; mean weight [units NR]: white 78.7 vs. 75, p<0.001, black: 83.5 vs 79.9, p=0.001). The association between fibre and | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>2 of the 3 studies in adults were in women only and results may not apply to the general population as a whole.<br><br>Setting and population selection criteria of the included studies were not clear. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| | change in BMI<br><br>Methods of outcome assessment included both objective anthropometric measurements by the research team, and self-report height and weight.<br><br>Follow up was between 4 and 12 years for adults and 1 and 10.9 years for children. | WHR was significant only amongst white individuals, with those in the lowest intake quintile having higher WHR after 10 years vs. those in the highest quintile (mean WHR: 0.813 in lowest quintile vs. 0.801 in highest quintile, p=0.004 for the trend); there was no significant association amongst black individuals (mean WHR: 0.809 in lowest quintile vs. 0.799 in highest quintile, p=0.05 for the trend).<br><br>All studies adjusted for potential confounders.<br><br>Children<br>Two cohort studies (n=11,506) were identified in children.<br><br>One study (n=10,769) found no association between g/day of fibre intake and 1 year weight gain (units NR) amongst girls (regression coefficient 0.0011, 95% CI -0.00733 to 0.00952, p=0.799) or boys (regression coefficient -0.0046, 95% CI -0.01381 to 0.00461, p=0.320).<br><br>A second study (n=737) found no significant association between large intake of fibre foods at age 3 and obesity in adolescence an average of 10.9 years later (OR 0.78, 95% CI 0.60 to 1.02).<br><br>**Adverse Effects:**<br>NR | |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | **Conclusions:**<br>NR | |
| **USDA2010w**<br><br>**Quality:** ++<br><br>**Search date:** Oct 2009<br><br>**Review design:**<br>Systematic review of RCTs and cohorts.<br><br>**Review aim:**<br>Is intake of dietary fibre related to adiposity in children?<br><br>**Review funding:**<br>Funding not explicitly reported. Reviews written by the US Department of Agriculture to support development of their guidelines.<br><br>**Study funding:**<br>Funding not explicitly stated but study funding was considered for quality rating and validity.<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Children 18 yrs. or younger.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 2 (0)<br>Cohort: 4 (3, n=12,363)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Exposures were: dietary pattern (not further defined), change in fibre intake during puberty (not further defined), dietary composition (not further defined).<br><br>Exposure assessment: FFQ (self-reported in 1 cohort and completed by the parent for the child in 1 cohort), 3 day dietary records (not further defined)<br><br>**Outcome(s):**<br>Change in BMI, change in % body fat, change in weight.<br><br>Height and weight were self-reported in 1 cohort, NR in 2 cohorts.<br><br>Follow up ranged from 1 to 4 years. | **Result(s):**<br>3 cohorts found no association between dietary fibre intake and adiposity in children:<br><br>1 cohort (n=10,769; also in Summerbell et al. 2009 [++]) found NS associations between energy-adjusted dietary fibre intake and BMI at 1 year (figures and direction of effect NR).<br><br>1 cohort (n=215) found change in fibre intake was not associated with change in % body fat or BMI over 4 years (change in % body fat per SD increase in fibre intake 0.02 [SE 0.14], p=0.9; BMI figures NR).<br><br>1 cohort (n=1,379) found NS association between total intake of dietary fibre and weight change at 1 year follow up (figures NR; p>0.05).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>There is insufficient evidence that dietary fibre is associated with adiposity in children. | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P<br>Unclear: Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>The review reports cross-sectional studies were excluded, however there is mixed reporting of 1 study that is described as a cohort in the review text and a cross-sectional study in the characteristics table. This study did not match the scope of the review as it included overweight children so results have not been extracted for it.<br><br>Population: Partial, 2 cohort appears to have included general populations. 1 cohort had a population inclusion criteria of at risk of obesity (BMI of at least 85th percentile). 1 cohort (results not extracted) had an overweight population. The RCTs were in overweight individuals.<br>Setting: Unclear. |
| **Wanders et al. 2011** | **Study participant inclusion criteria:**<br>NR | **Result(s):**<br>61 RCTs (n=2,486) had 66 fibre vs. control | **Applicable to the UK: Unclear** |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| **Quality:** +<br><br>**Search date:** Feb 2010<br><br>**Review design:**<br>Systematic review of RCTs of any length.<br><br>**Review aim:**<br>To systematically investigate the available literature on the relationship between dietary fibre types, appetite, acute and long-term energy intake and body weight.<br><br>**Review funding:**<br>NR<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Total # studies (# relevant and n=):**<br>RCT: 61 (unclear)<br>Cohort: 0<br>Other: 0<br><br>**Intervention/exposure description:**<br>Interventions: mean fibre dose (weighted by the number of subjects per comparison) ranged from 2.3 g to 28.9 g (pooled weighted mean 11.1 g), and controls were described as "non-fibre controls" (not further described).<br><br>The trials assessed different types of fibre (e.g. mannans, chitosan, wheat bran etc.), in liquid and solid forms, and in most cases (47 comparisons) were testing a supplement rather than fibre as part of food. For inclusion in the body weight analyses, energy intake in the trial had to be voluntary. In some cases the RCTs included advice to change lifestyle, it was not clear if this was equivalent in both groups.<br><br>**Outcome(s):**<br>Objectively measured changes in body weight.<br><br>Mean study duration ranged from 3 weeks to 14.5 weeks. | comparisons and of these 39 (59%) showed an absolute reduction in body weight with the fibre intervention (regardless of significance).<br><br>Irrespective of the fibre type, fibre reduced body weight by a pooled weighted mean of 1.3% over the complete study period (CI NR; range -18.5% to 2.9% across the different fibre groupings; equivalent to 0.72 kg over a pooled weighted mean 11.1 weeks) which corresponded to a reduction of 0.4% per 4 weeks (about 300 g for a person of weight 79 kg).<br><br>Across fibre types, dose-response lines showed a reduction in body weight of 0.014% per 4 weeks per gram increase of fibre intake.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Overall, effects of fibre on body weight are relatively small and clear dose-response relationships were not observed. | **Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>Most of the RCTs appeared to be in overweight and obese participants (appeared to be 47 comparisons in this population, 8 in normal weight participants, and remainder unclear) and these were not analysed separately to the RCTs not specifically in these populations.<br><br>Although the review suggested that it had not carried out meta-analysis, it did present what appeared to be pooled weighted means across all trials. No statistical comparisons of the effects were provided.<br><br>Limited details of methods of analysis were provided.<br><br>Population: Study populations included people selected based on weight status.<br>Setting: Unclear |
| **Ye et al. 2012** | **Study participant inclusion criteria:**<br>NR | **Result(s):**<br>The review reports the findings generally | **Applicable to the UK: Unclear** |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Quality:** +<br><br>**Search date:** Feb 2012<br><br>**Review design:**<br>Systematic review of prospective cohorts (on whole grain or fibre) and RCTs (on whole grain) of any length.<br><br>**Review aim:**<br>To systematically examine longitudinal studies investigating whole-grain and fibre intake in relation to risk of T2DM, CVD, weight gain and metabolic risk factors.<br><br>**Review funding:**<br>University of California at Los Angeles Burroughs Wellcome Fund Inter-school Program in Metabolic Diseases.<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 2 (2, n=101,173)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Exposures were: dietary fibre intake in quintiles (not further defined) in both cohorts. 1 cohort was in females and 1 cohort was in males.<br><br>Exposure assessment: FFQ in both cohorts.<br><br>**Outcome(s):**<br>Weight gain.<br><br>Follow up was 8 or 12 years. | indicated an inverse association between dietary fibre intake and weight gain over time:<br><br>1 cohort (n=74,091) of apparently healthy (not further defined) adult females found participants in the highest quintile of dietary fibre intake had a 49% lower risk of weight gain (OR 0.51, 95% CI 0.39 to 0.67, p value NR) (12 year follow up). Weight gain ranged from 1.73 kg (SD 0.02) in the lowest quintile of fibre intake to 0.97 kg (SD 0.02) in the highest quintile of fibre intake (adjustments were made for age, BMI, changes in PA, smoking, hormone use, dietary factors)<br><br>1 cohort (n=27,082) in adult males found weight gain ranged from 1.4 kg (SD 0.2) in the lowest quintile of fibre intake to 0.39 kg (SD 0.2) in the highest quintile of fibre intake (significance NR; 8 year follow up; adjustments were made for age, smoking, baseline weight, changes in dietary factors). No other results provided.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>No conclusions were drawn by the review on fibre. | **Alignment to NICE review scope:**<br>Complete: D<br>Partial: P<br>Unclear: Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>It is unclear if the population in one of the cohorts was representative of the general population.<br><br>Population: Partial, 1 cohort describes the population as apparently healthy, but it is unclear if participants in the other cohort were selected based on weight status (overweight/obese) or for specific conditions.<br>Setting: Unclear |

**Glycaemic index/glycaemic load**

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **USDA 2010j**<br><br>**Quality:** +<br><br>**Search date:** Mar 2009<br><br>**Review design:**<br>Systematic review. Narrative and systematic reviews and meta-analyses excluded.<br><br>**Review aim:**<br>The aim of the systematic review was to determine the relationship between glycaemic index or glycaemic load and body weight<br><br>**Review funding:**<br>NR. Reviews written by the US Department of Agriculture to support development of their guidelines.<br><br>**Study funding:**<br>Funding for individual studies included in the review was not reported, however, the quality appraisal for the studies meeting our scope reported that the sources of funding and investigators' affiliations were described and the studies were free from apparent conflicts of interest.<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Healthy and those with elevated chronic disease risk<br><br>**Total # studies (# relevant and n=):**<br>RCT: 13 (1, n=203)<br>Cohort: 2 (1, n=376)<br>Other: 7<br><br>**Intervention/exposure description:**<br>RCT: A low glycaemic index diet or a high glycaemic index diet. For each meal, low-glycaemic index diets were designed to maintain an average difference of 40 units compared with high glycaemic index diets (35 to 40 unit difference achieved). Both diets included a small energy restriction (100 to 300 kcal), and were designed to include 26% to 28% energy from fat.<br><br>Cohort study: In the relevant cohort study average glycaemic index and glycaemic load assessed through interview with a registered dietician based on dietary intake in the previous month in another study.<br><br>**Outcome(s):**<br>All were in adult populations.<br>RCT: weight after 18 months.<br>Cohort studies: The relevant cohort study (n=376) looked at changes in body weight, waist circumference, hip circumference, body composition, body fat and fat free mass | **Result(s):**<br>RCT: Although there was greater weight loss in the low GI group in the first 2 months of the study (-0.72kg vs. -0.31kg; p value NR), the groups regained weight subsequently. Mean weight loss at 18 months was not significantly different between groups (weight change: -0.41kg with low GI diet vs. -0.26kg with high GI diet, p=0.93).<br><br>Cohort study: Results diffed for the differing exposures and outcomes assessed, and by gender. No significant associations between glycaemic load (GL) and change in body weight were found for men or women. GL was not significantly associated with any of the body composition outcomes collected in men, but there was an inverse non-significant association between glycaemic load and changes in waist circumference in women in an adjusted analyses (p=0.06, factors adjusted for not reported). No significant association between glycaemic index (GI) and change in body weight (or other obesity measures) was observed for men. Among women, GI was positively associated with changes in body weight in adjusted analyses (p<0.04). At 6 year follow up , a 10-unit increase in baseline glycaemic index was associated with a 2% increase in body weight (95% CI 0.1% to 4%), a 0.9% increase in % body fat (95% CI 0.04% to 1.7%), and a non-significant 1.6 cm increase in | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D, P<br>Unclear: Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>Most of the studies included in this review were not relevant for the current review scope (12/13 RCTs; 1/2 cohort studies, 7/7 other study designs). The one extracted RCT recruited women only with relatively high BMI of 23 to 29.9kg/m2.<br><br>Only 60% of participants in the RCT completed the study.<br><br>It was unclear if the cohort study's analysis in sedentary women was a post-hoc or pre-specified analysis, and it was likely to include relatively small numbers of women given the size of the study.<br><br>Study design: RCTs, cohorts and cross-sectional studies were included<br>Population: Healthy and those with elevated chronic disease risk. 12/13 RCTs were in overweight/obese populations. 1 cohort study was in pregnant women. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | over six years, assessed in health examinations by study personnel. Average follow up time was not reported. | waist circumference (95% CI -0.1 cm to 3.2 cm). In sedentary women differences were greater, with a 10-unit increase in baseline GI associated with a 6% for increase in body weight (95% CI 2 to 9%; p=0.001), 3% increase in percentage body fat (95% CI 1% to 4%; p=0.002) for and 4cm increase in waist circumference (95% CI 1 cm to 7 cm; p=0.008).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>"Strong and consistent evidence shows that glycaemic index and/or glycaemic load are not associated with body weight and do not lead to greater weight loss or better weight maintenance." (Conclusions based on all studies included in review, including cross-sectional studies and studies in obese and overweight populations, and pregnant women). | Setting: no an inclusion/exclusion criterion. |

Sugars (fructose/glucose/sucrose/high fructose corn syrup)

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Sievenpiper et al. 2012**<br><br>**Quality:** ++<br><br>**Search date:** Nov 2011<br><br>**Review design:**<br>Systematic review of controlled feeding trials (randomised and non-randomised) that lasted 7 or more days that compared the effect on body weight of free fructose and nonfructose carbohydrate in diets providing similar calories (isocaloric trials) or of diets supplemented with free fructose to provide excess energy and usual or control diets (hypercaloric trials).<br><br>**Review aim:**<br>To review the effects of fructose on body weight in controlled feeding trials.<br><br>**Review funding:**<br>Canadian Institutes of Health Research<br><br>**Study funding:**<br>Of the isocaloric RCTs performed in normal weight participants, 3 publications (4 trials) reported a mixture of agency and industry funding and 3 were agency funded alone (where agency funding referred to funding from government, university, or non-for-profit health agency sources). Of the isocaloric trials in normal weight participants | **Study participant inclusion criteria:**<br>There were no population inclusion criteria.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 21, in 17 publications (10, in 7 publications, n=117)<br>Cohort: 0<br>Other: 20, in 17 publications [2 also reported RCTs] (0)<br><br>**Intervention/exposure description:**<br>Fructose in one of three forms: liquid, where all or most of the liquid was provided as beverages or crystalline fructose to be added to beverages; solid, where fructose was provided as solid foods; or mixed, where all or most of the fructose was provided as a mix of beverages, solid foods and crystalline fructose. In the isocaloric RCTs, fructose dosage ranged between 40g/day and 250g/day. In all isocaloric trials (including non randomised controlled trials), the dose ranged between 40g/day and 300g/day. In the hypercaloric RCTs (where fructose was added to the diet), the dose ranged between 213 and 220g/day. Across all hypercaloric trials (including non-randomised trials), the dose ranged between 104g/day and 250g/day (18% to 97% excess energy).<br><br>**Outcome(s):**<br>Body weight. How body weight was measured was not reported. Isocaloric trials | **Result(s):**<br>In isocaloric RCTs (when fructose in the fructose group was compared with nonfructose carbohydrate providing the same amount of energy in the control group) in normal weight participants, 6 RCTs found that fructose did not significantly change body weight, and 1 found that fructose did significantly increase body weight over 1 to 6 weeks. In the meta-analysis of all trials in normal weight participants (including non-randomised trials), fructose had no significant effect on body weight over 1 to 6 weeks (n=47; mean difference -0.13kg with fructose, 95% CI -0.37 to 0.10). In these trials, participants were generally healthy, although 3 non-randomised trials included people with hypertriglyceridemia and 1 trial recruited people with nondiabetic chronic kidney disease.<br><br>In hypercaloric feeding RCTs (where fructose in the fructose group was added to the usual or control diet so that fructose provided 18% to 97% excess energy relative to the diet alone) in normal weight populations, fructose did not significantly alter bodyweight in 2 RCTs, but significantly increased body weight in 1 RCT over 1 week. One of the RCTs was performed in normal weight offspring of parents with type 2 diabetes. In the meta-analysis of all trials in normal weight participants (including non- | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: P<br>Unclear: Set<br><br>**Authors' limitations:**<br>The trials enrolled more younger and middle aged men than older women.<br>The trials were short.<br>The end difference in weight rather than differences in weight change between groups were used for most trials.<br>Study quality was generally poor.<br>Most of the trial used crossover designs.<br>Publication bias is an issue.<br>(Limitations based on all studies included in the review, including non-randomised studies and studies in overweight/obese populations or populations with diabetes).<br><br>**Review team limitations:**<br>Comparators in the isocaloric trials included starch, sucrose, glucose, D-maltose and high fructose corn syrup. The diets provided a range of energy and macronutrient profiles. Most of the isocaloric trials provided energy under weight-maintaining conditions, but 4 in normal weight participants provided excess energy in both groups. Most of the isocaloric trials provided all meals, snacks, and study supplements under controlled |

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| as a whole (including non-randomised controlled trials), 4 publications (6 trials) reported a mixture of funding and 6 publications (6 trials) reported agency funding, and 1 study did not report the funding source. Of hypercaloric RCTs in normal weight populations, one publication (2 RCTs) reported a mixture of funding, and 1 reported agency funding. Considering hypercaloric trials in normal weight populations as a whole (including non-randomised controlled trials), three publications (4 trials) were agency and industry funded, and 4 publications (4 trials) were agency funded.<br><br>**Multifactor review:** No | has follow-up ranging between 7 days and 6 weeks. Hypercaloric trials had follow up ranging between 7 days (all RCTs) and 4 weeks. | randomised trials), fructose significantly increased body weight over 1 to 4 weeks (n=176; mean difference 0.37kg, 95% CI 0.15 to 0.58).<br><br>Results in the normal weight population were consistent in direction and significance with the overall meta-analysis of all trials.<br><br>**Adverse Effects:**<br>No adverse effects were reported.<br><br>**Conclusions:**<br>The review concluded "aggregate data of controlled feeding trials do not support a body weight-increasing effect of fructose in isocaloric exchange for other sources of carbohydrate in the diet. However, evidence indicates that added fructose providing excess energy at extreme levels of intake may have a body weight-increasing effect over the short term, although confounding from excess energy cannot be excluded." (conclusion based on meta-analyses of RCTs and non-randomised controlled trials, in people with diabetes, who are overweight, and who are normal weight). | conditions, but some provided supplements and one provided dietary advice on appropriate test and control diets.<br>In hypercaloric feeding RCTs (where fructose in the fructose group was added to the usual or control diet so that fructose provided excess energy relative to the diet alone), all trials provided excess energy. The trials provided all meals, snacks, and study supplements under controlled conditions to provided supplements.<br>How body weight was measured was not reported.<br>Meta analyses included non randomised controlled trials. The normal weight participants were generally healthy , although some had comorbid conditions.<br>None of the trials in normal weight participants was longer than 6 weeks.<br>High doses of fructose studied, especially in the hypercaloric trials.<br><br>Population: analyses were stratified into diabetes, overweight/obese and normal weight on the basis of trial entry criteria. In the absence of specific overweight/obese entry criteria, it was assumed that the trials were conducted in normal weight participants. However, some of the trials with normal weight participants had hypertriglyceridemia or chronic kidney disease (none of the RCTs) or in one RCT were the offspring of persons with type 2 diabetes. |

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| | | | Study design: Non-randomised and RCTs included.<br>Setting: not reported. |
| **Te Morenga et al. 2013**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2011<br><br>**Review design:**<br>Systematic review and meta-analysis of RCTs and prospective cohort studies.<br><br>**Review aim:**<br>To summarise evidence on the association between intake of dietary sugars and body weight in adults and children.<br><br>**Review funding:**<br>WHO, University of Otago, and Riddet Institute. In their competing interests statement the authors declare that they had no other financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years; and no other relationships or activities that could appear to have influenced the submitted work.<br><br>**Study funding:**<br>13 of the RCTs were reported to have sugar industry funding, and in 3 RCTs funding was unclear. 14 RCTs did not have sugar industry | **Study participant inclusion criteria:**<br>Adults and children free from acute illness. (Could include those with a non-communicable diseases which were stable, e.g. diabetes).<br><br>**Total # studies (# relevant and n=):**<br>RCT: 30 (13, n=1,387 adults/ 5, n=2,968 children)<br>Cohort: 38 (16, n=289,614 adults/ 22, n=29,219 children)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Sugar: total sugars, component of total sugars or intake of sugar containing foods and beverages.<br><br>In the RCTs, participants were required to consume different amounts of sugar (sucrose) or other "free sugars" including monosaccharide and disaccharides added to foods by the manufacturer, cook or consumer plus sugars naturally present in honey, syrups and fruit juices.<br><br>RCTs were divided into those aiming to reduce free sugars in the diet, add sugars to the diet, or assess isocaloric diets high in free sugars. | **Result(s):**<br>Children:<br>No RCTs of increasing dietary sugars were identified. A meta-analysis of 5 RCTs found no association between advice to reduce intake and change in BMI or BMI z-scores (weighted mean difference 0.09, 95% CI -0.14 to 0.32). The interventions achieved reductions of sugar intake compared with control of between 4.5 g/day to 63 g/day, or reduction of 0.1 glasses/day of sugar sweetened fizzy drinks, or reduction of 56 ml/day fizzy drinks. Poor compliance was reported in 3 studies.<br><br>22 cohort studies were included. 13 found a positive (and no inverse) association between increased sugar intake and a measure of adiposity (some studies showed non-significant findings for some analyses), 2 reported mixed positive and inverse associations (both showed positive associations for SSB and inverse associations for fruit juice), 2 studies reported an inverse (and no positive) association, and 4 showed no significant effects (directions NR). Most of the cohort studies in children assessed sugar sweetened beverages (SSB).<br><br>Adults: | **Applicable to the UK: Unclear**<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P<br>Unclear: Set<br><br>**Authors' limitations:**<br>Less consistent findings were found from trials conducted in children. In these trials adherence to dietary advice (typically advice to reduce sugar sweetened beverages) was poor.<br>Other limitations: inadequacy of dietary intake data, and variation in the nature and quality of the dietary intervention/heterogeneity of studies. Possibility of residual confounding in cohort studies.<br>Bias in trials: 4 trials in adults reported data for completers. Both participants and researchers in many of the trials were not blinded to intervention allocation. (Limitations based on all studies included in the review).<br><br>**Review team limitations:**<br>The only criteria for participants was that they had to be free from acute illness: participants could have diabetes or other |

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| funding.<br><br>**Multifactor review:** Yes | In RCTs in children assessing the effects of reducing dietary sugars, interventions included advice to reduce sugar sweetened beverages and other foods containing (free) sugars.<br><br>In RCTs in adults assessing the effect of reducing dietary sugars on measures of body fatness in adults, the interventions were limiting sugar containing foods or substituting sugar rich foods with low sugar alternatives. Differences in sugar intake between intervention and control groups ranged from 1% to 14% of total energy intake. In RCTs in adults assessing the effect of increasing dietary sugars on measures of body fatness in adults the studies involved an increase in dietary sugars, mostly sugar sweetened beverages. In isoenergetic exchange trials in adults, sugars were in the form of either sucrose or fructose used to sweeten foods or liquids.<br><br>Cohort studies reported sugar exposures including sugar sweetened beverages, fruit juice, sweets (including jams, cakes, and desserts), sucrose, or total sugars.<br><br>**Outcome(s):**<br>Measures of body fatness (BMI z score, BMI, body weight, waist circumference, % body fat, fat mass, % trunk fat [in order of importance for pooling]). | In a meta-analysis of 5 RCTs in adults (n=1,286) with ad libitum diets (with no strict control of food intake), reduced intake of dietary sugars (difference 1% to 14% of total energy) was associated with a decrease in body weight over 10 weeks to 8 months (WMD -0.80kg, 95% CI -1.21 to -0.39, $p<0.001$).<br>One trial (n=32) was in overweight men with hypertriglyceridemia, and one trial (n=159) was in overweight and obese adults. Of the three RCTs in normal weight populations, one found that reducing sugar intake significantly reduced weight, the other two trials found no significant difference.<br><br>In a meta-analysis of 10 RCTs (n=382) of adults with ad libitum diets, increased sugar intake (difference 6.6% to 23% total energy) was associated with a weight increase compared to no increase in sugar intake over 2 weeks to 6 months (0.75kg, 95% CI 0.30 to 1.19, p=0.001; random effects analysis used due to heterogeneity). The effect was significantly greater in trials that lasted for longer ($p<0.001$).<br><br>4 trials (n=142) were in overweight or post-obesity participants, 1 trial (n=17) was in men with one or more cardiovascular risk factors, and 1 trial (n=12) was in adults with radiolucent gallstones and bile supersaturated with cholesterol. Of the studies not in overweight or obese | non-communicable diseases, and could be overweight/obese.<br>In the quality assessment, the review stated that failure to conceal treatment allocation was the major potential source of bias in the RCTs. In many trials, it was unclear whether outcome measures were assessed by blinded observers, and whether there was selection bias. In 3 RCTs, in which there was evidence of differences between dropouts and completers, only data for completers reported. There was a lack of consistency in the covariates used to adjust analyses and a wide range of methods of assessing sugar exposures and adiposity outcomes, which made pooling studies difficult.<br><br>RCTs had to be at least 2 weeks long and cohort studies 1 year long to be included. The RCTs were generally small and short term.<br><br>Population: the only criteria for participants was that they had to be free from acute illness: participants could have diabetes or other non-communicable diseases, and could be overweight/obese. Some studies were in overweight/obese and diabetic populations, plus other in populations with other conditions.<br>Setting: Some of the RCTs in children (at least 2) recruited children from schools, and in another study the intervention was delivered in the classroom. |

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| | How outcomes were measured in the RCTs was not explicitly reported. Of the 38 cohort studies, 15 used self reported estimates of adiposity outcomes. However, the authors state that "measurement of body weight did not involve judgement that was subject to bias"<br><br>Studies of the effect of reducing dietary sugars on measures of body fatness in children were between 16 weeks and 12 months long.<br><br>Studies of the effect of reducing dietary sugars on measures of body fatness in adults lasted between 10 weeks and 8 months. Only 2 studies (both in overweight populations) of increasing intake of sugars on measures of body fatness in adults lasted longer than 8 weeks. The RCTs of isoenergetic exchange lasted between 2 weeks and 6 months (2 and 4 weeks in non-diabetic populations). | participants, 4 found that increased sugar intake significantly increased weight, 3 found no significant difference.<br><br>A meta-analysis of 11 RCTs of isoenergetic exchange of dietary sugars with other macronutrients (usually complex carbohydrates) in adults showed no effect on body weight over 2 weeks to 6 months (0.04kg, 95% CI -0.04 to 0.13; substituting about 17% to 20% of energy from sugars; or 30 to 140 g/d various sugars).<br>Eight trials (n=112) were in diabetic populations, one (n=9) was in men with non-metabolic health conditions. None of the 3 trials in non-diabetic populations (n=32) found a significant effect.<br><br>16 cohort studies in adults were included: 10 studies reported one or more significant positive association between a sugar consumption and a measure of adiposity, 1 one study reported both a significantly inverse associations and significant positive associations (with weight loss and weight gain); the remainder (4 studies) found no significant associations (figures NR).<br><br>The overall meta-regression of RCTs showed no evidence of a dose-response association between sugar as a percentage of total energy intake and body weight in adults (0.02 kg, 95% CI -0.03 to 0.08; p=0.393). | |

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| | | **Adverse Effects:**<br>No adverse events were reported.<br><br>**Conclusions:**<br>"Among free living people involving ad libitum diets, intake of free sugars or sugar sweetened beverages is a determinant of body weight. The change in body fatness that occurs with modifying intakes seems to be mediated via changes in energy intakes, since isoenergetic exchange of sugars with other carbohydrates was not associated with weight change." (Conclusions based on all studies in the review, including studies in overweight/obese populations and in diabetics) | |
| **Wiebe et al. 2011 (fructose)**<br><br>**Quality:** ++<br><br>**Search date:** Jan 2011<br><br>**Review design:**<br>Systematic review of RCTs that compared different sweeteners and that were at least 1 week long and reported weight change, energy intake, lipids, glycated haemoglobin, or insulin resistance, or measured 2-hour blood glucose responses. Trials had to have at least 10 participants per group.<br><br>**Review aim:**<br>The review aimed to systematically | **Study participant inclusion criteria:**<br>Obese, diabetic and healthy adult (16 years or older) populations.<br><br>**Total # studies (# relevant and n=):**<br>RCT: unclear* (2, n=35 for fructose) (6, n=240 across fructose, glucose, sucrose)<br>Cohort: 0<br>Other: 0<br>*53 RCTs of different sweeteners included in total<br><br>**Intervention/exposure description:**<br>3.5 g fructose/kg fat free mass per day or 80 g fructose/day including 17 g glucose . In both of these trials, total and distribution of energy was also restricted. | **Result(s):**<br>-One trial, comparing fructose with glucose found no significant difference in change in absolute weight between sweeteners (mean difference 0.1kg, 95% CI -3.4 to 3.6).<br>-One trial, comparing fructose (containing glucose) with glucose (containing fructose) found no significant difference in change in absolute weight between sweeteners (mean difference -0.4kg, 95% CI -3.1 to 2.3).<br><br>**Adverse Effects:**<br>Adverse events not reported in the review.<br><br>**Conclusions:**<br>The review concluded that "little high-quality clinical research has been done to | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P, O<br>Unclear: Set<br><br>**Authors' limitations:**<br>Relevant to this review: 13 trials with follow-up longer than 1 week and group sizes greater than 10 identified. 10/13 trials had a Jadad score of 1 and none had adequately concealed treatment assignment prior to blinding. The longest trial was only 10 weeks. Majority of trials did not restrict total energy consumed by each participant. All studies were small. |

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| summarise the available RCT evidence to determine the comparative effectiveness of sweetener additives (non-caloric, sugar alcohols, and saccharides).<br><br>**Review funding:**<br>Alberta Heritage Foundation for Medical Research<br><br>**Study funding:**<br>Funding for RCTs that meet scope extracted. Fructose: 1 mixed funding, 1 public funding.<br><br>**Multifactor review:** Yes | **Outcome(s):**<br>Across the relevant glucose/sucrose/fructose trials, change in body weight or BMI were assessed at 1 and 12 weeks follow-up; outcome measurement methods were not reported. | identify the potential harms and benefits of hypocaloric sweeteners" (conclusion based on all studies in review, which included studies in overweight/obese populations and/or diabetic populations as well as healthy populations, and assessed outcomes in addition to BMI/weight change). | **Review team limitations:**<br>Two small trials, both cross-over RCTs. Maximum follow-up was 6 weeks. How outcomes were measured was not reported.<br><br>Outcome: energy intake, lipids, glycerated haemoglobin, insulin resistance and blood glucose responses were alternative outcomes<br>Population: trials in healthy, overweight/ obese and/or diabetic adults included.<br>Setting: setting not reported. |
| **Wiebe et al. 2011 (glucose)**<br><br>Details as above | **Study participant inclusion criteria:**<br>Obese, diabetic and healthy adult (16 years or older) populations.<br><br>**Total # studies (# relevant and n=):**<br>RCT: unclear* (3, n=45 for glucose) (6, n=240 across fructose, glucose, sucrose)<br>Cohort: 0<br>Other: 0<br>*53 RCTs of different sweeteners included in total<br><br>**Intervention/exposure description:**<br>3.5 g glucose/kg fat free mass per day or 6.5 g glucose/kg per day or 80 g glucose/day including 15 g fructose. In two of the trials total and distribution of energy was also restricted, in the other trial participants were restricted to 1g/kg calcium caseinate. | **Result(s):**<br>-One trial, comparing fructose with glucose found no significant difference in change in absolute weight between sweeteners (mean difference 0.1 kg, 95% CI -3.4 to 3.6).<br>-One trial, comparing fructose (containing glucose) with glucose (containing fructose) found no significant difference in change in absolute weight between sweeteners (mean difference -0.4kg, 95% CI -3.1 to 2.3). (NB. This trial was also addressed in the fructose section)<br>-One trial comparing sucrose and glucose found no significant difference in change in absolute weight between sweeteners (mean difference 0.2 kg, 95% CI -0.07 to 0.4).<br><br>**Adverse Effects:**<br>Adverse events not reported in the review. | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P,O<br>Unclear: Set<br><br>**Authors' limitations:**<br>Relevant to this review: 13 trials with follow-up longer than 1 week and group sizes greater than 10 identified. 10/13 trials had a Jadad score of 1 and none had adequately concealed treatment assignment prior to blinding. The longest trial was only 10 weeks. Majority of trials did not restrict total energy consumed by each participant. All studies were small.<br><br>**Review team limitations:**<br>Three small trials, all cross-over RCTs. |

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| | **Outcome(s):**<br>Across the relevant glucose/sucrose/fructose trials, change in body weight or BMI were assessed at 1 and 12 weeks follow-up; outcome measurement methods were not reported. | **Conclusions:**<br>The review concluded that "little high-quality clinical research has been done to identify the potential harms and benefits of hypocaloric sweeteners" (conclusion based on all studies in review, which included studies in overweight/obese populations and/or diabetic populations as well as healthy populations, and assessed outcomes in addition to BMI/weight change). | Maximum follow-up was 6 weeks. How outcomes were measured was not reported.<br><br>Outcome: energy intake, lipids, glycerated haemoglobin, insulin resistance and blood glucose responses were alternative outcomes.<br>Population: trials in healthy, overweight/obese and/or diabetic adults included.<br>Setting: setting not reported. |
| **Wiebe et al. 2011 (sucrose)**<br><br>Details as above | **Study participant inclusion criteria:**<br>Obese, diabetic and healthy adult (16 years or older) populations.<br><br>**Total # studies (# relevant and n=):**<br>RCT: unclear (4, n=205 for sucrose) (6, n=240 across fructose, glucose, sucrose)<br>Cohort: 0<br>Other: 0<br><br>**Intervention/exposure description:**<br>20 g sucrose/day , 40 g/day , and 42 g/day or 6.5 g sucrose/kg/day. In one trial, participants were restricted to 1g/kg calcium caseinate, in another a low-fibre diet was recommended.<br><br>**Outcome(s):**<br>Across the relevant glucose/sucrose/fructose trials, change in body weight or BMI were assessed at 1 and 12 weeks follow-up; outcome measurement methods were not | **Result(s):**<br>One trial, comparing a mixture of isomaltulose and sucrose to sucrose found no significant difference in change in BMI between sweeteners (mean difference -0.04kg/m2, 95% CI -0.4 to 0.3) or in absolute weight (mean difference -0.06kg, 95% CI -0.9 to 0.8).<br>One trial, comparing fructooligosaccharide to sucrose found no difference in change in absolute weight between sweeteners (mean difference 1.0kg, 95% CI -2.4 to 4.4).<br>One trial comparing sucrose to glucose found no difference in change in absolute weight between sweeteners (mean difference 0.2kg, 95% CI -0.07 to 0.4).<br>One trial that compared aspartame to sucrose found no significant difference in change in BMI (mean difference -0.3kg/m2, 95% CI -1.1 to 0.5)<br><br>**Adverse Effects:** | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: O, P<br>Unclear: Set<br><br>**Authors' limitations:**<br>Relevant to this review: 13 trials with follow-up longer than 1 week and group sizes greater than 10 identified. 10/13 trials had a Jadad score of 1 and none had adequately concealed treatment assignment prior to blinding. The longest trial was only 10 weeks. Majority of trials did not restrict total energy consumed by each participant. All studies were small.<br><br>**Review team limitations:**<br>Four small trials, with different comparators. Two trials were cross-over RCTs. Maximum follow-up was 12 weeks. |

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| | reported. | Adverse events not reported in the review.<br><br>**Conclusions:**<br>The review concluded that "little high-quality clinical research has been done to identify the potential harms and benefits of hypocaloric sweeteners" (conclusion based on all studies in review, which included studies in overweight/obese populations and/or diabetic populations as well as healthy populations, and assessed outcomes in addition to BMI/weight change). | How outcomes were measured was not reported.<br><br>Outcome: energy intake, lipids, glycerated haemoglobin, insulin resistance and blood glucose responses were alternative outcomes<br>Population: trials in healthy, overweight/obese and/or diabetic adults included.<br>Setting: setting not reported. |

## Eating patterns

**Breakfast consumption**

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| **USDA 2010f**<br><br>**Quality:** +<br><br>**Search date:** Jan 2010<br><br>**Review design:**<br>Systematic review of systematic reviews, meta-analysis, RCT or clinical controlled studies, large non-randomised observational studies, cohort and case-control studies.<br><br>**Review aim:**<br>What is the relationship between breakfast and body weight?<br><br>**Review funding:**<br>Funding not explicitly reported. Reviews written by the US Department of Agriculture to support development of their guidelines.<br><br>**Study funding:**<br>Funding sources not explicitly stated but study funding was considered for quality rating and validity.<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>Children and adults of healthy weight and with elevated chronic disease risk.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 1 (0)<br>Cohort: 16 (3, n=27,116 adults/ 13, n=unclear children)<br>Other: 1<br><br>**Intervention/exposure description:**<br>Children:<br>The RCT in children involved eating cereal for breakfast, or both breakfast and dinner, or combining eating cereal for breakfast with a nutrition education program compared with a control group.<br><br>The cohort studies assessed the frequency of breakfast consumption using three day FFQ, or asking children how many times per week they eat breakfast.<br><br>Adults: breakfast consumption, breakfast consumption patterns (subjects who reported consuming breakfast at least four days a week were considered to be regular breakfast consumers), frequency of breakfast consumption (0 to 7 days/week), changes in lifestyle (not further defined), percentage of total daily energy intake consumed at breakfast, | **Result(s):**<br>Children and adolescents:<br>Overall, inconsistent results were seen across the cohort studies. Nine studies (from 4 cohorts) found an inverse relationship between breakfast consumption and body weight , in some cases only for one gender or in overweight children only; 2 studies (2 cohorts) found an inverse relationship that was no longer significant after adjustment for confounders; 1 found no significant relationship; and one found a positive association. Detailed results are reported below:<br>Significant inverse association:<br>-One (n=2,371) found that for girls with a high BMI at baseline, those who ate breakfast more often had a lower BMI at the end of the study compared to those who ate breakfast less often.<br>-One (n=2,516) found that breakfast was inversely associated with overweight after 5 years (boys: OR=0.89, 95% CI 0.82, 0.97; $p<0.05$; girls: OR=0.89, 95% CI 0.83, 0.97; $p<0.05$).<br>-One (n=7,788) found that adolescents who were obese at baseline and follow up were less likely to eat breakfast (OR=0.59; 95% CI: 0.52 to 0.68; $p<0.001$).<br>-One (n=9,919) found that breakfast consumption at baseline predicted BMI z score after 8 years ($\beta=-0.01$, $p<0.05$). For | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>1 RCT included children who were overweight or at risk of overweightso it was not included here.<br><br>Three cohort studies looked at non-Hispanic white or black girls from the National Growth and Health Study.<br><br>Three cohort studies looked at respondents from the National Longitudinal Study of Adolescent Health - 1 reported on Wave one(1995; ages 12-18) and Wave three(2001-2002; ages 18-26) and 2 reported on a different number of respondents from Wave two (year not reported; age 11-18) and Wave three. These results were included in the analysis for both children and adults.<br><br>The Project Eating Among Teens study was reported on by 3 studies. |

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| | Self-reported consumption of breakfast in 1 cohort, FFQ in 2 cohorts, NR in 3 cohorts.<br><br>**Outcome(s):**<br>Children and adolescents:<br>For the RCT, BMI was measured after 12 weeks.<br><br>For the cohorts BMI was recorded between 5-9 years after the initial measurement.<br><br>Adults:<br>Outcomes: weight status, BMI, obesity (not further defined).<br><br>Height and weight self-reported at baseline and measured at follow up (not further defined) in 1 cohort, self-reported in 2 cohorts, measured in 3 cohorts.<br><br>Follow up was 5 to 10 years (NR in cohort) | each additional day of breakfast consumption at baseline, BMI z was predicted to decrease 0.01.<br>-One (n=355) found that adolescents who skipped breakfast were more likely to have an increase in BMI four years later ($p<0.05$).<br><br>Significant positive association:<br>-One study (n=159) found that college students who gained ≥5% of body weight were more likely to eat breakfast regularly (≥4 times/week) in the first 3 months of college than during high school, compared to those who did not gain ≥5% of body weight ($p<0.05$).<br><br>Direction of the relationship varied by weight status:<br>-One (n=14,586) found that overweight children who never ate breakfast lost BMI over the following year compared to overweight children who ate breakfast nearly every day (boys: -0.66 kg/m2; girls: -0.50 kg/m2), however normal weight children who never ate breakfast gained weight relative to peers who ate breakfast nearly every day (boys:+0.21; girls: +0.08).<br><br>Significance of association varied by sex (but not consistently):<br>-One study (n=2,516) did not find an association for boys but that frequency of breakfast consumption was associated with decreased BMI in girls (-0.11 BMI units, | Participants from each study have been added even though they may be the same children.<br><br>Three of the adult studies only included men.<br><br>The evidence summary overviews were unclear.<br><br>Study design: 1 non-randomised controlled trial was reported on in the review.<br>Population: healthy and those with elevated chronic disease risk, but the weight status is unclear.<br>Setting: unclear if the setting includes schools and the workplace. |

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| | | p=0.013).<br>-One study (n=650), more days of cereal consumption was associated with lower BMI in boys over 7.5 years follow-up (p=0.02). Boys who consumed no cereal over 3 days had a BMI of 20.4 kg/m2 while boys who had 3/3 days of cereal had a BMI of 20.1 kg/m2 (p=0.008, d=0.147). No association was found for girls or for cereal consumption and BMI z scores. (The overall association for breakfast was not assessed, but cereal was mainly reported to be consumed at breakfast.)<br>-One study (n=6,378) found no association for females, but males who skipped breakfast during adolescence were more likely to be overweight or obese 6 years later (OR =1.37, p<0.05).<br><br>Significant for specific breakfast subgroups only:<br>-One study (n=2, 379) found that breakfast consumption overall was not associated with BMI (p>0.17), but girls eating cereal on three days per week had lower BMI z scores than girls who ate cereal on zero, one or two days (p<0.05).<br><br>No significant association:<br>-Two studies (n=2,379 and n=2,216) found no association after adjusting for psychosocial variables or parental education, physical activity and energy intake.<br><br>Adults: | |

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| | | Results of the cohorts were mixed:<br>-Three studies (n=7,788 and n=9,919 in two potentially overlapping cohorts; n=6,764) found an inverse relationship between breakfast consumption and body weight in adults. The 2 studies based on the same cohort found that breakfast consumption in adolescence (age 11 to 18) predicted z BMI in young adulthood (age 18 to 26; each additional day of breakfast consumption was associated with a 0.01 reduction in zBMI, $p<0.01$). They also found that chronic obesity (at both adolescence and young adulthood) was associated with a reduced likelihood of consuming breakfast in young adulthood (OR 0.75, 95% CI 0.68 to 0.83). However, this latter figure seemed to assess obesity in advance of breakfast consumption, and may reflect reverse causality. The third study (n=6,764 men aged 40-74 at baseline) found that increased percentage of daily energy consumed at breakfast was associated with relatively lower weight gain (adjusted $\beta= -0.021$, 95% CI -0.035 to -0.007; p=0.004).<br>-One study (n=6,378) that analysed participants from the same adolescent cohort as the two studies above found an inverse relationship between breakfast intake and body weight in men and no relationship in women . Men who skipped breakfast during adolescence (age 11 to 18 years) were more likely to be overweight or obese six years later (OR 1.37, $p<0.05$).<br>One study in men (n=288) initially found a | |

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| | | significant relationship between frequency of eating breakfast and weight gain (ß=0.07, p<0.05, units NR), but after adjusting for potential confounders, the relationship was no longer significant (ß=0.04, p=0.21, units NR). This study was considered cross sectional in the review by Mesas et al. 2012.<br>-One study (n=20,064 ) in men found breakfast consumption was inversely associated with the risk of 5kg weight gain after adjustment for age, lifestyle and BMI at baseline (HR 0.87, 95% CI 0.82 to 0.93 ). The inverse association was stronger in men with a baseline BMI of ≤25 kg/m2 (HR 0.78, 95% CI 0.70 to 0.87) than in men who were overweight at baseline (HR 0.92, 95% CI 0.85 to 1.00).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Moderate evidence suggests that children who do not eat breakfast are at increased risk of being overweight and obese. The evidence is stronger for adolescents. There is inconsistent evidence that adults who skip breakfast are at increased risk for overweight and obesity. | |
| **Mesas et al. 2012**<br><br>**Quality:** +<br><br>**Search date:** Dec 2010 | **Study participant inclusion criteria:**<br>Children and adults from the general population<br><br>**Total # studies (# relevant and n=):** | **Result(s):**<br>Children:<br>Results of the cohorts were mixed, with 2 cohorts finding an inverse association in overall analyses, 2 cohorts finding an | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: P<br>Partial: D, Set |

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| **Review design:**<br>Systematic review of cross-sectional, cohort, case-control, experimental and laboratory studies<br><br>**Review aim:**<br>This study examined the association between selected eating behaviours and excess weight in the general population throughout a systematic review.<br><br>**Review funding:**<br>FIS research grant, CIBERESP, the National Plan on Drug Addiction and 'Ramon y Cajal'<br><br>**Study funding:**<br>Funding sources were not reported<br><br>**Multifactor review:** Yes | RCT: 0<br>Cohort: 10 (2, n=20,698 adults/8, n=unclear children - 3 of the cohorts appear to be from the same cohort of children but this is not explicitly stated so the total number of participants unclear - see limitations)<br>Other: 76 (13 adults, 63 children, cross sectional)<br><br>**Intervention/exposure description:**<br>Children:<br>Exposures were: days of breakfast eating (0 to 3 days), regular breakfast consumption (<4 days/week, >4 days/week), eating breakfast (number of days per week), breakfast frequency (daily, intermittent, never).<br><br>Exposure assessments: annually measured in 3 day food diary (n=3), NR (n=5).<br><br>Adults:<br>Exposures were: frequently skipping breakfast (yes/no), breakfast consumption (yes/no).<br><br>Exposure assessments: NR in both studies.<br><br>**Outcome(s):**<br>Children:<br>Outcomes: BMI, BMI Z score, at risk of overweight (BMI at or more than 85 percentile, using BMI cut-offs by CDC growth charts), change in BMI per year or over 5 | inverse association in overweight or obese children only but not in normal weight children (positive direction of effect), and 4 finding no significant association (3 direction NR, 1 inverse direction of effect):<br>-2 cohorts (n=2,379 in both) in females only (both set in schools and the community) found that skipping breakfast (0-3 days/week) did not predict BMI after adjusting for numerous confounders (not further defined) (9 to 10 year follow up); number of days eating breakfast (out of 3 possible days) was not predictive of BMI z score or risk of overweight (figures NR; p>0.17).<br>1 cohort (n= 2,371; may overlap with the 2 cohorts described above) of females and set in schools and the community found eating breakfast on 2 or more days/week was not associated with a change in BMI Z score after 10 year follow up in girls with median baseline BMI Z score (not further defined) (B 0.02, 95% CI -0.01 to 0.05) but it was associated with a decrease in BMI Z score in girls with baseline BMI in the 95th percentile (B -0.04, 95% CI -0.08 to -0.01) and at the 97th percentile (B -0.05, 95% CI -0.10 to 0.01).<br>-1 cohort (n=14,586) not set in school found skipping breakfast (never eating) was associated with a decrease in BMI after 1 year in overweight boys (beta -0.70, p=0.01) and girls (beta -0.47, p=0.01) but not in normal weight boys (B 0.22, p=0.11) and girls | Unclear: None<br><br>**Authors' limitations:**<br>The authors report almost all of the studies skipping breakfast in children were cross-sectional studies and causality cannot be inferred from these findings.<br><br>In relation to the 2 studies in adults, the authors report the findings may not be applicable to the general population because they were conducted only in men - in university students in 1 study and in healthy professionals in the other study.<br><br>**Review team limitations:**<br>The studies included in this review focused on breakfast skipping and did not look at other meal skipping.<br><br>Results are only reported here for the 4 cohorts that were not set in schools (n=1) or set in in schools/community (n=3).<br><br>Of the 8 cohorts in children, 3 cohorts were in settings that were schools and the community, 3 had school settings (it is unclear if this was just for recruitment purposes) and 1 cohort was not set in schools.<br>3 of the cohorts in children appear to have used the same cohort (reported as n=2,379 in 2 cohorts and n=2,379 in 1 cohort). |

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| | years, obesity (BMI > 30 kg/m2), using cut-offs by CDC growth charts.<br><br>Outcome measurement: measured weight and height (n=5) (not further defined), self-reported weight and height (n=2), 95% measured and 5% self-reported weight and height (n=1)<br><br>Follow up ranged from 3 to 10 yrs.<br><br>Adults:<br>Outcomes: BMI change of 5% or more (difference in kg/m2 from baseline), weight change (difference in kg from baseline).<br><br>Outcome measurement: reported as measured weight and height in 1 cohort (not further defined), self reported weight and height in 1 cohort.<br><br>Follow up ranged from 1 to 10 years. | (B 0.10, p=0.09) compared with eating breakfast 5 or more days/week.<br>-2 cohorts (n=17,707, school setting) found that skipping breakfast was associated with excess weight:<br>- 1 cohort (n=7,788) found that eating breakfast > 4 days/week was associated with lower frequency of chronic obesity (OR 0.59, 95% CI 0.52 to 0.68) compared with eating breakfast < 4 days/week<br>- 1 cohort (n=9,919) found number of days eating breakfast at baseline (ß -0.02, p<0.001) and changing breakfast consumption over the 5 year follow up (ß -0.01, p<0.01) were associated with BMI Z score.<br>-1 cohort (n=2,216, school setting) did not find an association between breakfast frequency and BMI (5 year follow up; p>0.05).<br>-1 cohort (n=508, not included in the other reviews) found that eating breakfast daily was not associated with obesity compared with not eating breakfast daily (OR 0.63, 95% CI 0.36 to 1.10).<br><br>Adults:<br>The 2 cohorts found results in the same direction:<br>1 cohort (n=4,634) of males found that frequently skipping breakfast was associated with a 5% or greater increase in BMI after 1 year follow up (OR 1.34, 95% CI 1.12 to 1.61, | Study design: Partial, the review included study designs that did not match the scope of this review (cross-sectional studies).<br>Setting: Partial, of the 8 cohorts identified in children, 3 cohorts (that appear to be the same cohort) were set in schools and the community and 3 other cohorts were set in schools only. Only 1 cohort did not have a setting that included schools. |

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| | | p value NR) (adjustments were made for exercise frequency, alcohol drinking, preference for fatty food, living alone).<br>1 cohort (n=20,064) of males found that compared with men who did not consume breakfast, men who did consume breakfast had a 23% lower risk of a 5 kg weight gain after adjustment for age (HR 0.77, 95% CI 0.72 to 0.82, p value NR). Further adjustment for potential confounders (age, physical activity, marital and work status, baseline BMI, smoking, alcohol intake, weight lifting) weakened the association but it was still significant (HR 0.87, 95% CI 0.82 to 0.93, p value NR). Dietary factors (nutrient and fibre intake, number of eating occasion) was said to explain part of the association, because after adjustment for such factors the HR was 0.91 (95% CI 0.85 to 0.97, p value NR) but again, the relationship was still significant.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>We found only small or inconsistent evidence of a relationship between excess weight and skipping breakfast, daily eating frequency, snacking, irregular meals, eating away from home, consumption of fast food, takeaway food intake, consumption of large food portions, eating until full and eating quickly. | |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | (This conclusion appears to be based on all study designs) | |

**Drinks with meals**

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Daniels and Popkin 2010**<br><br>**Quality:** +<br><br>**Search date:** NR<br><br>**Review design:**<br>Systematic review of feeding trials, epidemiological and intervention studies<br><br>**Review aim:**<br>To assess the impact of consuming water vs. other beverages before or with meals on total energy intake.<br><br>**Review funding:**<br>Nestle Waters and the NIH.<br><br>**Study funding:**<br>Non-industry funding for all water vs. no water studies; both industry and non-industry funding for the remaining studies (SSB, milk/juice, artificially sweetened beverages); specific study funders NR.<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>NR<br><br>**Total # studies (# relevant and n=):**<br>RCT: 3 (2, n=54 adults/1, n=24 children)<br>Cohort: 0<br>Other: 21<br><br>**Intervention/exposure description:**<br>Included studies compared drinking water to other beverages (milk, fruit juice, diet and non-diet sweetened beverages) and no beverage.<br><br>In clinical studies on removing water, comparisons included no water to water preload (237 to 500mL), drinking time in relation to meal time was 30 to 60 minutes prior to the meal (preloading) and with the meal. Meals in question were breakfast in two studies, lunch in four studies, and dinner in one study.<br><br>In clinical studies comparing water to milk & juice, beverage volume ranged from 50 to 591mL; timing ranged from more than >2hr delay between consumption of drinks and the meal, consumption just before or with the meal. Lunch was the assessed meal in all three studies.<br><br>In clinical studies on water vs. SSB, assessed beverages included those sweetened with | **Result(s):**<br>Water vs. no water<br>Six small, short term crossover trials (n=232) assessed the impact of the removal of water during mealtime on energy intake.<br><br>The one RCT (n=28 adults) found that removal of water 30 to 60 minutes before mealtime, or immediately before or during meals had no significant impact on Total Energy Intake (TEI).<br><br>Water vs. milk or juice<br>Two studies (n=76) assessed the impact of swapping milk or juice with water on TEI in adults. None of these were RCTs.<br><br>Water vs. SSB (sucrose and HFCS beverages)<br>Six studies assess sucrose and/or HFCS sweetened beverage consumption vs. water (n=158). None of these were RCTs.<br><br>Water vs. SSB (glucose and fructose sweetened beverages)<br>Four studies (n=121) compared glucose or fructose sweetened beverages to water.<br><br>The 1 RCT (n=40 adults) found that consuming lemonade sweetened with glucose rather than water before a meal increased TEI ($p<0.05$), but consuming lemonade sweetened with fructose rather than water did not this effect (sigificance NR). | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: Set<br><br>**Authors' limitations:**<br>The review included 24 trials (some crossover trials). Only 3 of these were reported as randomised (2 in adults: 1 comparing water vs. no beverage drunk with or at varying times before a meal, 1 comparing water vs. lemonade sweetened with glucose or fructose; 1 in children of water versus sugar sweetened fruit drink or diet fruit drink). The trials assessed short term impact only.<br><br>**Review team limitations:**<br>The significance of pooled results was not reported in the forest plots, and was unclear in the narrative.<br><br>Population: included studies that selected participants based on overweight/obese status.<br><br>Study design: review included short term clinical trials (pre-load studies) that assessed the short term impact of a variety of beverages before or during a meal on total energy intake. |

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| | fructose (>=65% fructose), glucose, sucrose, and HFCS (usually 55% fructose/45% glucose).<br><br>Studies comparing water to diet beverages before or during meals included beverages sweetened with aspartame, saccharin, or acesulfame-K47, in isolation or combined.<br><br>**Outcome(s):**<br>Total Energy Intake (TEI) in kcal was the main outcome of interest across the review; | Water vs. diet beverages<br>Ten studies (n=234) with 19 comparisons assessed the impact of water vs. diet beverages on TEI. None of these were RCTs.<br><br>Children<br>Water vs. milk<br>One study (n=36) assessed the impact milk vs. water on TEI in normal weight preschool children. This was not an RCT.<br><br>Water vs. SSB (sucrose and HFCS beverages) or diet beverages<br>One RCT (n=44 preschoolsers; 45 to 66 months old) compared the effcet of a sucrose sweetened fruit drink (SSB), a diet fruit drink, and water on snack intake among pre-schoolers. Three delay schedules were used (0, 30 and 60 minutes before the meal). Across the schedules, children consumed significantly fewer calories from snacks in the SSB group compared to the water group. In all comparisons, calorie intake reduction from snacks was balanced by the calorie intake increase from the SSB, so difference in TEI was not significant (p values NR).<br><br>Children consumed fewer snack calories when drinking the diet fruit drink vs. water 30 minutes before the snack ($p<0.05$), but not when the beverages were served 60 minutes before (p value NR). | |

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| | | **Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The impact of replacing water drunk before or during a meal with no beverages or other beverages (of equal volume) on TEI varied with the substituted beverage. It suggested that, compared with drinking the same volume of water certain drinks before or with a meal may increase TEI (beverages sweetened with sucrose or high fructose corn syrup), some have no effect (drinking no water, or non-nutritively sweetened drinks), and for some the evidence was unclear (milk or juice, drinks sweetened with glucose or fructose).<br><br>Limited evidence was identified in children, and thus, no conclusions could be drawn for this age group. | |

**Eating meals prepared outside of the home (eating out/fast food/takeaway meals)**

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| **Bezerra et al. 2012**<br><br>**Quality:** ++<br><br>**Search date:** Jun 2010<br><br>**Review design:**<br>A systematic review of observational studies (cross-sectional and cohort studies).<br><br>**Review aim:**<br>To assess the association between out-of-home eating and body weight in adults.<br><br>**Review funding:**<br>The Research Council State of Rio de Janeiro.<br><br>**Study funding:**<br>Funding sources were not reported.<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Adults of any weight, health status not recorded.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 8 (8, n=35,938*)<br>Other: 20<br>* likely overlap of 3 of these cohorts would reduce this total<br><br>**Intervention/exposure description:**<br>Some cohorts looked at out-of-home eating not described as fast food or take away meals, while others looked at take away meals or consumption of meals at fast food restaurants. All exposures were self-reported.<br><br>**Outcome(s):**<br>BMI or body weight after between1 to 15 years follow up (weight and height measured in 6/8, self-reported in 2/8). | **Result(s):**<br>Three cohort studies showed a positive association between the consumption of meals away from home and body weight or BMI:<br>-the cohort reported in 3 studies (n ranged from 3,031 to 3,643, extent of overlap unclear) found that 1 additional restaurant eating occasion per week were positively associated with changes in weight over 13 years (beta=0.09, p=0.04; weight units NR)<br>-1 study (n=9,182) reported higher frequency of away from home meals (≥2 times/week) was positively associated with: weight gain in 1 year (beta=0.129, 95% CI reported as 62 to 197, presumably missing decimal places; p<0.001); BMI gain in 1 year (beta=0.07, 95% CI 0.04 to 0.10, p<0.001); risk of becoming overweight or obese during an average of 4.4 years' follow up (HR 1.33, 95% CI 1.13 to 1.57, p<0.001).<br>-1 cohort (n=6,012) found a reduction in spending on eating out was associated with a reduction in BMI over 10 years (beta=-0.0003 kg/m2; p value NR).<br><br>Four studies investigated the consumption of fast food or takeaway food:<br>-the cohort reported in 3 studies (n ranged from 3,031 to 3,643) found a positive association between increased baseline fast food consumption and BMI gain over 3 years (beta=0.20, 95% CI 0.01 to 0.39, p=0.04) and | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>There was a lack of a common definition of the out-of-home eating concept and the appropriate way to measure the amount of consumption.<br><br>Many of the studies relied on self-reported measures of height and weight which may be inaccurate.<br><br>Household food intake may confound the association.<br><br>**Review team limitations:**<br>The results described narratively in the text of the review did not correspond with the results reported for the cohort studies in the results table. This is in part due to combining the results of three studies relating to the same study cohort in the table. Findings described here are based on the narrative description of results, figures have been added to these findings from the results table where available.<br><br>Partial: Study design included cross-sectional |

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| | | between fast food and restaurant consumption and BMI gain (beta=0.29, 95% CI 0.06 to 0.51, p=0.01). One additional fast food eating occasion per week were positively associated changes in weight over 13 years (beta=0.15, p=0.05; weight units NR)<br>-1 cohort (n=891 women) found a positive association increased frequency of use of fast food restaurants and increased body weight over 3 years (beta=0.72, p=0.01).<br>-1 cohort (n=8,726) that investigated takeaway food found a positive relationship with BMI - compared to women who gained weight (BMI more than 5% greater at 4 years than baseline BMI), less frequent takeaways were associated with weight maintenance (BMI at 4 years within 5% of baseline BMI, OR 0.85, 95% CI 0.75 to 0.96, p=0.008 for occasional take away; unclear exactly what comparison this figure represented).<br>-1 cohort (n=1,059) did not find any association between fast food consumption and 1 year change in BMI (beta values for men: -0.23, 95% CI -0.56 to 0.11; high income women 0.02, 95% CI -0.05 to 0.09; low income women -0.06, 95% CI -0.20 to 0.08).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>There is a consistent positive association | studies.<br>Unclear: Population health or weight status. |

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| | | between the consumption of meals away from the home and BMI or weight gain. | |
| **Mesas et al. 2012**<br><br>**Quality:** +<br><br>**Search date:** Dec 2010<br><br>**Review design:**<br>Systematic review of cross-sectional, cohort, case-control, experimental and laboratory studies<br><br>**Review aim:**<br>This study examined the association between selected eating behaviours and excess weight in the general population throughout a systematic review.<br><br>**Review funding:**<br>FIS research grant, CIBERESP, the National Plan on Drug Addiction and 'Ramon y Cajal'<br><br>**Study funding:**<br>Funding sources were not reported<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>Children and adults from the general population<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 10 (7, n=34,913 adults/3, n=24,375 children)<br>Other: 32 (0)<br><br>**Intervention/exposure description:**<br>Children:<br>*Fast food intake*<br>Exposures were eating at fast food (no further detail provided) (number of days per week) and fast food intake (fried food intake as a proxy for fast food intake; never, or <1 time/week, 1 to 3 or 4 to 7 times/week).<br>*Take away food consumption*<br>The exposure was takeaway food consumption never, 1 or ≥2 times/week.<br><br>Adults:<br>*Eating away from home*<br>Exposures were eating away from home (never to 3 times/month, 1 time/week, ≥2 times/week) in one study and eating at restaurants and fast food intake (increased, decreased or maintained frequency during follow up) in the other study.<br><br>*Fast food intake* | **Result(s):**<br>Children (age range 6 to 21):<br>*Eating away from home*<br>No studies identified.<br><br>*Fast food intake*<br>2 cohorts (n=24,274) were consistent in showing that consumption of fast food at baseline or increasing fast food over time was associated with increased BMI:<br>In one cohort (n=9,919) of children aged 11 to 21 years, eating fast foods at baseline was associated with BMI Z-score after 5 years of follow-up (beta=0.02, p<0.05) compared with not eating fast foods.<br>In one cohort (n=14,355) of children aged 9 to 14 years, increasing fried food intake away from home from <1 time/week to 4 to 7 times/week was associated with increased BMI over 1 year of follow-up (beta=0.21; 95% CI 0.03 to 0.39) compared with maintaining fried food frequency at <1 time/week.<br><br>*Take away food consumption*<br>1 cohort (n=101) of females aged 8 to 12 years had results dscribed inconsistently between the narrative text and the results table. The narrative reports eating takeaway foods was not associated with change in BMI after 10 years (figures NR) whereas the results table reports frequency of eating quick service food (not further defined) was | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: P<br>Partial: D<br>Unclear: Set<br><br>**Authors' limitations:**<br>Compared with non-obese persons, the obese under-report total energy intake and, specifically, fried food which is a characteristic component of fast food tends to bias the observed observations towards the null. They also report that it is possible that fast food may simply be a marker of low socioeconomic level, of low quality diet and of an unhealthy lifestyle.<br><br>**Review team limitations:**<br>In Adults, of 6 longitudinal studies, 5 are included in the high quality review by Bezerra et al. 2012 [++]. It is unclear if the longitudinal studies were all cohorts.<br>In children, 2 longitudinal studies were identified for fast food and 1 for take away meals.<br><br>In children, 1 of the cohorts had an age range of 11 to 21 year olds and a school setting, however it is unclear if this was for recruitment or for study activities. It has been reported here. |

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| | In 3 cohorts, fast food consumption was assessed by the number of times subjects ate in fast food restaurants. The frequency of eating fast food (e.g. french fries, other fried foods, hot dogs, sandwiches, pizza) was assessed in 2 cohorts and 1 other cohort assessed whether or not adults ate fast food (hamburgers, sausages and pizza).<br><br>**Outcome(s):**<br>Children<br>*Fast food intake*<br>Outcomes were BMI Z score (weight and height were 95% measured and 5% self-reported) in 1 study and BMI and change in BMI (self-reported weight and height) in the other. Follow up was 3 or 5 years.<br><br>*<u>Take away food consumption</u>*<br>Change in BMI Z score over a 10 year follow up. Weight and height were reported as measured (not further defined).<br><br>Adults<br>*<u>Eating away from home</u>*<br>weight change (change in g/year of follow up as a continuous variable and as changing ≥2 kg/year); incidence of overweight/obese participants (BMI <25 kg/m$^2$ at baseline and BMI ≥25 kg/m$^2$ at follow up) and change in BMI. Weight and height were reported as measured in 1 study and self-reported in the other. Follow up was 3 or 4.4 years.<br>*Fast food intake* | positively associated with change in BMI Z score (F=6.49, p<0.01) over time but that no association was found for food purchased in other establishments (restaurants, coffee shops).<br><br>Adults<br>Overall, 5/7 cohort found positive associations with weight related outcomes.<br><br>*<u>Eating away from home</u>*<br>In adults, two cohorts (n=12,576 ) that matched the scope of this review and 10 studies outside the scope of this review (cross sectional studies) were identified.<br><br>The 2 cohorts had conflicting results. In one study (n=9,182) individuals eating away from home ≥2 times/week had a significantly higher weight gain (+129 g/year, 95% CI +62 to +97 g/year, p<0.001), with gaining more than 2 kg (OR 1.36, 95% CI 1.13 to 1.63, p value NR) and a higher risk of overweight or obesity (HR 1.33, 95% CI 1.13 to 1.57) compared with never eating or up to 3 times/month eating away from home over a 4.4 year follow up. In this study eating away from home 1 time/week was not associated with weight gain or gaining more than 2 kg but it was associated with an increased risk of overweight/obesity (HR 1.22, 95% CI 1.02 to 1.45) compared with never eating or up to 3 times/month eating away from home.<br>In the other study, (n=3,394), increased | In children, 1 of the cohorts had a setting reported as schools but it is unclear if this was for recruitment purposes or for study activities.<br><br>For the cohort in children on take away foods, the text reports that there was no association with takeaway food and BMI but the supplementary table reports that there is. Both results have been reported.<br><br>Partial: study design included cross-sectional studies.<br>Unclear: Setting |

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| | Outcomes were weight gain or change in BMI after 1 to 10 years. | consumption of restaurant food was unrelated to BMI change after 3 year follow up. This study did find an association for fast food intake (see below for details).<br><br>*Fast food intake*<br>Of the 6 cohorts (n=25,731), 4 reported that greater frequency of fast food consumption was positively associated with weight gain (3 studies) and with increased BMI (1 study). Individual study results were:<br>• In one cohort (n=7,194), those in the highest quintile of fast food consumption showed an increased risk (OR 1.2; 95% CI 1.0 to 1.4) of any weight gain compared with those in the lowest quintile (2.4 year follow up).<br>• In one cohort (n=3,394). fast food intake at restaurants at baseline was associated with an increase in BMI (0.16 ±0.05 kg/m$^2$) after 3 years of follow up.<br>• In one cohort (n=891), an increase of one fast food meal per week (at a restaurant) was associated with a weight gain of 0.72 kg (standard error=0.20 kg) over 3 years (p=0.01).<br>• In one cohort (n=3,031), eating at fast foods restaurants >2 times/week both at baseline and at the end of follow-up was associated with a 4.5 kg weight gain (p=0.0054) | |

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| | | compared with eating fast food <1 time/week in both periods.<br>• However in one cohort (n=10,162) those in the highest tercile of fast food intake did not show a statistically significant increase in the risk (OR 1.31; 95% CI 0.83 to 2.07) of substantial weight gain (≥3 kg/year) or in the risk (OR 1.11; 95% CI 0.80 to 1.55) of becoming obese compared with those in the lowest tercile (follow up of 4.6 years).<br>• In a cohort (n=1,059) frequency of fast food consumption (times/week) was not associated with 1-year BMI change in men (β -0.23; 95% CI -0.56 to 0.11), in high-income women (β 0.02; 95% CI -0.05 to 0.09) and in low-income women (β -0.06; 95% CI -0.20 to 0.08).<br><br>*<u>Take away food consumption</u>*<br>No cohorts or RCTs identified.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>There is some evidence of the obesogenic role of fast food and take away food but this is limited. | |
| **Rosenheck 2008**<br><br>**Quality:** + | **Study participant inclusion criteria:**<br>Children and adults, but no further criteria specified. | **Result(s):**<br>Adults:<br>In the RCT in women (n=891), no difference | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:** |

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| **Search date:** Feb 2008<br><br>**Review design:**<br>Systematic review of prospective cohorts lasting longer than 6 months, experimental and cross-sectional studies.<br><br>**Review aim:**<br>To examine whether an association exists between fast food consumption and weight gain.<br><br>**Review funding:**<br>NR<br><br>**Study funding:**<br>Funding sources were not reported.<br><br>**Multifactor review:** No | **Total # studies (# relevant and n=):**<br>RCT: 2 (1, n=891)<br>Cohort: 7 (4, n=23,538 adults/3, n=7,004 children)<br>Other: 7<br><br>**Intervention/exposure description:**<br>Adolescents and adults:<br>Self report of frequency of fast food consumption.<br><br>In the RCT for adult women, the exposure group received a mail-based intervention of monthly newsletters (unclear if specifically targeted reduced fast food consumption) and periodic opportunities to participate in eating and exercise programmes over 3 years. Control was no contact<br><br>**Outcome(s):**<br>Adolescents:<br>Change in BMI after 4 to 10 years.<br><br>Adults:<br>Change in BMI or weight after 3 to 15 years. | was found between the intervention and control group on fast food restaurant use (figures NR); any overall differences in weight between the groups were not reported. Increased frequency of fast food restaurant use was associated with increased weight. An increase of one fast food meal per week was associated with a weight gain of 0.72kg (p=0.01) (3 year follow up).<br><br>All 4 cohorts (n=23,538) found a direct link between fast food consumption and increases in BMI.<br>In 1 cohort, (n=3,031) baseline fast food frequency was directly associated with changes in body weight for African Americans (p=0.005) and White people (p=0.0013). Compared to the average 15 year weight gain in participants with infrequent fast food restaurant use, defined as less than once per week, those with frequent use or consumption of more than twice per week gained an extra 4.5kg (p=0.0083).<br>In a cohort study (n=3,394), for every increase in fast food restaurant visit per week, BMI increased 0.0488 (p=0.016) at 3 year follow-up.<br>In a cohort (n=7,194) those in the highest consumption (fifth) quartile for hamburgers, pizza and sausages had an OR of 1.2 (p for trend=0.05) for weight gain compared to those in the first quartile.<br>In 1 cohort (n=9,919; consider in the review | Complete: None<br>Partial: D, P<br>Unclear: Set<br><br>**Authors' limitations:**<br>Confounding factors include physical inactivity and less inhibited food consumption.<br><br>**Review team limitations:**<br>The RCT appeared to essentially be an analysed as a cohort, rather than as an RCT. It was unclear if the analysis was adjusted for confounders, and as the trial did not appear to solely reduce fast food consumption, this result may also be influenced by other factors. In addition, the change in fast food consumption and weight appeared to be over the same time period, meaning that the temporal pattern of these changes cannot be established.<br><br>One of the cohorts described by the review as in adolescents had an age range from 18 to 27 years but this has been reported here under adults.<br><br>The 1 cohort identified in children did not report weight outcomes so has not been described here.<br><br>Partial: Population<br>Partial: Study design included cross-sectional and experimental studies and results that |

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| | | as adolescents, but aged 18 to 27, so considered as adults here) greater days of fast food predicted increased BMI Z score after 5 years.<br><br>Adolescents (age 8 to 19 years):<br>Results of the 3 cohorts showed a positive association in 2 studies, and no significant association in the third:<br>-In a cohort (n=4,524) a non-significant correlation was found between fast food consumption and BMI.<br>-In a cohort (n=101) those eating fast food twice a week or more experienced the highest in mean BMI z-score compared with those who ate it once a week or not at all.<br>- One cohort (n=2,379) found that those who consumed fast food had significantly higher BMI z score over 10 years than those who did not consume fast food often (figures NR ). This study did not adjust for confounders in other analyses, but the adjustment of this BMI analysis was not reported.<br><br>Unless otherwise stated above, the exact exposures being compared were not quantified.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>One RCT and 6/7 prospective cohort studies found a positive association between more | looked at energy intake rather than weight.<br>Unclear: Setting |

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| | | frequent fast food consumption and an increase in BMI or weight gain. While a causal relationship cannot be stated, an unequivocal association exists between increased fast food consumption and increased caloric intake making individuals much more susceptible to weight gain and obesity. | |
| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 6 (4, n=16,829 adults/ 2, n=1,626 children)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Exposure definition varied across studies. Adult exposures were: number of times they ate at any of a number of fast-food restaurants per week, number of fast food meals (not further defined) per week, frequency of consumption of fast foods (not further defined) and frequency of take away food.<br>Children exposures were: food purchased away from home, and take away food factor from FFQ.<br><br>Methods of assessing consumption in the 2 cohorts on children were FFQ and a 7-day | **Result(s):**<br>Adults<br>Results of the 4 cohorts found fast foods and takeaway meals were positively associated with assessed outcomes in at least one analysis:<br><br>One study (n=1,059) found that the number of fast food meals consumed per week was significantly associated with BMI after 1 year follow-up in women but not men. The association was significant in both low- and high-income women but not men (regression coefficients for low income women: 0.85 kg/m2, 95% CI 0.43 to 1.27, p<0.05; high income women 0.39 kg/m2, 95% CI 0.15 to 0.64, p<0.05; men: -0.1 kg/m2, CI NR, p>0.05). Change in BMI was not significant in women or men (regression coefficients for: low income women -0.06 kg/m2, high income women 0.02 kg/m2, men -0.23kg/m2, all p>0.05, CIs NR).<br><br>One study (n=9,657) reported that women who occasionally consumed takeaway food were less likely to maintain weight (OR 0.85, | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Adjustment for confounders varied across studies, and only 2 of the 6 adjusted for physical activity levels (it is not reported whether these 2 studies were in adults or children).<br><br>**Review team limitations:**<br>In one long term study amongst children, it is not clear whether it is the mother or child's takeaway food consumption that is being assessed, and if the child's it is not clear at what age assessment took place.<br><br>Population weight and health status unclear. |

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| | food record.<br><br>In adults, frequency of eating at fast food restaurants was assessed via FFQ in two studies; consuming takeaway was assessed by a single question in two studies (instrument NR).<br><br>**Outcome(s):**<br>Adults: change in weight, change in BMI, weight,<br>Children: change in BMI Z score, BMI<br><br>Weight and height were measured by the research team in both children studies and three adult studies, outcomes were self-reported in one of the adult studies.<br><br>Follow up in children: 6 years in 1 study and children reported as followed from the 16th week of gestation till age 8 in the other cohort.<br><br>Follow up in adults: 1 to 15 years. | 95% CI 0.75 to 0.96) than women who never or rarely consumed takeaway. 42.8% of participants who gained 5% or more of their baseline body weight over the four year follow-up period were occasional takeaway consumers, compared to 15% of participants who lost 5% or more of their baseline weight.<br><br>One study (n=5,115) found that visiting fast food restaurants frequently (more than twice per week) was associated with a greater weight gain over 15 years compared to infrequently visiting; the association was significant across assessed ethnicities (black: 1.72kg, 95% CI 0.52 to 2.92, p=0.005; white: 1.84kg, 95% CI 0.86 to 2.82, p<0.0013).<br><br>One study (n=998) found that visiting fast food restaurants more than twice per week gained 0.72kg more over three year follow-up than those who infrequently visited (95% CI 0.33 to 1.11, p<0.01).<br><br>Children<br>One study that included girls aged 8 to 12 years (n=196) found that frequency of fast food consumption was significantly positively associated with BMI z-score at 6 year follow-up; mean change in BMI z-score was 0.82 amongst girls who ate fast food more than twice/week, compared to 0.28 amongst those who never ate fast food (p=0.0023).<br><br>One study (n=1,430) that followed | |

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| | | participants from the 16th week of gestation to age 8 found that eating 'takeaway food' was associated with BMI at age 8 when adjusting for gender only (regression coefficient 0.399, 95% CI 0.056 to 0.742) but not when adjusting for sex and maternal education.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>There is limited evidence that consuming fast foods as defined in the literature (number of fast-food meals consumed/takeaway food consumed/fast food restaurants visited, per unit of time) is associated with slightly higher levels of subsequent excess weight gain and obesity. | |
| **USDA 2010i**<br><br>**Quality:** +<br><br>**Search date:** Jan 2010<br><br>**Review design:**<br>Systematic review of systematic reviews, meta-analyses, RCTs, clinical controlled studies, large non-randomised observational studies, cohort and case-control studies<br><br>**Review aim:**<br>What is the relationship between eating out and body weight? | **Study participant inclusion criteria:**<br>Healthy children and adults and those with elevated chronic disease risk.<br><br>**Total # studies (# relevant and n=):**<br>RCT:0<br>Cohort: 9 (5, n=18,380 adults/5, n=28,079 children; 1 cohort included in both age groups)<br>Other:2<br><br>**Intervention/exposure description:**<br>In children, FFQ was used to measured the number of times fast food was eaten in the previous week(3/5), or fried food away from | **Result(s):**<br>Children and adolescents:<br>A significant positive relationship was found between food consumption of fast food and body weight in 4 studies in children:<br><br>In 1 cohort (n=1,188), children who were obese aged 14 reported a higher consumption of fast food aged 9 (coefficient [SE] 0.77 [0.33]; p<0.05; unclear which variables this coefficient represented the relationship between).<br><br>In 1 cohort (n=9,919) of adolescents, increased fast food consumption aged 16 | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>There is not enough evidence to similarly evaluate eating out at other types of restaurants.<br><br>**Review team limitations:**<br>In 1 cohort in children (n=101), the baseline median BMI was only 16.4 and the median |

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| **Review funding:**<br>Funding not explicitly reported. Reviews written by the US Department of Agriculture to support development of their guidelines.<br><br>**Study funding:**<br>Funding sources not explicitly stated but study funding was considered for quality rating and validity.<br><br>**Multifactor review:** No | home(1/5) or a 7 day food record (1/5).<br><br>In adult studies, fast food questionnaires or FFQ or interview (not further defined) were used.<br><br>**Outcome(s):**<br>In children, aged between 8 and 16, BMI was measured 3 to 6 years after the questionnaire.<br><br>In adults, BMI after 1 to 15 years. | predicted significantly higher BMI Z-scores aged 21 (p<0.05). Change in fast food consumption during that time did not significantly predict BMI Z-score.<br><br>In 1 cohort (n=14,355), BMI increased across increasing intake of fried foods away from home in boys only (p<0.02; figures for girls NR). Children who increased their consumption of fried foods from "never or less than once a week" to "four to seven times a week" over 3 years increased their BMI by 0.21. Boys who reduced their consumption from "four to seven times a week" to "never or less than once a week" had a borderline significant decrease in BMI (-0.31 [-0.62 to 0.00]) but girls had a non-significant BMI increase (0.27 [-0.02 to 0.56]). As these changes were assessed concurrently, this could be influenced by reverse causality.<br><br>In 1 cohort (n=101) weekly frequency of consuming quick-service food at baseline was positively associated with change in BMI Z-score (F=6.49, p<0.01), but the frequency of eating in coffee shops and restaurants at baseline was not.<br><br>One cohort (n=2,516) found an inverse association between fast food consumption at baseline and being overweight after 5 years in 12 to 16 year old girls (OR 0.88, 95% CI 0.79 to 0.98; p<0.05). In boys, fast food | follow-up BMI was within the normal range at 20.3.<br><br>Partial: study design included 2 systematic reviews.<br>Unclear: The health status is unclear and the mean BMI in 3 of the adult studies was overweight, but it is unclear if this was intentional.<br>Unclear: Setting |

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| | | consumption was not associated with weight change.<br><br>Adults:<br>All 5 cohorts found a significant positive relationship between consumption of fast food and body weight (this included the adolescent study already reported).<br><br>In 1 cohort study (n=3,394) increased consumption of fast food was associated with a positive increase in BMI after 3 years (0.0488, 95% CI 0.01 to 0.09, p=0.016). Increased restaurant food consumption was not associated with a change in BMI.<br><br>In 1 cohort of women (n=891), an increase of one fast food meal per week over 3 years increased weight by 0.72kg above the average weight gain (p<0.01).<br><br>In 1 cohort (n=1,145) fast food consumption more than 1 to 2 times per week had significant increase in body weight over a year than those that didn't (1.4 +/-0.61kg, p<0.05).<br><br>In 1 cohort (n=9,919) of adolescents, increased fast food consumption aged 16 predicted significantly higher BMI Z-scores aged 21 (p<0.05). Change in fast food consumption during that time did not significantly predict BMI Z-score. | |

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| | | In 1 cohort (n=3,031), a difference of fast-food frequency of 3 times per week was associated with mean gains of 2.2kg in black subjects (p=0.014) and 1.6kg in white subjects (p=0.064) after 15 years. Compared to participants with less than 1 fast food intake per week, those eating it more than twice per week gained an extra 4.5kg (p=0.0054).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Strong and consistent evidence indicates that children and adults who eat fast food are at increased risk of weight gain, overweight and obese. The strongest documented relationship between fast food and obesity is when one or more fast food meals are consumed per week. | |

**Eating in the evening**

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| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:**<br>To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:** NR<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 2 (2, n=13,411)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Evening eating, categorised in one study % of daily energy intake consumed after 17:00. Night time eating, defined by self-reported response to the single question "Do you get up at night to eat".<br><br>Methods of assessment were self-reported night eating and 24hr dietary recall.<br><br>**Outcome(s):**<br>Weight change. Weight and height were measured by the research team in both studies. | **Result(s):**<br>Adults<br>One study (n=10,424) found no association between the % of daily energy intake consumed after 17:00 and change in weight over 10 years (data NR).Age of the male and female participants ranged from 25 to 74 years (average not reported).<br><br>One study (n=2,987) found no association between night eating and change in weight over 6 years (data NR).Age of participants ranged from 35 to 65 years (average not reported).<br><br>2 Cohort combined figures used in evidence statement (n=13,411, age range 25 to 74, follow up 6 to 10 years).<br><br>Children<br>No studies identified<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>The is no epidemiological evidence of a consistent association between night eating and subsequent weight gain or obesity. | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Both studies adjusted for physical activity levels.<br><br>**Review team limitations:**<br>Validity and consistency of assessment methods not reported. |

Eating occasions (eating frequency)

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| **Mesas et al. 2012**<br><br>**Quality:** +<br><br>**Search date:** Dec 2010<br><br>**Review design:**<br>Systematic review of cross-sectional, cohort, case-control, experimental and laboratory studies<br><br>**Review aim:**<br>This study examined the association between selected eating behaviours and excess weight in the general population throughout a systematic review.<br><br>**Review funding:**<br>FIS research grant, CIBERESP, the National Plan on Drug Addiction and 'Ramon y Cajal'<br><br>**Study funding:**<br>Funding sources were not reported<br><br>**Multifactor review:** Yes | **Study participant inclusion criteria:**<br>Children and adults from the general population<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 4 (2, n=27,211 adults/2, n=2,476 children)<br>Other: 35<br><br>**Intervention/exposure description:**<br>One of the cohortsof children aged 9-10 looked at daily meal frequency of 3 or more meals per day compared to lower frequency from a food diary. The other looked at daily eating frequency (0 to4; 4 to 5; or 6 or more times/day).<br><br>In adults, eating frequency assessed as less than 2, 3,4,5,6 or 7 or more meals or snacks per day in one study or 3,4 or more than 5 in the other.<br><br>**Outcome(s):**<br>Children:<br>BMI z score; overweight (BMI at or above 95$^{th}$ percentile; change in BMI Z score after 10 years.<br><br>Adults:<br>Weight change after 8 to 10 years - measured in one study and self-measured in the other. | **Result(s):**<br>The review identified 4 cohort studies and 35 other study types, of which 3 cohort studies (n=29,586) matched the scope of this review and 2 were in adults (n=27,211) and two were in children (n=2,476).<br><br>Children:<br>In 1 cohort (n=2,375) eating 3 or more meals/day was associated with higher BMI z scores (Beta -0.0472, p<0.0001) but not with overweight (OR 0.91; 95%CI 0.79-1.05) compared with eating <3 meals/day.<br><br>In 1 cohort (n=101), eating 4 to 5 meals/day was associated with an increase in BMI Z score after 10 years (beta 0.24, p=0.028) compared with eating 6 times or more/day.<br><br>Adults:<br>In 1 cohort study (n=7,147) daily eating frequency at baseline was not associated with weight change in men (Beta 0.0211, p=0.86) and in women (beta 0.1101, p=0.21).<br><br>In 1 cohort study (n=20,064) eating 4 meals per day (HR 1.07, 95% CI 1.02-1.14) or 5 or more meals per day (HR 1.15, 95%CI 1.06-1.25) were associated with higher risk of 5kg weight gain after 10 years of follow-up compared with eating 3 meals/day.<br><br>**Adverse Effects:** | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: P<br>Partial: D<br>Unclear: Set<br><br>**Authors' limitations:**<br>The definition of meals is heterogeneous because it includes both the main meals (e.g. skipping breakfast reduces the number of meals) and additional ones (in some studies, not snacking could also reduce the number of meals).<br><br>There is a predominance of cross-sectional studies with little control of confounders.<br><br>**Review team limitations:**<br>The cohort study on children is reported to have occurred in public and parochial schools and community based. It is unclear if this fits the scope for setting.<br><br>Partial: Study design included 31 cross-sectional studies, an experimental study and 3 case controls.<br>Unclear: Setting |

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| | | NR<br><br>**Conclusions:**<br>They did not find sufficient evidence for the association between meal frequency and excess body weight at any age. | |

Family meals

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| **Hammons and Fiese 2011**<br><br>**Quality:** +<br><br>**Search date:** 2009 (month NR)<br><br>**Review design:**<br>Systematic review of<br><br>**Review aim:**<br>We used meta-analytic methods to examine the frequency of shared family mealtimes in relation to nutritional health in children and adolescents. We were interested in 3 major public health concerns: obesity, unhealthy eating and disordered eating. IN particular we examined the effects of sharing 3 or more meals per week versus 1 or none. When study designs allowed, we investigated the long-term potential for family meals operating as a protective factor for these health indicators.<br><br>**Review funding:**<br>Reported to be supported in part by the US Department of Agriculture National Institute of Food and Agriculture.<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Children and adolescents (age range inclusion criteria NR)<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 4 (4, n=29,961)<br>Other: 4 (cross-sectional studies)<br><br>**Intervention/exposure description:**<br>Exposures were: family meals 3 or more times/week vs. never; family meals per week (composite variable, not further defined); family meals 5 to 7 days/week vs. 0 days/week; family meals most days vs. never/some days.<br><br>Family meals: the review reported most studies (n=12) asked participants to consider the number of family members present for the meal. Other studies asked participants to report on how often regular family dinners occurred but made no mention of the number of family members present (n=3). 2 studies asked participants to report only on shared meals that had at least 1 parent present.<br>This is based on all studies included in the review cross-sectional cohorts) and studies looking at outcomes additional to weight such as food consumption and disordered eating. | **Result(s):**<br>Meta-analysis (included cross-sectional and cohort studies) of 8 studies (n=44,016 [range 145 to 14,431]; 4 cross-sectional; 4 cohorts) found that children and adolescents were 12% less likely to be overweight in families that had at least 3 shared family meals per week than those who ate fewer than 3 shared family meals per week ((OR 0.88, 95% CI 0.81 to 0.97 p-value not reported, heterogeneity: I2=48.45%, p=0.06).<br><br>Cohorts:<br>Overall meta-analysis of the cohort studies found that family meals were associated with a significant reduction in the risk of overweight (OR 0.93, 95% CI 0.90 to 0.95).<br><br>Heterogeneity in this analysis was not reported but the individual cohort studies were reported to be suggestive of little association between shared family mealtimes and outcomes (weight status or disordered eating).<br><br>Of the 4 cohorts, only 1 (average age 5.7 years) reported significant findings (the remaining 3 studies were all in adolescents):<br>- 1 cohort (n=8,000) had an OR of 0.93 (overweight ≥95th percentile; p<0.001; 3 year follow up). Mean age 5.7 years.<br>- 1 cohort (n=2,516) had an OR of 0.55 (overweight: BMI ≥85th percentile) 95% CI | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>The review authors report there was a large amoutn of variability in the studies conducted on family meals.<br><br>The revies authors report the way in which outcomes and family meals were measured varied in the studies. The authors also report the definition of family is also often overlooked.<br><br>**Review team limitations:**<br>The main meta-analysis and review conclusions on weight-related outcomes are based on mixed study designs (cross-sectional and cohorts).<br><br>The meta-analysis of cohort and cross sectional studies had borderline significant heterogeneity meaning the underlying studies exhibited moderate levels of variation (I2=48.45%, p=0.06).<br><br>Looking at just the included cohort studies: 1 found a significant association (n=8,000, up to 5 year follow up) compared with 3 that |

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| | **Outcome(s):**<br>Overweight (defined as having a BMI at or above the 85th percentile); overweight onset (defined as at or above the 95th percentile); obesity (defined as at or above the 95th percentile); at risk of overweight (defined as BMI between 85th and 95th percentile); obesity (defined as above the 85th percentile).<br><br>BMI assessment was self reported (n=3) and reported as 'collected' (not further defined) (n=1).<br><br>Follow up ranged from 2 to 5 years (2 year follow up [n=1], 3 year follow up [n=1], 5 year follow up [n=2]). | and p value not reported (5 year follow up). This included middle and high school age students (no average age reported)<br>-<br>- 1 cohort (n=5,014) had an OR 1.28 (BMI ≥95th percentile), 95% CI and p value not reported (5 year follow up). Mean age 13.33 years.<br>1 cohort (n=14,431) had an OR of 0.99 (Obesity: >85th percentile, age- and gender-specific), 95% CI and p value not reported (2 year follow up). Included 9 to 14 year olds (average age not reported).<br><br>All cohort studies adjusted for at least some confounders. Among others, this included energy intake in 1 study (non-significant inverse direction of effect); physical activity in 2 studies; and SES or related factors (e.g. maternal education, household income) in 3 studies (including the study with significant results).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Shared family mealtimes may improve nutritional health of children and adolescents. The benefits of sharing 3 or more family mealtimes per week include a reduction in the odds for overweight (12%), eating unhealthy foods (20%) and disordered eating (35%) and an increase in the odds for | found no association (combined n=21,961, follow up range 2 to 5 years)<br><br>It is unclear if study populations were selected based on body weight status or for specific conditions or if they were representative of the general population.<br><br>Population: Unclear if study populations were selected based on weight-related outcomes or specific conditions.<br>Setting: Unclear |

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| | | eating healthy foods (24%). | |

Meal setting or distractions

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| **Robinson 2013**<br><br>**Quality:** +<br><br>**Search date:** Feb 2012<br><br>**Review design:**<br>Systematic review and meta-analysis of experimental studies.<br><br>**Review aim:**<br>To examine whether cognitive processes such as attention and memory influence the amount of food eaten either immediately or in subsequent meals.<br><br>**Review funding:**<br>British Heart Foundation, Cancer Research UK, Economic and Social Research Council, Medical Research Council and the Department of Health.<br><br>**Study funding:**<br>Funding sources were not reported.<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Neurologically intact adults.<br><br>**Total # studies (# relevant and n=):**<br>RCT:24, 19 publications (24, n=961)<br>Cohort:0<br>Other:0<br><br>**Intervention/exposure description:**<br>Effect of distraction on immediate intake: Distraction with radio or TV during mealtime, or increased attention on eating food through audio instructions or eating with people compared to eating alone.<br><br>Effects of distraction on later intake: Fixed amount of food eaten whilst being distracted with TV or cards compared to neither.<br><br>Effect of decreasing awareness of food being eaten on immediate intake:<br>Pistachio nut shells removed from desk every 2 hours or not over 2 days; lunch eaten in a dark restaurant area or a normally lit area; refilling a soup bowl compared to a normal bowl; buffet consumed with or without plates being removed.<br><br>Effect of enhancing memory on later intake: Instruction to write about lunch eaten earlier that day or the previous day compared to writing about anything before | **Result(s):**<br>Effect of distraction on immediate intake: Meta-analysis of 10 studies (n=911) found that distraction increased immediate intake (z=5.43; p<0.001; SMD:0.39; 95% CI 0.25 to 0.53).<br><br>Effects of distraction on later intake: Meta-analysis of 4 studies (n=192) found that distraction increased later intake (z=4.77; p<0.001; SMD: 0.76; 95% CI 0.45 to 1.07).<br><br>Effect of decreasing awareness of food being eaten on immediate intake:<br>Meta-analysis of four studies (n=203) found that decreasing awareness increased immediate intake (z=4.56; p<0.001; SMD: 0.63; 95% CI 0.25 to 1.02; random effects analysis carried out due to heterogeneity in fixed effects analysis).<br><br>Effect of increased attention on immediate intake:<br>Meta-analysis of two studies (n=136) found that increased attention did not influence immediate intake (z=0.51; p=0.61; SMD:-0.09; 95% CI -0.42 to 0.35).<br><br>Effect of enhancing memory on later intake: Meta-analysis of six studies (n=203) found that enhancing memory reduced later intake (z=2.81; p=0.005; SMD:-0.40; 95% CI, -0.12 to -0.68). | **Applicable to the UK: Unclear**<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: None<br>Unclear: D, P, Set<br><br>**Authors' limitations:**<br>Heterogeneity across studies and limited number of studies.<br><br>**Review team limitations:**<br>The studies were of small size and most of the participants were young female students. It is unclear how applicable these findings would be to the wider population. The control group were still in experimental conditions including eating lunch in a laboratory setting.<br><br>Unclear: Study design was described throughout as experimental sessions, but they all had control conditions and participants were randomly assigned.<br>Unclear: population included some studies where participants were excluded if their BMI was outside of the normal range and in some it was not reported. Health status not always clear.<br>Unclear: Setting was in Universities in 12 of the studies. |

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| | consuming a snack.<br><br>**Outcome(s):**<br>Amount of intake of the meal or snack being studied or the subsequent meal or snack. | **Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Reducing attention via distraction during eating may increase immediate intake and later intake. Enhancing memory for food consumed decreases later intake. Reducing awareness of food being consumed increases immediate food intake. | |

Snacking / snacks

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| **Larson and Story 2013**<br><br>**Quality:** +<br><br>**Search date:** Dec 2011<br><br>**Review design:**<br>Systematic review of studies that have examined associations of snacking behaviour with weight status in children (2-11 years) and adolescents (12-19 years). No studies were excluded based on study design.<br><br>**Review aim:**<br>The study aimed to review studies conducted in the US and internationally that have examined associations of snacking behaviour with weight status. The study also summarised US research that has addressed trends in snacking behaviour and its contribution to dietary intake, as well as research describing snack food availability in settings where youth spend their time.<br><br>**Review funding:**<br>The review was funded in part by the Robert Wood Johnson Foundation Healthy Eating Research Program.<br><br>**Study funding:**<br>Funding for the individual studies included in the review was not reported. | **Study participant inclusion criteria:**<br>Studies in children (2-11 years) and adolescents (12-19 years). No other population inclusion criteria were reported.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0 (0)<br>Cohort: 7 (7, n=28,958)<br>Other: 25<br><br>**Intervention/exposure description:**<br>Exposures analysed were a sweet and salty snack food pattern characterised by a high consumption of foods such as chocolate bars, cake, brownies, potato chips and nachos; a snacking pattern characterised by consumption of energy-dense foods and sugar-sweetened beverages between meals; a sedentary-snacking pattern characterised by much TV watching and high consumption of sweets and sugar, pastry and cookies, savoury snacks and sauce; usual daily servings of snacks and sugar sweetened beverages, energy per day from snacks, and percentage of daily energy contributed; usual daily servings of energy-dense snack items (baked goods, ice cream, chips, candy, and sugar sweetened soda) and percentage of daily energy contributed; eating between meals 1-2 times per week; and snacking while watching TV, snacking frequency and fat intake from energy-dense snack foods. Measured by food frequency questionnaire in | **Result(s):**<br>2/7 cohort studies found that snacking was associated with higher BMI in at least some groups of children. The other five cohort studies either found no evidence of a relationship between snacking behaviour and weight status or found evidence indicating that children who consumed food or beverages between meals were less likely to be obese.<br>One of the studies that found a positive association (n=2,002) found that adherence to the sedentary-snacking pattern at baseline was positively associated with BMI z-score and the likelihood that children were obese. The other study that found a positive association (n=173) found that among girls (only girls included in the study) from families in which one or both parents were overweight increases in BMI from age 5 to 9 were predicted by higher intakes of fat from energy-dense snacks.<br>Two studies found inverse associations in at least some groups of children. One study (n=14,977) found that among boys, consumption of reduced-fat snack food was associated with less weight gain, the other study (n=8,170) found that among boys snacking was inversely associated with becoming overweight between ages 3 and 6.<br><br>**Adverse Effects:**<br>Adverse effects were not reported. | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Snacking was defined differently in different studies. Multiple different criteria were used to define as snack occasion such as time of day, the types or amounts of food consumed, and subjective assessment of the participant. Diverse definitions were also used to define energy-dense snacks.<br>Studies included were all observational, and it is difficult to account for other dietary and lifestyle factors that may influence associations.<br>Few studies clearly addressed the potential for biased associations resulting from overweight youth reducing their kilocalorie intake for weight loss or underreporting intake more often than youth at a health weight.<br><br>**Review team limitations:**<br>Some of the snacking patterns assessed included aspects of non-snack related behaviours (mainly sedentary behaviour) and therefore their results may not reflect the effects of snacking alone. Exposures self-reported in four studies, reported by parents |

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| **Multifactor review:** | five studies (self-report in 3 studies, parental report in 2 studies), by dietary recall in one study (children and their mothers at the same time point) and by child report of eating between meals.<br><br>**Outcome(s):**<br>Height and weight, BMI, percentage body fat (self reported in two studies, parental report in one study, measured in four studies).<br>Where reported, follow-up ranged between 3 and 10 years. | **Conclusions:**<br>"The majority of studies either found no evidence of a relationship between snacking behaviour and weight status or found evidence indicating that young people who consumed more snacks were less likely to be obese." (Conclusions based on all studies included in the review- including case-control and cross-sectional studies). | in two studies and reported by both children and parents in one study.<br>Length of follow-up was unclear for some studies.<br><br>Study design: Studies were not excluded on the basis of design. Cross-sectional, case-control and cohort studies examining the association between snacking and weight status were included.<br>Population: Studies in children (2-11 years) and adolescents (12-19 years). No other population inclusion criteria were reported.<br>In the cohort studies, baseline weight status of participants was only reported in 1 study (participants were described as nonobese)<br>Setting: unclear/not explicitly reported. |
| **Mesas et al. 2012**<br><br>**Quality:** +<br><br>**Search date:** Dec 2010<br><br>**Review design:**<br>Systematic review of cross-sectional, cohort, case-control, experimental and laboratory studies<br><br>**Review aim:**<br>This study examined the association between selected eating behaviours and excess weight in the general population throughout a systematic review. | **Study participant inclusion criteria:**<br>Children and adults from the general population<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 8 (4, n=73,068/4, n=19,562 children)<br>Other: 36<br><br>**Intervention/exposure description:**<br>Children:<br>In cohort studies in children, the snack food exposures were snack food intake (yes/no); snacking frequency (zero to 4 times per day); snacking patterns- snacking between meals, snacks replace meals (possible | **Result(s):**<br>Children:<br>-1 study (n=14,977 ) in children aged 9 to 14 years found that snack food consumption (fried and salty food, sweets, or cakes) was not associated with annual change in BMI z score over 3 years compared with not snacking (ß -0.006, 95% CI -0.013 to 0.001).<br>-1 study (n=173 ) found snack frequency (0 to 4 times/day) in 5 years olds was not associated with change in BMI after 4 years of follow-up (figures NR; p>0.05). Unlike the other studies, this analysis was not adjusted for any confounders.<br>-1 study (n=196 girls in a school setting) found that daily frequency of snack food | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: P<br>Partial: D, Set<br>Unclear:<br><br>**Authors' limitations:**<br>The definition of snacking varied across studies.<br><br>**Review team limitations:**<br>1. The studies in adults were reported to have good adjustment for confounders, with two adjusting for energy intake. |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Review funding:**<br>FIS research grant, CIBERESP, the National Plan on Drug Addiction and 'Ramon y Cajal'<br><br>**Study funding:**<br>Funding sources were not reported<br><br>**Multifactor review:** Yes | categories of response were frequent, usually or often, not frequent, sometimes or rarely); and daily servings of snack foods (times per day). How these were measured was not reported.<br><br>Adults<br>In cohort studies in adults, the snack food exposures were snacking (yes/no) in two studies; snack consumption (kcal/day); and variety of snack intake (% difference from baseline). How these were measured was not reported.<br><br>**Outcome(s):**<br>Children:<br>Change in BMI, BMI z-scores, overweight/obesity based on BMI scores and percentage body fat (self-reported weight and height in two studies, measured in two studies). Follow-up was between 3 and 8 years, or until 4 years after menarche.<br><br>Adults<br>Body weight change (self- reported weight in two studies), waist circumference, BMI (measured in one study) and overweight based on BMI (measured in one study). Studies had between 4 and 9 years of follow-up. | intake among 8 to 12 year olds was not associated with BMI z score (figures NR; p=0.33) or with percentage of body fat (figures NR; p=0.49) over 4 years.<br>-1 The study (n=4,393) with inconsistent findings had mixed results in terms of direction of effect and significance for analyses of frequent snacking, or replacing meals by snacks in 16 year olds over 8 years' follow up. It found a consistent positive direction of effect for comparisons of frequent (usually or often) snacking versus not frequent snacking for the outcomes of overweight (defined as 25≤BMI<27 kg/m2 or 27≤BMI<30 kg/m2) and obesity (not defined) in boys and girls, these were almost all statistically significant (5/6 comparisons; ORs ranged from 1.3 [95% CI 0.9 to 1.8] to 3.0 [95% CI 1.7 to 5.5]). Effects became larger the more extreme the outcome (i.e. ORs were smallest for overweight 25≤BMI<27 kg/m2 and largest for obesity). Frequently replacing meals by snacks was not associated with overweight (25≤BMI<27 kg/m2; direction of effect inverse) or obesity (direction of effect positive), but was associated with overweight (27≤BMI<30 kg/m2) in boys (OR1.9, 95% CI 1.1 to 3.2) but not girls (direction of effect positive).<br><br>Adults<br>All four cohort studies found an association between snacking and excess weight. | Setting: The setting of the studies is described. Of the cohort studies for this factor, three were population based, one was in a public school, one was in pre-school children, one was in offspring of Nurses' Health Study, one was in Health Professionals and one was in University graduates. Although some of the settings were school as these were not school- or work-based interventions they have been described.<br>Two of the four cohort studies in children and all four cohort studies in adults were judged to have had good control of confounders.<br>How snacking was assessed was not reported.<br><br>D: included observational and experimental studies<br>Setting: The setting of the studies is described. Of the cohort studies for this factor, three were population based, one was in a public school, one was in pre-school children, one was in offspring of Nurses' Health Study, One was in Health Professionals and one was in University graduates.<br>[Although some of the settings were school/eqv as these were not school- or work-based interventions have described all of the cohort studies]. |

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| | | In one cohort study (n=10,162) usual snacking (eating between meals, not further defined) was associated with weight gain ≥3 kg/year (OR 1.66; 95% CI 1.17 to 2.35), gaining ≥5 kg/year (OR 2.75; 95% CI 1.17 to 6.50), and weight increasing ≥10% of baseline weight (OR 1.29; 95% CI 1.06 to 1.56) compared with not usual snacking over 4.6 years.<br>In one cohort study (n=19,478 men) snacking (eating between meals, not further defined) was associated with weight increase (kg) in men aged 45-54 years (β 0.25, p≤0.01) and 55-64 years (β 0.31, p≤0.01), but not in men aged ≥65 years (β -0.01, p>0.05) over 4 years. No other results were provided for this study, and it was unclear of the analyses by age were a priori analyses.<br>One study (n=42,696) found that snack consumption (snacks defined as specific foods, not further defined in review) was associated with 5-year change in waist circumference in men (β 0.09 cm per 60 kcal of snack foods consumption; 95% CI 0.05, 0.13) and in women (β 0.06; 95% CI 0.003, 0.11).<br>One study (n=732) found that increasing variety of snack intake (% difference from baseline, not further defined) over the follow-up was associated with becoming overweight (in this study defined as BMI 23kg/m2 or more) (OR 1.45; 95% CI 1.06 to 1.98). | |

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| | | These cohort studies were reported to have good control of confounders (all adjusted for gender, age, socioeconomic indicators, physical activity/sedentariness, and 2 studies also adjusted for energy intake or eating behaviours).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>"We failed to find clear evidence of an association between snacking and excess weight, especially in children and adolescents…In contrast, various longitudinal studies in adults with a good control of confounders have consistently observed a higher frequency of obesity in those who snack several times a day." (Conclusions based on all studies included in the review for snacking, which included cross-sectional and case-control studies in addition to cohort studies). | |
| **Summerbell et al. 2009**<br><br>**Quality:** ++<br><br>**Search date:** Dec 2007<br><br>**Review design:**<br>Systematic review of prospective cohort studies with a follow-up of more than 1 year<br><br>**Review aim:** | **Study participant inclusion criteria:**<br>To be included in the review, participants had to be at least 5 years or older. Body weight status inclusion criteria NR.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 4 (1, n=7,147 adults/unclear, but >1,092 children)<br>Other: 0 | **Result(s):**<br>Four prospective cohort studies were identified, 1 in adults (n=7,147) 3 in children (n=17,974).<br><br>Adults<br>One study (n=7,147) reported that regression analysis found no significant association between eating frequency at baseline and weight change in either men or women (men: regression coefficient 0.0211, 95% CI - | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: None<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Two of the four studies adjusted for PAL.<br><br>Methods of exposure assessment varied |

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| To assess the association between food, food groups, nutrition and physical activity and subsequent excess weight gain and obesity in humans<br><br>**Review funding:**<br>World Cancer Research Fund<br><br>**Study funding:** NR<br><br>**Multifactor review:** Yes | **Intervention/exposure description:**<br>assessed by summing number of eating occasions reported in 24hr recall interview. In children dietary assessment methods included the FFQ in one study, and was not reported in two studies.<br><br>**Outcome(s):**<br>Outcomes included: weight gain, BMI, BMI z-score<br><br>Weight and height were measured by the research team in the adults study and in 2 of the three children studies; weight and height were self-reported in the remaining study in children. | 0.2331 to 0.2653, p=0.863; women: regression coefficient 0.1101, 95% CI -0.0654 to 0.2847, p=0.215). This study looked at eating frequency as a whole,<br><br>Children<br>Three studies were identified that related to children (n=17,974).<br><br>One study (n=16,882) found that there was no association between consumption of snack foods and changes in BMI z-score in boys (regression coefficient -0.004, p=NR) but there was a weak inverse association in girls (regression coefficient -0.006, p<0.05); this association in girls was no longer significant once dieting status and maternal overweight status were controlled for.<br><br>One study (n=355) amongst children with a mean baseline age of 12.3 years found that the number of snacks per day at baseline was significantly associated with BMI at four year follow-up (regression coefficient 0.13, p<0.05). There was, however, no significant association between baseline snack frequency and four year change in BMI.<br><br>The third study (n=737) found that children who snacked at fixed times at age 3 were significantly more likely to be obese in adolescence compared to those with no fixed snacking pattern (OR 2.12, 95% CI 1.25 to 3.61) | across studies.<br><br>**Review team limitations:**<br>Study in adults ran between 1971 and 1984, unclear applicability to current UK dietary patterns.<br><br>OR in the third children's study is from the multi-variate model; covariates were not reported, however.<br><br>Weight status and eating/meal/snacking setting were not reported. |

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| | | **Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>There is no epidemiological evidence of a consistent association between snacking and subsequent excess weight gain or obesity. | |
| **USDA 2010m**<br><br>**Quality:** +<br><br>**Search date:** Dec 2009<br><br>**Review design:**<br>Systematic review of systematic reviews and meta-analyses, RCTs or clinical controlled studies, large non-randomized observational studies, cohort and case-control studies.<br><br>**Review aim:**<br>The review aimed to determine the relationship between snacking and body weight.<br><br>**Review funding:**<br>NR. Reviews written by the US Department of Agriculture to support development of their guidelines.<br><br>**Study funding:**<br>Funding for individual studies included in the review was not reported, however, the quality appraisal for the studies meeting our | **Study participant inclusion criteria:**<br>Healthy and those with elevated chronic disease risk; people with history of polyps adenomatous, adenoma or adenocarcinoma. Studies in diseased subjects, hospitalised patients, or malnourished or third world populations were excluded.<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 5 (5, n=16,634)<br>Other: 1 (0)<br><br>**Intervention/exposure description:**<br>Snacking: low-quality snacking (doughnuts, cakes or pastries, chips, candy (sweets) or chocolate bars); snacks and dessert servings per day; snack foods; snacking, energy-dense snacks (cookies/pastries, crackers/chips and sweets/confectionaries), and snacking whilst watching TV; and energy dense snack foods (baked goods including cookies, pies, cakes and brownies; ice cream; potato and corn chips; chocolate and sweets; and sugar sweetened soda). Exposures were measured using food frequency questionnaires (4 | **Result(s):**<br>Children<br>[There was overlap with the review described by Mesas et al. 2012 [++] (3/5 studies in common).]<br><br>2/5 cohort studies found a positive relationship between snacking and body weight in children. In both cases the exact analyses being reported in the review as significant was unclear, and in one case the analyses appeared to reflect the association between obesity and snacking over time rather than the opposite.<br><br>The individual results of the 2 studies finding a positive relationship are follows:<br>-In one cohort study (n=1,188) BMI was associated with changes in the frequency of low-quality snacking over time (-0.31 [0.14], T=-2.22; p<0.05), such that while snacking increased in the sample over time, low-quality snacking remained relatively stable in obese subjects. This assessment was essentially cross sectional, as snacking and BMI were assessed concurrently. | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: O<br>Partial: D, P<br>Unclear: Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>Review population inclusion criteria were a mix of healthy people (matching the scope of this review) and those with elevated chronic disease risk (not matching the scope).<br>Study design: Systematic review of systematic reviews and meta-analyses, RCTs or clinical controlled studies, large non-randomized observational studies, cohort and case-control studies. One case-control study included in addition to cohort studies.<br>Population: Review population inclusion criteria were healthy and those with elevated chronic disease risk. In one cohort study in adults the average BMI was 25kg/m2 |

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| scope reported that the sources of funding and investigators' affiliations were described and the studies were free from apparent conflicts of interest, apart from one cohort study in children which was not free from apparent conflict of interest.<br><br>**Multifactor review:** No | studies) and dietary recalls (1 study).<br><br>**Outcome(s):**<br>BMI and BMI z-scores. Height and weight were self-reported in two studies and measured in three studies. Follow up varied from 1 year to an average of 7.7 years. | The other cohort study (n=173 girls) found that girls who watched TV snacked more frequently ($p<0.05$) and girls who snacked more frequently had higher intake of fat from energy dense snacks ($p<0.05$), which was reported to predict their increase in BMI from age five to nine ($p<0.05$). It was unclear whether these analyses were cross sectional, and whether the latter result referred to the relationship between snacking as a whole, or just fat intake from snacks or just snacks eaten in front of the TV.<br><br>One additional study (n=14,977) found a weak inverse association between snacking and weight change in girls only (beta -0.007, $p<0.05$), but this was no longer significant after controlling for potential confounders (dieting status and maternal weight status). The other 2 studies found no relationship between snacking and deserts and change in BMI z score over 1 year (n=118, study in teenagers 1 year post-partum; figures NR), or between total energy dense snack consumption and BMI z-score (n=173 girls, figures NR).<br><br>[This review also assessed adults but was not prioritised for this age group as the studies included were also included in Mesas et al. 2012] | in women and 26kg/m2 in men. However, the review did not include studies on the use of snacking as a tool to lose weight in adults.<br>Setting: unclear |

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| | | **Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Limited and inconsistent evidence suggests that snacking is associated with increased body weight. (Conclusion based on all studies included in the review, which included studies in adults and one case-control study). | |

## Other factors

### Holiday weight gain

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| **Cook et al. 2012**<br><br>**Quality: +**<br><br>**Search date:** NA<br><br>**Review design:**<br>Prospective cohort<br><br>**Review aim:**<br>To assess whether holiday weight gain is associated with baseline BMI or total energy expenditure (TEE).<br><br>**Review funding:**<br>NA<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>n=443 men and women aged 40-69y who had participated in a previous cohort study (OPEN).<br><br>**Total # studies (# relevant and n=):**<br>NA<br><br>**Intervention/exposure description:**<br>Change in weight was assessed for the US winter holiday season (Thanksgiving to New Year's).<br><br>Baseline total energy expenditure (TEE) was assessed objectively via doubly labelled water, and estimated based on weight, height and age using Mifflin equations. PAEE (kcal/d) was calculated using these equations, and TEE.<br><br>**Outcome(s):**<br>Weight and height were objectively measured before and after the winter holiday season (mid-September to mid-October and mid-January to early-March) | **Result(s):**<br>Mean weight change over the study, kg (SD)<br>men: 0.9 kg (1.4), range -3.2 to 5.2kg<br>women: 0.6 kg (1.3), range -3.4 to 4.2kg)<br>$p<0.05$ for men vs. women<br><br>Mean weight change over the study, % (SD)<br>men: 1.0% (1.5%), range -4.0% to 5.4%<br>women: 0.9% (1.8%), range -4.6% to 5.8%)<br>$p<0.05$ for men vs. women.<br><br>Weight increase >=0.5kg, n (%)<br>men: 157 (65%)<br>women: 117 (58%)<br><br>Weight increase >=2.0kg, n (%)<br>men: 40 (17%)<br>women: 25 (12%)<br><br>There was no significant difference in incidence of excessive weight gain (>2kg) across BMI categories (healthy, overweight, obese) within sexes<br>Neither baseline TEE nor PAL were correlated with change in weight over the holiday season (TEE: $r2<0.01$, p=NS; PAL: $r2<0.01$, p=NS).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:** | **Applicable to the UK:** No<br><br>**Alignment to NICE review scope:**<br>Complete: NA<br>Partial: NA<br>Unclear: NA<br><br>**Authors' limitations:**<br>Participants were primarily white, educated, older individuals and may not be representative of the general US population.<br><br>The analysis assumes that baseline PAL and TEE are representative of year round activity and energy expenditure, and are thus maintained during the holiday period.<br><br>PAL was calculated based on previously published equations, and not measured directly for the study.<br><br>**Review team limitations:**<br>Secondary analysis of existing data from a larger cohort study.<br><br>As a US based study, results are unlikely to be directly relevant to a UK population, given the extended holiday period due to the inclusion of Thanksgiving.<br><br>Study did not assess energy intake, and was thus unable to either adjust for it or assess |

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| | | Evidence does not suggest that baseline physical activity level or total energy expenditure (after adjusting for weight, height and sex) are protective against weight gain during the Thanksgiving to New Year's period.<br><br>Author's posit that winder holiday weight gain may be attributed to excess food consumption above weight maintenance requirements. | its impact on energy balance and weight gain.<br><br>NA |
| **Moreno et al. 2013**<br><br>**Quality:** +<br><br>**Search date:** NA<br><br>**Review design:**<br>Prospective cohort<br><br>**Review aim:**<br>To assess the impact of the school and summer environment on children's weight.<br><br>**Review funding:**<br>NA<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>n=3,588 children (mean baseline age 5.7 (SD 0.3) enrolled in the 2005 kindergarten class in a Southeast Texas school district (n=41 schools)<br><br>**Total # studies (# relevant and n=):**<br>NA<br><br>**Intervention/exposure description:**<br>Time of year was divided between school year and summer months; differences in weight change between these two seasons were compared to determine the relative impact of summer vs. school year on weight gain in children.<br><br>**Outcome(s):**<br>Height and weight were objectively measured in the autumn and spring of each school year.<br><br>Weight status was categorised as: | **Result(s):**<br>Over the five year follow-up period, change in BMI percentile was calculated for the summer months and the school year.<br><br>The generalized linear model identified a main effect of time, with a significant difference between zBMI during the school year and summer months (-0.52, 95% CI -0.59 to -0.45, p<0.001).<br><br>Across all participants, there was a reduction in BMI percentile, and an increase during the summer months.<br>Mean five-year change in BMI percentile, mean (SD)<br>School terms: -1.5 (25.1)<br>Summer months: 5.2 (27.1)<br><br>When assessed by baseline weight category, variation in BMI percentile changes were observed.<br>From the school term to summer months, | **Applicable to the UK:** Partial<br><br>**Alignment to NICE review scope:**<br>Complete: NA<br>Partial: NA<br>Unclear: NA<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>No information provided on sample size or power calculations.<br><br>No information provided on study attrition/% follow-up.<br><br>Clustering in schools was accounted for in generalized linear models.<br><br>NA |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | Underweight (<5th BMI percentile)<br>Normal weight (>=5th <85th BMI percentile; n=2,520)<br>Overweight (>+85th <95th BMI percentile; n=542)<br>Obese (>=95th BMI percentile; n=526) | overweight and obese children experienced significantly greater changes in zBMI compared to normal weight children, however, there was no significant differences between overweight and obese children.<br>Post hoc analysis revealed that overweight and obese children significantly decreased zBMI during the school year and increased during summer months, while normal weight children increased zBMI during both terms, although more so during the summer ($p<0.001$ for all weight categories).<br>Mean five-year change in BMI percentile, mean (SD) during school term:<br>Normal weight 0.4 (28.2)<br>Overweight -7.9 (18.0)<br>Obese -3.7 (9.6)<br><br>Mean five-year change in BMI percentile, mean (SD) during summer months:<br>Normal weight 6.2 (30.8)<br>Overweight 4.2 (18.9)<br>Obese 1.8 (8.2)<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Elementary school children have a significant increase in the rate of weight change during the summer holidays compared to the school year. The impact holiday:term time varied across baseline weight categories, with | |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | overweight and obese children experiencing an increase in zBMI during the summer months, but a reduction during the school year; normal weight students increased zBMI during both time periods, but experienced a more rapid change during the summer months. | |
| **Wagner et al. 2012**<br><br>**Quality:** -<br><br>**Search date:** NA<br><br>**Review design:**<br>Longitudinal observational study<br><br>**Review aim:**<br>To quantify body composition changes from Thanksgiving to New Year's, and to assess the correlation between dietary or exercise factors and body composition changes during this period.<br><br>**Review funding:**<br>NA<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>n=37 adults aged 23 to 61 years in northern Utah<br><br>**Total # studies (# relevant and n=):**<br>NA<br><br>**Intervention/exposure description:**<br>Measurements were taken on the Monday or Tuesday before Thanksgiving and again on the Monday or Tuesday following New Years Day.<br><br>Physical activity and dietary habits were assessed before and after the holiday period with a brief questionnaire (assessed fruit, vegetable, alcohol intake and days per week engaged in exercise; the period covered by the questionnaire [e.g. diet and exercise during the previous 30 days] was not reported)<br><br>**Outcome(s):**<br>Height, weight, WC, % body fat were objectively measured by researchers. | **Result(s):**<br>Over the six week study period, body composition changes included:<br><br>Weight, mean (SD)<br>pre-holiday: 74.0kg (17.8)<br>post-holiday: 73.9kg (18.1)<br>p=0.876<br><br>BMI, mean (SD)<br>pre-holiday: 25.3kg/m2 (5.3)<br>post-holiday: 25.3kg/m2 (5.4)<br>p=0.857<br><br>Percentage body fat, mean (SD)<br>pre-holiday: 25.4% (9.0)<br>post-holiday: 25.4% (8.9)<br>p=0.974<br><br>WC, mean (SD)<br>pre-holiday: 82.0cm (12.6)<br>post-holiday: 82.9cm (12.5)<br>p=0.013<br><br>There were no significant differences in change in the various body composition measures between normal weight (n=22) and | **Applicable to the UK:** No<br><br>**Alignment to NICE review scope:**<br>Complete: NA<br>Partial: NA<br>Unclear: NA<br><br>**Authors' limitations:**<br>Study may not have been sufficiently powered to deted changes in body weight.<br><br>The small but statistically significant observed increase in WC may have arisen due to measurement error, as WC is more prone to higher measurement variability than other measures of body composition.<br><br>Sample may not be representative of the general population in dietary habits (The majority of participants were white, well educated females with a healthy BMI [<25kg/m2]; 10% reported drinking alochol, vs. 64% of the general US population).<br><br>**Review team limitations:**<br>Small sample size (n=37). |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
|---|---|---|---|
| | | overweight individuals (n=12), nor between men (n=13) and women (n=21).<br><br>Over the six week study period, diet and PA changes included:<br><br>vegetable intake, mean (SD)<br>pre-holiday: 8.6 cups/week (8.3)<br>post-holiday: 6.1 cups/week (4.0)<br>p=0.034<br><br>Soda intake, mean (SD)<br>pre-holiday: 1.5 cans/week (2.2)<br>post-holiday: 2.2 cans/week (2.6)<br>p=0.028<br><br>"Splurging" (number of days overeating), mean (SD)<br>pre-holiday: 1.6 days/week (1.9)<br>post-holiday: 2.5 days/week (2.1)<br>p=0.019<br><br>Social events (not further defined), mean (SD)<br>pre-holiday: 1.6 days/week (1.5)<br>post-holiday: 2.6 days/week (1.7)<br>p=0.044<br><br>Exercise, mean (SD)<br>pre-holiday: 3.7 days/week (2.0)<br>post-holiday: 2.6 days/week (2.3)<br>p=0.001<br><br>Only the number of days overeating was | Effect sizes were provided for variables that varied significantly over the six week study period, however no information was provided on the analyses or statistic used to evaluate effect size.<br><br>NA |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | reported to be significantly correlated with body composition changes:<br>Weight: r=0.8, p=0.004)<br>BMI: r=0.50, p=0.003)<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Despite changes in dietary and exercise habits during the six week holiday period, no significant changes in most measures of body composition were observed. | |
| **Yanovski et al. 2000**<br><br>**Quality:** +<br><br>**Search date:** NA<br><br>**Review design:**<br>Prospective observational study<br><br>**Review aim:**<br>To estimate holiday weight gain in adults.<br><br>**Review funding:**<br>NA<br><br>**Study funding:**<br>National Institute of Child Health and Human Development, Office of Research on Minority Health<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Adults in good general health (n=200)<br><br>**Total # studies (# relevant and n=):**<br>NA<br><br>**Intervention/exposure description:**<br>The study period was split into three 6 to 8 week periods:<br><br>Pre-holiday (late September/early October to mid-November [before Thanksgiving])<br>Holiday (late November to early/mid January [Thanksgiving to New Years])<br>Post-holiday (mid/late January to late February/early March)<br><br>A follow-up assessment the following late September/early October was conducted to assess the long term impact of any holiday weight gain. | **Result(s):**<br>ANOVA revealed a significant increase in weight during the entire study period (p=0.01).<br>Change in weight varied according to time period, mean change (SD):<br>pre-holiday 0.18 kg (1.49), p=0.09<br>holiday period 0.37 kg (SD 1.52), p<0.001)<br>post-holiday -0.07 kg (1.14), p=0.36)<br><br>The weight change during the holiday period was not significantly different from that seen during the pre-holiday months (p=0.23), but was significantly greater than that seen during the post-holiday period (p=0.002).<br><br>Over the entire time period (September/early October to February/March) participants had an significant mean weight gain of 0.48kg (SD 2.22); p=0.003. | **Applicable to the UK:** No<br><br>**Alignment to NICE review scope:**<br>Complete: NA<br>Partial: NA<br>Unclear: NA<br><br>**Authors' limitations:**<br><br>**Review team limitations:**<br>Convenience sample; majority of participants were employees of the US National Institutes of Health.<br><br>Study retention for the primary analysis was good (98%); 85% of subjects participated in longer term follow-up.<br><br>NA |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | **Outcome(s):**<br>Weight was objectively measured on four occasions (beginning of the pre-holiday period; between pre-holiday and holiday periods; between holiday and post-holiday period; at end of post-holiday period). | When assessing the frequency distribution of weight change, the majority of subjects did not experience a large change in weight (>50% of measurements were within 1kg (+/-)of the previous measurement.<br><br>Baseline BMI was not significantly correlated with amount of weight change during the holiday period (r2=0.006). When assessed by categorical weight status, however, there was a trend of greater likelihood of weight gain of 2.3kg or more with increasing weight status (not overweight, overweight or obese). This correlates to a weight gain of 3% or more based on the average baseline weight across participants.<br><br>Correlation with other self-reported factors were assessed (changes in level of perceived stress, hunger or activity; changes in smoking habits, presence of seasonal affective disorder, number of parties or receptions attended). From these analyses, two were found to be significantly correlated to holiday weight gain:<br><br>Change in activity was significantly inversely associated with weight (p=0.01); change in hunger was significantly positively associated with weight (p<0.001).<br><br>Overall, 165 participants returned for weight assessment the following | |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | September/October; there was no significant change in weight between the end of the post-holiday period and approximately seven months later (mean (SD) weight change 0.21kg (SD 2.3), p=0.13), indicating that weight gained during the holiday season may not be reversed during the rest of the year.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Average holiday weight gain is lower than previous reported, however, as the average gain of 0.48 kg is not reversed during the course of the rest of the year, it likely contributes to the increase in body mass that is commonly observed throughout adulthood. | |

Monitoring

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Bravata et al. 2007**<br><br>**Quality:** +<br><br>**Search date:** NR<br><br>**Review design:**<br>Systematic review of RCTs and observational studies<br><br>**Review aim:**<br>To evaluate the association of pedometer use with physical activity and health outcomes among outpatient adults.<br><br>**Review funding:**<br>National Institute on Ageing, NSF<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>NR<br><br>**Total # studies (# relevant and n=):**<br>RCT: 8 (unclear)<br>Cohort: 18 (unclear)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Across the RCTs, interventions included provision of a pedometer (participants were encouraged to view and record daily step counts).<br><br>Four studies did not incorporate a step goal, eight included a goal of 10,000 steps/day, and 17 included a step goal other than 10,000/day (range 2,000 up to 8,800) or other physical activity goal.<br><br>Intervention duration ranged from 3 to 104 weeks.<br><br>**Outcome(s):**<br>BMI was the only weight related outcome reported; assessment methods NR. | **Result(s):**<br>BMI was assessed in 18 studies (n=562). It is not clear which studies were included in the analysis (study design and participant characteristics unclear).<br><br>Regression analysis suggests that across the studies, BMI significantly decrease from baseline (mean change -0.38 kg/m2, 95% CI -0.05 to -0.72, p=0.03). The decrease was associated with older age (p=0.001), white ethnicity (n=0.009), having a step goal (n=0.04) and longer intervention duration (p=0.07 for trend). Decrease in BMI was not associated with baseline steps/day, changes in steps/day, sex, diet counselling or baseline BMI.<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Use of pedometers may be associated with clinical relevant reductions in weight.<br><br>Authors note that while pedometer users had significant reductions to BMI, the weight loss was not a function of increased daily steps, suggesting that intervention participant increased PA that was not captured by the pedometer, or decreased energy intake. | **Applicable to the UK:** Unclear<br><br>**Alignment to NICE review scope:**<br>Complete: D, Set<br>Partial: P<br>Unclear: None<br><br>**Authors' limitations:**<br>Dietary intake was not assessed by the majority of studies, making it impossible to account for the potential confounder of reduced energy intake on weight loss in analyses.<br><br>Studies were generally small, with short follow-up and heterogenous design. Few provided detailed information on participants.<br><br>Due to the use of mulitple behaviour change techniques (monitoring through pedometers and diaries; support in the form of counselling; and goal setting) it is not possible to determine the individual contribution of these components on PA or BMI.<br><br>**Review team limitations:**<br>All RCTs were small (RCT size range 21 to 62 participants).<br><br>The majority of participants across studies were female (85%). |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | | Due to the relatively short duration of the included studies, it is not known whether monitoring through the use of pedometers has long term weight maintenance benefits.<br><br>The mean BMI of participants in the 18 studies with weight related outcomes was approximately 30 kg/m2 (the commonly used cutoff for obesity in adults). It is not possible to determine the whether pedometers are associated with weight maintenance and obesity prevention in healthy weight individuals based on the reviews presentation of the results.<br><br>Eleven studies enrolled participants based on overweight/obesity status, or health status (diabetes, coronary artery disease, hypertension, arthritis). |

Sleep

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Chen et al. 2008**<br><br>**Quality:** +<br><br>**Search date:** May 2007<br><br>**Review design:**<br>Systematic review of RCTs, cohort, cross-sectional and case control studies.<br><br>**Review aim:**<br>To quantitatively evaluate the relationship between sleep duration and childhood obesity.<br><br>**Review funding:**<br>U.S. National Institute of Diabetes and Digestive and Kidney Diseases, USDA, Johns Hopkins Bloomberg School of Public Health.<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Children aged 0 to 18 years<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 3 (3, n=10,189)<br>Other: 14 (cross-sectional and case control)<br><br>**Intervention/exposure description:**<br>Across the studies, sleep duration was the exposure; the majority of studies used self-report measures to assess sleep duration, one study used wrist actigraphy, and another used both self-report and time-diary for assessment.<br><br>For the main meta-analyses, the review compared 'shorter', 'much shorter' and 'shortest' sleep duration to recommended duration.<br>The following age specific durations were used for each category:<br><br>'Shorter'<br><5y: 10-11hr<br>5-10y: 9-10hr<br>>10y: 8-9hr<br><br>'Much shorter'<br><5y: 9-10hr<br>5-10y: 8-9hr<br>>10y: 7-8hr | **Result(s):**<br>All 17 studies reported a significant association between shorter sleep duration and obesity in at least one comparison or sex.<br><br>For the main meta-analyses, the review compared 'shorter' (≤1 hour less than recommended duration), 'much shorter' (1-2 hours less than recommended) and 'shortest' (>2 hours less) sleep duration to recommended age-specific sleep durations.<br><br>Meta-analysis of 11 studies (2 cohort, 9 cross sectional, n=128,604) found that across the assessed ages (0 to 18 years) 'shorter' sleep duration was associated with a 43% increased odds of overweight or obesity compared to age-specific recommended hours of sleep (pooled OR 1.43, 95% CI 1.07 to 1.91).<br><br>Subgroup analysis for shorter vs. recommended by sex revealed a significant relationship in boys (OR 2.57, 95% CI 1.19 to 5.57) but not girls (OR 1.33, 95% CI 0.83 to 2.12).<br><br>Subgroup analysis for shorter vs. recommended by age revealed a significant relationship in those aged under 10y (OR 1.38, 95% CI 1.00 to 1.90) and those aged 10y or more (OR 1.57, 95% CI 1.25 to 1.97). | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D<br>Unclear: P, Set<br><br>**Authors' limitations:**<br>Potential selection bias, failure to adjust for some potential confounders.<br><br>Differences in study populations, assessment of exposure and covariates and classification of outcomes may result in heterogeneity and affect pooled estimates.<br><br>Analysis is mainly based on cross-sectional studies, and cannot establish causality.<br><br>Bias from individual studies assessed as small, and unlikely to influence results.<br><br>Likely measurement errors based on self-report/survey assessment of sleep duration. Validity of self- or proxy-reported sleep duration needs to be investigated.<br><br>Most assessed studies did not included mental health status as potential confounder; depression is well know to affect sleep.<br><br>**Review team limitations:** |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | 'Shortest'<br><5y: <9hr<br>5-10y: <8hr<br>>10y: <7hr<br><br>Reference/Recommended<br><5y: >=11hr<br>5-10y: >=10hr<br>>10y:- >=9hr<br><br>**Outcome(s):**<br>All studies included measurement of BMI, which was used to categorize overweight and obesity status. Definition/cutoff varied across assessed studies; the majority of included studies used the age- and sex-specific BMI cutoff points recommended by the International Obesity Task Force; some studies used the 2000 CDC Growth Chart 85th and 95th percentile to define overweight and obesity.<br><br>BMI assessment methods across studies NR. | Meta-analysis of 8 studies (2 cohort, 6 cross-sectional, n=40,164) found that across the assessed ages 'much shorter' sleep duration was associated with a 60% increased odds of overweight or obesity compared to age-specific recommended sleep duration (pooled OR 1.60, 95% CI 1.22 to 2.10).<br><br>Subgroup analysis for much shorter vs. recommended by sex revealed a stronger relationship in boys (OR 2.13, 95% CI 1.58 to 2.87) than girls (OR 1.30, 95% CI 1.00 to 1.69) (p<0.05 between sexes).<br>Subgroup analysis for much shorter vs. recommended by age revealed a significant relationship in those aged under 10y (OR 1.61, 95% CI 1.18 to 2.19) and those aged 10y or more (OR 1.47, 95% CI 1.14 to 1.89).<br><br>Meta-analysis of 5 studies (all cross-sectional, n=25,614) found that across the assessed ages 'shortest' sleep duration was associated with a 92% increased odds of overweight obesity compared to age-specific recommended sleep duration (pooled OR 1.92, 95% CI 1.15 to 3.20).<br><br>Subgroup analysis for shortest vs. recommended by sex revealed a significant relationship in boys (OR 3.28, 95% CI 2.31 to 4.46) but not girls (OR 1.19, 95% CI 0.91 to 1.555) (p<0.05 between sexes).<br>Subgroup analysis for shortest vs. | Based on the large number of cross-sectional studies in the analysis, it is not possible to determine whether short sleep duration preceded weight status; possible that overweight/obese children and adolescents sleep for shorter durations for reasons associated with weight status (e.g. sleep apnoea).<br><br>Study design: 14/17 were cross sectional or case control designs<br>Population: unclear health/weight status of included participants<br>Setting: unclear |

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| | | recommended by age revealed a significant relationship in those aged under 10y (OR 2.09, 95% CI 1.49 to 2.92) but not those aged 10y or more (OR 1.77, 95% CI 0.74 to 4.25). Meta-regression found that for each 1h increase in sleep duration, there was a 9% reduction in odds of overweight/obesity (pooled OR 0.91, 95% CI 0.84 to 1.00, p=0.044).<br><br>Analysis by gender<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Meta-analysis demonstrates a clear association between short sleep duration and increased obesity risk in children.<br><br>The pooled effects are supported by results from the three included prospective cohort studies that show a clear and consistent relationship between early life short sleep duration and obesity later in childhood. | |
| **Magee and Hale 2012**<br><br>**Quality:** +<br><br>**Search date:** Oct 2010<br><br>**Review design:**<br>Systematic review of longitudinal observational studies | **Study participant inclusion criteria:**<br>None reported<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 20 (11, n=120,690 adults/ 7, n=10,959 children)<br>Other: 0 | **Result(s):**<br>Adults<br>13 studies were identified in adult populations; baseline age ranged from 18 to 81 years and follow-up ranged from 6 months to 16 years.<br><br>Four studies (n=69,123 in women only studies, n=3,803 men only studies, n=496 in | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P<br>Unclear: Set<br><br>**Authors' limitations:**<br>Three main limitations were identified: |

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| **Review aim:**<br>To assess the relationship between sleep duration and subsequent weight gain in adults and children.<br><br>**Review funding:**<br>US National Institute of Child Health and Human Development and National Institute of Aging.<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Intervention/exposure description:**<br>Adults<br>12 of the 13 studies used self-reported sleep duration; one study used actigraphy to assess exposure.<br><br>Short sleep duration definition varied between <=5 hrs. up to 6 hours; long sleep duration definition varied from 8 to >10 hrs.; comparator durations ranged from 7-8hrs.<br><br>Children<br>Studies consistently reported results for short sleep duration, but did not consistently define hours/day in the category. All seven studies relied on parental report to assess sleep duration.<br><br>**Outcome(s):**<br>Adults<br><br>The majority of studies used objective measures of height and weight; five studies used self-report height and weight, and one used objectively measured height and self-reported weight.<br><br>Children<br>Outcomes included overweight, obesity and BMI. Height and weight were self (parent) reported for all studies. | mixed sex studies) reported a significant relationship between short sleep duration and several weight related outcomes, but not between long sleep duration and these outcomes. The individual studies found that short sleep duration was associated with (across studies):<br>-Odds of obesity varied depending on age of exposure: age 27 OR 8.2 (95% CI 1.9 to 36.3), p<0.01; age 29 OR 4.6 (95% CI 1.13 to 16.5), p<0.05; age 34 OR 3.5 (95% CI 1.0 to 12.2), p<0.05 (outcome age NR)<br>-Increased BMI over 4 years: ß=0.015 kg/m2, 95% CI 0.03 to 0.27<br>-Weight gain over 16 years: sleep duration ≤5 hours 0.78 kg (95% CI 0.13 to 1.44) greater weight gain compared to ≥7 hours (RR of 15 kg weight gain 1.28 , 95% CI 1.15 to 1.42); sleep duration 6 hours. vs. ≥7 hours RR of 15 kg weight gain 1.10 (1.04 to 1.17)<br>-Likelihood of retaining 5 kg at 1 year postpartum: OR 3.13 (95% CI 1.42 to 6.94), p=0.02<br><br>Four studies (n=39,470) identified a significant U-shaped relationship between sleep and weight related outcomes (both short and long sleep duration were significantly associated with weight). Short sleep duration associated with:<br>Increased weight: 1.84kg (95% CI 1.13 to 2.62) greater weight gain, and 35% greater likelihood of a 5kg weight gain; >=5kg weight gain in females (NS in males): OR 3.41, 95% | 1) diminishing association between short sleep duration and weight over time since transitioning to a short duration sleep pattern - there appear to be age related changes in the association between sleep duration and weight. The reasons underlying these differences are not clear.<br><br>2) studies adjusted for a wide range of potential confounders. Inclusion of appropriate confounding variables (e.g. sleep related problems, media use, and behavioural confounders) may influence the strength and significance of associations.<br><br>3) measurement of exposure and outcome variables - only one study used an objective measure for the exposure; self-reported sleep may be biased towards over reporting. Only studies using objectively measured outcomes reported a U-shaped relationship between sleep and weight in adults.<br><br>**Review team limitations:**<br>Short sleep duration definition not consistently identified in children.<br><br>Population: one study (n=940) included mothers 6 months post-partum in a weight loss study; one study recruited postmenopausal overweight women only; |

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| | | CI 1.34 to 8.69.<br>Increased BMI: in people aged less than 40y, but not in those over 40y (data and comparator hours NR; p<0.001); In men: <5hr beta 0.016, 95% CI 0.024 to 0.146, p<0.01; 5-6hr beta 0.013, 95% CI 0.001 to 0.061, p<0.04 (no significant relationship in females).<br><br>Long sleep duration associated with:<br>Increased weight: 1.49kg (95% CI 0.92 to 2.48) greater weight gain, and 25% greater likelihood of a 5kg weight gain; >=5kg weight gain in females (NS in males): 8hr OR : 3.03, 95% CI 1.29 to 7.12; 9hr OR 3.77, 95% CI 1.55 to 9.17.<br>Increased BMI: in people aged less than 40y, but not in those over 40y (data and comparator hours NR; p<0.001); in males >=9hr beta 0.018, 95% CI 0.079 to 0.340, p<0.01 (no significant relationship in females).<br><br>Five studies (n=173 in women only studies, n=10,289 in mixed sex studies) found no significant relationship between sleep duration and weight related outcomes. The direction of the non-significant effect in these studies ranged from small inverse relationships in 3 studies to small positive relationship in 1 study (direction of effect NR for one study). This group of studies included the only study using actigraphy measurement of sleep duration (beta coefficient for | |

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| | | relationship between sleep and 5 year change in BMI: -0.02, 95% CI -0.30 to 0.025), and also included the two studies in overweight or obese populations.<br><br>Children<br>Seven studies (n=10,959) were identified in children, with mean baseline age ranging from 0 to 12 years, and follow-up ranging from 3 to 27 years. All seven studies reported a significant inverse association between sleep duration and weight related outcomes:<br>Overweight: sleep at age 3-4 was associated with overweight risk at age 9.5 (p<0.01, other data NR); longer sleep duration at age 9 associated with reduced odds of overweight at age 12 (OR 0.60, 95% CI 0.36 to 0.99, p<0.05);<br>Obesity: sleep at age 5 was associated with reduced obesity odds at age 32 (OR 0.65, 95% CI 0.43 to 0.97, p=0.034); <10.5h sleep at age 3 associated with higher odds of obesity at age 7 (OR 1.45, 95% CI 1.10 to 1.89, p<0.01); <10h sleep consistently between ages 0-2.5 years associated with increased odds of both overweight/obesity at age 6 (OR 4.2, 95% CI 1.6 to 11.1; comparator NR).<br>BMI: <12hr sleep at age 0 associated with increased odds of overweight at age 3 (OR 2.04, 95% CI 1.07 to 3.91)<br>BMI z score: <12h sleep at age 0 associated with significantly higher BMI z-score at age 3 | |

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| | | (beta 0.16, 95% CI 0.01 to 0.29)<br><br>One study found that the association was significant among younger children (age 3 to 7.9 each additional hour of sleep associated with reduced probability of overweight (beta -0.061, p<0.01) after 5 years, but not among older children (results NR; age 8-12.9 at baseline).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Shorter sleep duration is consistently associated with weight gain in children. Inconsistent associations between sleep duration and weight gain were seen in adults. | |

Stress

| Review Overview | Included studies, Intervention/Exposure and Outcomes | Main results and conclusions | Applicability and limitations |
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| **Wardle et al. 2011**<br><br>**Quality:** ++<br><br>**Search date:** Jan 2009<br><br>**Review design:**<br>Systematic review and meta-analysis of prospective cohort studies<br><br>**Review aim:**<br>To examine the relationship between psychosocial stress and adiposity.<br><br>**Review funding:**<br>Kanae Foundation for the Promotion of Medical Science, the National Prevention Research Initiative, British Heart Foundation, Cancer Research UK<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>Adults (>=16 yrs.) not suffering from severe illness<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Cohort: 14 (13, n=22,571)<br>Other: 0<br><br>**Intervention/exposure description:**<br>Psychosocial stress exposures included: perceived stress; job demand-control-support; effort-reward imbalance; childhood adversity; job stress; job dissatisfaction; caregiver stress' negative life change; daily hassles' life events; and financial security concerns. Exposure assessment methods were widely unreported.<br><br>**Outcome(s):**<br>Outcomes included BMI, WC, and WHR, all of which were assessed during a clinical exam. | **Result(s):**<br>Fourteen studies were identified, which included 32 comparisons. Participant age ranged from 7 to 70 years (only one study in children), and follow-up ranged from 1 to 28 years.<br><br>Eight comparisons (25%) reported significant positive associations between psychosocial stress and weight related outcomes. Two comparisons (6.3%) reported significant inverse associations between stress and weight outcomes and 22 comparisons (68.8%) reported no association between the variables.<br><br>Overall meta-analysis of the 32 comparisons reveal a small significant association between all measures of psychosocial stress and all weight outcomes (r=0.014, 95% CI 0.002 to 0.025, p=0.023, no significant heterogeneity found). When assessed as an aggregate effect across the 14 studies, the association was no longer significant (r=0.011, 95% CI -0.007 to 0.029, p=0.22, no significant heterogeneity).<br><br>Subgroup analysis by duration of follow-up revealed no significant association among studies with less than 5 year follow-up (r=0.008, 95% CI -0.023 to 0.039, p=0.60). Those with longer term follow-up did have significant correlations (r=0.016, 95% CI | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: D<br>Partial: P, Set<br>Unclear: None<br><br>**Authors' limitations:**<br>Given the variability in correlation across the studies, there is likely to be moderating variables that have yet to be elucidated.<br><br>**Review team limitations:**<br>Review assessed the association between stress and adiposity, but not between stress alleviating behaviours and adiposity.<br><br>Work stress was included as an exposure; one study enrolled only individuals with diabetes mellitus. |

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| | | 0.004 to 0.028, p=0.009, no significant heterogeneity).<br><br>In the 20 comparisons that controlled for potential confounders (age, sex, smoking, SES) no significant correlation was seen (r=0.013, 95% CI -0.000 to 0.026, p=0.056).<br><br>Subgroup analysis by sex revealed significant associations in men (r=0.024, 95% CI 0.006 to 0.042, p=0.010) but not women (r=0.017, 95% CI -0.008 to 0.042, p=0.17).<br><br>When outcomes were analysed separately, only WC was significantly correlated with stress (r=0.025, 95% CI 0.001 to 0.048, p=0.044).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Psychosocial stress is a risk factor for weight gain, however, effects are very small. | |

Support

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| **Cunningham et al. 2012**<br><br>**Quality:** +<br><br>**Search date:** Feb 2012<br><br>**Review design:**<br>Systematic review of any study type.<br><br>**Review aim:**<br>To critically analyze available data regarding whether and how body weight can be affected by close social contacts, especially friends.<br><br>**Review funding:**<br>NIH<br><br>**Study funding:**<br>NR<br><br>**Multifactor review:** No | **Study participant inclusion criteria:**<br>NR<br><br>**Total # studies (# relevant and n=):**<br>RCT: 0<br>Longitudinal: 8 (1, n=790)<br>Other: 8 (cross sectional or not specified)<br><br>**Intervention/exposure description:**<br>Exposures from the five studies on friends' communication regarding weight included: number of friends who pressure to diet (none, some, half, most/all); friends discourage unhealthy eating; friends encourage unhealthy eating; friends discourage PA; friends encourage PA; friends are preoccupied with weight and dieting; friends give anti-dieting advice; conversations about appearances with friends; friends tease about weight. These exposures were assessed via self-report.<br><br>**Outcome(s):**<br>Outcomes from the five studies on friends' communication regarding weight included: overweight or risk of overweight; BMI; weight change over two years; change in % overweight over 10 years. Outcome assessment methods were not reported. | **Result(s):**<br>Five studies assessed the impact of friends' communication about weight behaviours on weight related outcomes.<br><br>Two of these studies were longitudinal designs (unclear if they were prospective cohort studies) and the other three were cross sectional or the design was not specified. One of the longitudinal studies was specifically in children enrolled in weight loss programmes, and is outside the scope of the current review.<br><br>Overall, the studies found significant but modest associations between communication with friends on weight and weight related behaviours and BMI.<br><br>One longitudinal study (n=790) among women aged 18 to 23 assessed the association of friends encouraging healthy eating, and either encouraging or discouraging PA with BMI and 2-year weight change.<br>Friends encouraging unhealthy eating or discouraging PA was not significantly associated with BMI (data NR).<br>Friends encouraging unhealthy eating or PA was not significantly associated with 2-year weight change (data NR).<br>Friends discouraging PA was significantly associated with 2-year weight change | **Applicable to the UK:** Yes<br><br>**Alignment to NICE review scope:**<br>Complete: None<br>Partial: D, P<br>Unclear: Set<br><br>**Authors' limitations:**<br>NR<br><br>**Review team limitations:**<br>Friends' communication about weight was one of three categories of exposure assessed (but the one most directly related to support). Weight/BMI within friend groups was found to be significantly correlated.<br><br>The majority of studies were cross-sectional and involved adolescents. However, the only relevant primary study was amongst young adult women.<br><br>Populations included individuals enrolled in weight loss programmes; some population weight characteristics were not reported.<br>Study designs include longitudinal, cross-sectional and intervention studies.<br>The setting and population selection criteria were unclear. |

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| | | (regression coefficient 0.14, p<=0.01).<br><br>**Adverse Effects:**<br>NR<br><br>**Conclusions:**<br>Limited evidence was identified that friends' communication about weight and weight related behaviours influences weight. | |