Section 3: Prevention

6 Prevention evidence summary: determinants of weight gain and weight maintenance ('energy balance')

The following is based on an evidence review produced by the University of Teesside. Detailed evidence tables and supporting information are in Appendix 4.

6.1 Evidence statements (Table 6.1)

Table 6.1 Evidence statements and grading

No.	Statement	Grade	Evidence
Weight outcomes			
1	There are limited data from cohort studies on the factors associated with weight gain in children	N/A	N/A
2	There is a body of evidence which suggests that the offspring of overweight and obese parent(s) are at increased risk of themselves becoming overweight or obese in childhood or adulthood	2+	Parsons et al. 1999[1] (2++) and Klesges et al. 1995[2] Reilly et al. 2005[3], Burke et al. 2005[4] (no significant association found in Thompson et al. 2004[5] and O'Loughlin et al. 2000[6])
3	Cohort studies suggest that children who increase calorie intake, increase fat intake, consume "junk food", "takeaways" and "carbonated drinks" and/or do not eat breakfast, tend to gain weight. The evidence on 'snacking' is limited and inconsistent	2+	Moore et al. 2003[7], Klesges et al. 1995[2] (2+), GUT study[8;9–10] (2+) (O'Loughlin et al. 2000[6] [2+] and Bogaert et al. 2003[11] [2+] found no significant association with fat and calories), Burke et al. 2005[4] found inverse relationship between % energy from fat and BMI); Reilly 2005[3] (junk food); Burke 2005[4] (takeaways); Phiilips 2004[12] (carbonated drinks); Elgar et al. 2005[13] (snacking associated with obesity but did not predict change in BMI), Philips et al. 2004 found no significant

No.	Statement	Grade	Evidence
			relationship between BMI z-score or % body fat and total energy-dense snack consumption).
3b	There is limited evidence from prospective cohort studies over at least one year for the relationship between regular meals, portion size or snacking with weight in children	2+	McConahy et al. 2004[14] (portion size); Elgar et al. 2005[13] (skipping meals)
4	Cohort studies suggest that children who do not participate in sport outside school and who are the least active appear to gain more weight than their more active peers	2+	Burke et al. 2005[4], Elgar et al. 2005[13], Moore et al. 2003[7], O'Loughlin et al. 2000[6] (2+), GUT study[9–10] (2+), Klesges et al. 1995[2] (2+), Datar et al. 2004[15] (2+)
5	The evidence from cohort studies is inconsistent on the associations between television viewing and weight gain. Some but not all identified studies found a significant association between greater television viewing and weight gain	2+	Supportive: Viner et al. 2005[16], Burke et al. 2005[4], Elgar et al. 2005[13], Reilly et al. 2005[3], Moore et al. 2003[7], Kaur 2003 et al[17](2+), GUT study[9–10] (2+) Not supportive: Robinson et al.1993[18] (2+), Bogaert et al. 2003[11] (2+) Inconsistent: O'Loughlin et al. 2000[6] (2+)
6	Among adults, there is a body of evidence from cohort studies that pregnancy, menopause and smoking cessation are key stages in the life-course associated with weight gain. The evidence on the importance of other life stages, such as marriage, divorce and a change in work patterns (for example, shift working)	2+	*Pregnancy* (all 2+) Supportive: Williamson et al. 1994[19], Smith et al. 1994 (CARDIA),[20] Linne et al. 2003 (SPAWN),[21] Olson and Strawderman 2003,[22] Rosenberg et al. 2003[23], Wolfe et al. 1997,[24] Sowers et al. 1998[25] *Menopause* (all 2+) Supportive: Macdonald et al. 2003,[26] Nagata et al. 2002,[27] Blumel et al.

No.	Statement	Grade	Evidence
	remains unclear		2001[28] Not supportive: Wing et al. 1991,[29] Burnette et al. 1998[30] (two papers on same cohort) *Smoking* (all 2+) Supportive: Williamson et al.1991[31] (short term only) Gerace and George 1996,[32] Swan and Carmelli 2005,[33] Froom et al. 1999,[34] Burnette et al. 1998[30] in Burke et al. 2000[35] (small % variance) *Marriage* (all 2+) Supportive: Kahn and Williamson 1990,[36] Rauschenbach et al. 1995[37] and Gerace and George1996[32] *Shift work* (2+) Supportive: Yamada et al. 2001[38]
7	There is limited evidence from cohort studies that increasing physical activity may minimise the weight gain associated with smoking cessation	2+	Kawachi et al. 2005[39] (2+)
8	There is a body of evidence from cohort studies that adults are more likely to maintain a healthy weight if they maintain an active lifestyle and reduce sedentary behaviours such as television viewing	2++	Body of evidence (all 2+) Two reviews (both 2++): Williamson 1996[40] and Saris et al. 2003.[41] In Saris, 9 of 11 studies (2++) showed significant inverse associations between PAL and BMI/weight Body of individual studies (2+): Nooyens et al. 2005[42], Klesges 1992[43] and Owens 1992,[44] Gerace 1996,[32] DiPietro 1998,[45] Martikainen 1999,[46] NHS II,[47] Ball 2002,[48] Bell 2001,[49] Droyvold 2004,[50] Sundquist 1998,[51] Wagner 2001,[52] CARDIA,[53–54] Lissner 1997,[55] Kahn 1990[36]
9	There is a body of evidence from cohort studies that adults are more likely to maintain a healthy weight if	2+	Body of evidence (all 2+) Rissanen et al.1991[56] and Klesges et al. 1992[43] (both for women only,

No.	Statement	Grade	Evidence
	they consume a low-fat diet containing less 'takeaway' foods, more fruit and vegetables, salad and fibre and little alcohol. Reducing consumption of confectionary and drinks high in sugar may also help to prevent weight gain		out of Williamson 1996[34] review) French et al. 1994,[57] Kahn et al. 1997,[58] Parson et al. 2005,[59] Sammel et al. 2003,[60] Ball et al. 2002,[48] CARDIA,[61], Greenlund, 1996 4388 /id}[–54] He et al. 2004[62], Schulze et al. 2004,[63] Koh-Banerjee et al. 2003,[64] Martikainen and Marmot 1999[46], Schulz et al. 2005[65], Quatromoni et al. 2002[66], Nooyens et al. 2005[42]

BMI, body mass index.

See Appendix 4 for associated evidence tables.

6.2 Methodology

Database searches were carried out in March 2005 for papers published from 1990 onwards (1995 onwards for systematic reviews). A final update search of MEDLINE captured papers published up to 1st December 2005. The review parameters for inclusion and exclusion were adapted for this review which focused primarily on observational studies. Prospective cohorts of at least 12 months duration that assessed factors potentially associated with weight gain or weight control in adults and/or children who were not all obese at baseline and reported a weight outcome at baseline and follow-up were included. Due to time constraints, studies without weight outcomes were excluded from this review. From an initial 4988 hits, 433 papers were assessed in detail, of which 55 cohort studies and 3 systematic reviews met the criteria for inclusion in this review.

Additional searching was carried out for key cohorts on advice from the GDG and a further 3 cohorts met the criteria for inclusion in this review, including the Framingham Children's cohort, the Framingham Offspring/Spouse cohort and the ALPAC cohort. Additional and specific searches were conducted for the terms raised by stakeholders: "regular meals", "snacking" and "portion size" which

yielded another 2 cohorts. One additional reference suggested by stakeholders met our criteria for inclusion.

The World Cancer Research Fund (WCRF) database at the University of Teesside was searched for any potentially relevant studies. A further 2 cohorts were identified which fit the criteria for inclusion in this review. It had originally been hoped that this review could supplement the energy balance review. However the WCRF review will not now be published until after the guidance is published.

The final update search plus additional searching produced 11 cohorts that met the criteria for inclusion in this review.

Given the quality element of the inclusion criteria (ie only prospective and controlled cohort studies), the included papers were not critically appraised and all studies were graded 2+.

6.3 Weight outcomes: children

One systematic review examined the role of childhood predictors of adult obesity and a further 11 prospective cohorts assessed factors influencing weight gain in childhood.[1] Children tended to be over 8 years of age and although follow-up varied, the majority of studies lasted 1–3 years. Based on the parameters of this review, the evidence identified regarding determinants of weight gain in children was limited. A broad range of factors were considered but the majority were only assessed by single cohorts. Where there are more than one cohort that assesses a particular factor (that is, fat and calorie intake, hours in activity and television viewing) the evidence was often inconsistent. There was no body of evidence underpinning any of the factors found to be associated with weight change in children.

6.3.1 Parental obesity

A systematic review identified eight cohort studies that considered factors in childhood which may influence the development of obesity in adulthood.[1] Offspring of obese parent(s) were consistently seen to be at increased risk of overweight or obesity, although few studies have looked at this relation over longer periods of childhood and into adulthood. Data from one study suggested that this relation may be stronger between mothers and their offspring than fathers and offspring, and that the mother–offspring relation strengthens over time. One study found that parental obesity was a more important predictor of offspring obesity earlier in childhood (< 6 years becoming less important with increasing age. Data from another study showed that parental obesity influences tracking of the offspring's own obesity, which is much stronger if both parents are obese. The reviewers highlighted that the relative contributions of genes and inherited lifestyle factors to the parent–child fatness association remains unclear.

6.3.2 Dietary factors

Eleven longitudinal prospective cohorts and one cross-sectional study specifically assessed the association between weight and dietary factors, and the cross-sectional study (McConahy 2004[14]) focused on portion size.

Three of the cohorts were set in the UK([3,13,16]), six were set in the USA (GUTS[8-10;67-70]; Framingham Children's Cohort[7,71,72]; Phillips 2004[12]; Klesges 1995[2]; Thompson 2004[5]; McConahy 2004[14]), one in Canada[6] and two in Australia[4,11]

The studies identified suggest that children of normal weight, who do not eat breakfast, increase calorie intake, increase fat intake and eat more 'fast foods' appear to gain more weight than their peers.

Higher baseline levels of percentage of calories from fat among children aged 3–5 years were associated with greater increases in body mass index (BMI) as

were recent increases in the percentage of intake as fat.[2] Among 9–14-year-old children of normal weight, not eating breakfast was associated with weight increase over 1 year [69] as were higher reported caloric intake (girls only). For both boys and girls a larger rise in caloric increase predicted larger BMI increases[9]. The effects of milk and dietary calcium intake on weight appeared to be explained by energy intake; however skimmed milk intake in girls remained marginally significant after adjustment for energy intake (GUTS[8] Moore (2003)[7] investigated the relationships between physical activity level, TV viewing and change in body fat in 106, 3-5-year-olds from the Framingham Children's Study over a period of eight years. Children with high fat diets (>34% calories from fat) exacerbated body fat gain in children watching TV for more than 3 hours per day. They gained approximately 30mm of body fat (sum of five skinfolds) compared with children who watched least TV (<1.75h per day) and consumed a lower-fat diet (<34% calories from fat). Burke (2005)[4] investigated the relationships between different food categories and BMI at 8 years in 340 Australian children. An inverse relationship was found for 'cereals' and '% energy from total fat' ($p = 0.046$ and $p = 0.025$ respectively).

Whilst cross-sectional data showed children were less likely to be overweight if they ate dinner most days with their family, this relationship was not apparent in the longitudinal analyses over 2 years(GUTS[67])

Thompson and coworkers[5] followed up 9-year-old girls over an average of 6 years. Girls who ate 'quick-service food' (that is, food from 'fast food' outlets, ice cream parlours, street vendors, etc.) twice a week or more at baseline had the greatest mean increase in BMI z-score at follow-up, and this change was significantly different from that seen in girls who ate quick-service food once or twice a week or not at all. Burke (2005)[4] investigated the relationships between different food categories and BMI at 8 years in 340 Australian children. A positive relationship was identified between weight gain and 'takeaways' ($p = 0.025$). Reilly (2005)[3] examined 25 risk factors for obesity from the inter-uterine period to

7 years in the ALSPAC cohort (UK). Eight factors were associated with risk of obesity. None were dietary, although a 'junk food type dietary pattern' (not defined further) at 3 years was significant at the 10% level.

Elgar (2005)[13] found that skipping meals and snacking (not further defined) were associated with obesity, but did not predict change in BMI between the ages of 11-12 and 15-16 years in 355 Welsh adolescents. Phillips (2004)[12] investigated the relationship between energy dense snacks (EDS) and BMI z-scores in 196 non-obese pre-menarcheal girls 8 to 12 years old for four years. Categories of EDS foods considered were baked goods, ice cream, chips, sugar-sweetened carbonated drinks and sweets. No relationship was found between BMI z-score or % body fat and total EDS food consumption. However, carbonated drinks were the only EDS food significantly related to BMI z-score over the 10-year study period (p-value for trend <0.001), but it was not related to % body fat.

McConahy (2004)[14] looked at dietary behaviours in 5447 children aged 2-5 years from the Continuing Survey of Food Intakes by Individuals across the US, over a two year period. Based on parental self-report, this cross-sectional study found that body weight, food portion size, number of eating occasions and number of foods accounted for 38% of the variance in 2-3-year-olds and 39% in 4-5-year-olds. Portion size as a single predictor explained 17% of the variance in 2-3-year-olds and 19% in 4-5-year-olds.

No significant associations were observed between weight change and fat intake, calorie intake, fruit and vegetable intake or snacking in the other cohorts identified.[4,6–10]

6.3.3 Physical activity

Eight prospective cohorts specifically assessed the association between weight and physical activity[2;4;6;7;9;11;13;15;68]. The studies suggest that children who do not

participate in sport outside school and who are the least active appear to gain more weight than their more active peers.

Only one study failed to find significant correlation between BMI and measures of energy expenditure although children's activity levels were correlated with their parents activity levels.[11] Other cohorts found that no sports outside school [6] and fewer hours of physical activity (not defined)[9;68] were associated with increases in BMI in 3–5-year-old boys and girls, whereas higher aerobic activity and increased leisure activity were associated with BMI decrease.[2] Overweight 5–7-year-old girls (but not normal weight children or overweight boys) had reduced BMI with an additional 1-hour per week physical education (PE) in school.[15] Elgar (2005)[13] assessed the relationship between physical activity and change in BMI in 355 Welsh adolescents who were part of the Health Behaviour of School-aged Children Study. Physical activity questions were from the HBSC questionnaire and hours of sports participation was associated with lower increases in BMI ($p<0.05$) over the four year period (from 11-12 to 15-16 years). Details about amount of hours of sport were not reported.

Burke (2005)[4] used parental questionnaires to assess levels of physical activity in 1430 Australian children at 6 years. Playing organised sport at age 6 was not predictive of BMI at age 8, but 'being slightly active' and 'active' at 8 years were (OR 0.44; 95 CI 0.28, 0.70 ($p<0.001$) and OR 0.23; 95 CI 0.14, 0.38 ($p<0.001$)) respectively. Duration of physical activity was not reported.

Moore (2003)[7] examined 106 children aged 3-5 years from the Framingham Children's Study with Caltrac motion sensors to assess physical activity levels. Children were categorised as having low, medium or high activity levels (based on average number of counts per hour and then averaged over the eight year study period). Children in the highest tertile for daily physical activity had consistently smaller gains in BMI, triceps and sum of 5 triceps throughout childhood. By 11 years, sum of 5 skinfolds was 95.1mm, 94.5mm and 74.1mm for the low, medium and high tertiles respectively (p-value for trend = 0.045).

This relationship was evident for both sexes. Children with the lowest levels of PA and highest levels of TV viewing gained nearly 40 mm of body fat than children with highest levels of PA and least TV by 11 years.

The evidence on television viewing and weight gain was inconsistent with some but not all cohort studies finding a significant association between greater time television viewing and weight gain. Ten prospective cohorts assessed television viewing as a potential predictor of weight change. [4;6;11;17;18;68;13;7;3;16].

Seven studies, including 3 UK-based studies, with children entering the studies at ages ranging from 3 years to adolescence reported a significant association with increased television/video viewing/computer games and weight gain from 2 to 30 years' follow-up. [3;4;7;13;16;17;68] One study reported inconsistent findings; O'Loughlin and coworkers[6] reported that playing video games every day was significantly associated with increase in BMI in 9-12 year old girls but not in boys. One study in 6–9-year-old children[11] and one study in 12-year-old children[18] did not find any significant associations.

Viner (2005) [16] UK conducted an analysis of the 1970 British Birth cohort of over 8000 subjects followed up at 5, 10 and 30 years (30 year follow-up self-reported) examining the relationship between television viewing and BMI change. Clearer relationships were found from ages 5 to 10 years than to 30 years. Using obesity at 10 as the outcome in logistic regression, each additional hour of TV watched on weekdays at 5 years increased the risk of obesity by 12% (OR 1.12; 95 CI 1.04, 1.21; p = 0.002); and each additional hour at weekends increased risk by 10% (OR 1.10; 95 CI 1.03, 1.18; p = 0.003). Weekend but not weekday TV viewing in early childhood independently predicted increased adult BMI.

6.4 Weight outcomes: adults

There is more evidence regarding determinants of weight gain in adults than in children. Two reviews and 49 cohorts were considered, which addressed factors in adulthood associated with weight gain and maintenance. The size of studies and length of follow-up varied enormously, for example, Olson and Strawderman[22] followed up 600 women for 2 years after pregnancy whereas Parsons and coworkers[59] reported the results of the 1958 birth cohort which includes 16,000 men and women followed up at 33 and 42 years of age. Many determinants identified are interdependent and can only partially account for variation in weight between individuals.

6.4.1 Menopause

Five cohorts assessed a number of variables with weight change during menopause. The findings suggest that weight gain during menopause transition is itself inconsistent and may indicate underlying behavioural variables contributing to weight change. According to Macdonald and coworkers[26] who analysed 1064 Caucasian women in the UK for 6 years, mean weight was influenced more by reduced energy expenditure than increased energy intake. Nagata and coworkers,[27] who analysed a cohort of Japanese women for 6 years, reported that nutrient intakes were not significantly associated with difference in weight change between premenopausal and postmenopausal women. They did not find a significant association between weight and exercise, However the Massachusetts Women's Health Study[73] a cohort of 400 women followed for 3 years, found that reduced exercise was more strongly related to weight gain than menopause transition.

Both the Healthy Women's Study,[29;30] which followed 500 US women for 3–4 years and a study which analysed 271 Chilean women for 5 years[28] found a significant increase in weight during the menopause. Blumel and coworkers[28] concluded that weight gain in the perimenopausal period appears independent of the menopause.

6.4.2 Pregnancy

Seven cohorts examined weight change and pregnancy. Pregnancy appears to be a risk factor for persistent weight gain, and probability of weight gain rises with increase in parity for some women and this was shown in studies of Caucasian and African American women. Those who gained more weight or ate more during pregnancy were more likely to retain weight gain after pregnancy.

The findings of two large US-based cohorts[20;24;74] following women for 4–10 years suggests that the probability of weight gain appears to rise with increase in parity. For African American women this tends to occur after the first child and for white women this tends to occur after the second child.[24] African American women gained more weight over 10 years than white women (5.5 kg vs 4.4 kg).[24] Black women demonstrated greater adverse changes in adiposity than did white women at each level of parity.[74] Another cohort suggests that weight gain is greater for the first child compared to subsequent children and weight gain increases with increasing baseline BMI.[23]

An additional small US-based cohort followed women who breastfed for 18 months to compare baseline pregnancy with post-pregnancy weight following the subsequent pregnancy.[25] On average, cases weighed 1.3 kg more after the subsequent pregnancy than they weighed following the baseline pregnancy.

The SPAWN study, which examined long-term weight development after pregnancy of 1423 women from Sweden over 15 years, reported that women who started to eat more irregularly retained more weight at 1-year postpartum.[21] Olson and coworkers[22] – following 622 healthy US women – found less physical activity was significantly related to excessive gestational weight gain, and in the SPAWN study[21] women who started to exercise less frequently after their pregnancies retained more weight 1-year postpartum.

Williamson (1994)[75] examined 2547 white women aged 25-45 years from the first National Health and Nutrition Examination Survey. The risk of becoming overweight was increased by 60-110% in women having live births over the 12-

year study period. Over 12 years average weight gain whilst having children was modest in US white women, but for some women the risks of major weight gain and becoming overweight are increased in association with childbearing.

6.4.3 Marriage

Three cohorts considered weight change and marital status. Rauschenbach and coworkers[37] reported that women but not men who entered marriage had greater weight gain than their peers who remained unmarried and lost less weight than those who remained married. For men (but not women) there was a significant interaction such that those with more education who became separated or divorced were likely to gain more weight. Another cohort reported that men who became married during the 10-year study period showed a trend towards a greater gain in BMI when compared with men who were consistently married.[36] Those men whose marriage ended appeared to experience a relative loss in BMI. Among a work-based cohort married or cohabiting men gained less weight than their peers.[32]

6.4.4 Smoking

Five US and one Israeli cohort suggest that those who quit smoking for at least a year experience greater weight gain than their peers who continue to smoke. However the results of the National Health and Nutrition Examination Survey 1 (NHANES 1)[31] suggest that 'significant' weight gain only occurs in a minority and Kawachi and coworkers[39] found that weight gains may be minimised if cessation was accompanied with moderate increase in levels of physical activity. The amount of weight gained with cessation may differ by age, social status and other behaviours.[33] Among a work-based cohort quitters who had been heavy smokers (20+/a day) appeared to gain more weight than those who smoked less.[32]

Stopping smoking during menopause was associated with greater weight gain[32;73] and relatively more women who became overweight during pregnancy had stopped smoking.[21;32]

6.4.5 Occupation- and work-based cohorts

Eleven cohorts assessed weight change among occupation- or work-based groups. The six cohorts which assessed diet suggest that a lower risk of becoming obese or gaining excess weight is found among those with the highest fruit and vegetable intake[62] consumption of at least one portion of cereals per day[76] lower consumption of sugar sweetened beverages[63] more favourable intakes of fat and fibre[64] slower pace of eating and less 'nibbling'[32] and with a 'good' diet.[46] Men in the US physicians[64] and UK Whitehall II cohorts[46] who were more active were less likely to gain in waist circumference or BMI, respectively. Among fire fighters[32] greater recreational activity was associated with lower weight gain, although self-reported activity levels at baseline were not. In the Nurses Health Study II vigorous physical activity was protective against weight gain.[47] Physical inactivity was associated with weight gain.

Other studies reported that weight gain was associated with long (12-hour) work shifts,[38] lower employment grade,[46] overtime working,[77] job insecurity,[78] and periods of unemployment.[79] The Whitehall II study reported that it was the element of perceived control rather than the employment grade per se that was significantly associated with weight gain (that is, less control more weight gain).[46]

6.4.6 General population cohorts

A total of 24 general population cohorts considered factors associated with weight in adulthood. Results from 12 general population cohorts specifically addressing diet reflected the findings of other cohorts. Lower risk of weight gain was associated with lower consumption of chips and fried foods;[59] higher fruit and vegetable intake and lower confectionary consumption;[42;60] higher fat intake (women with obese parents only,[80] women who were sedentary only[55]); and less restrictive eating practices and infrequent consumption of takeaway foods[48] or infrequent fast food restaurant use.[61] A diet containing more fibre,[42;81] little alcohol[50] and less sugar-containing drinks also appears to help prevent weight gain. There was no independent association of frequency of eating with

prospective weight change over the preceding 8–10 years in the NHANES I Epidemiologic Follow-up Study (NHEFS) cohort.[82] In the Danish MONICA study of 3000 Danish adults, obese women with night eating experienced a greater average 6-year weight gain.[83]

Quatrimoni (2002)[66] found that in 737 non-overweight women from the Framingham Offspring/Spouse cohort, the likelihood of becoming overweight at 12 years follow-up was approximately 29%. The relative risk of developing overweight was RR 1.4; (95 CI 0.9, 2.2) in women who ate an 'Empty Calorie' diet that was rich in sweets and fats with fewer servings of nutrient-dense fruits, vegetables, and lean food choices, compared with women who ate a lower-fat, nutritionally varied 'Heart Healthy' diet.

Schulz (2005)[65] looked at food patterns and subsequent weight gain nearly 25,000 subjects from the German cohort in the EPIC study. Those with a food pattern of a high consumption of whole-grain bread, fruits, fruit juices, grain flakes/cereals, and raw vegetables, and of low consumption of processed meat, butter, high-fat cheese, margarine, and meat were less likely to gain weight. Mean annual weight gain gradually decreased with increasing pattern score (higher score indicates healthier diet) (p-value for trend < 0.0001), i.e., subjects scoring high for the pattern maintained their weight or gained significantly less weight over time compared with subjects with an opposite pattern. However the prediction of annual weight change by the food pattern was significant only in non-obese subjects, ie dietary patterns predicted weight gain in normal weight subjects by not in those already obese.

On balance it appears that an active daily lifestyle can help maintain weight. The UK 1958 birth cohort found no relation between activity level (assessing **change** in activity level) and change in weight.[59] Data from one small study also found no significant association between weight and physical activity.[60]

The other cohorts reported reduced risk of excess weight gain with lower sedentary activity[48] higher baseline activity levels and lower television viewing,[45] high level of physical activity,[50] and higher frequency of active travel to work and recreational activities.[52] In men from the NHANES I and NHEFS cohorts,[36] the incidence of major weight gain was lowest among men who reported high levels of physical activity or whose baseline BMI was between 24.0 kg/m^2 and 27.8 kg/m^2.

Nooyens (2005)[42] investigated the effects of retirement on lifestyle and weight and waist circumference in 288 Dutch men. Over five years increases in weight and waist circumference were associated with a decrease in several physical activities, such as household activities, bicycling ($p = 0.03$), and walking ($p = 0.02$). Increase in body weight and waist circumference was higher among men who retired from active jobs (0.42 kg per year and 0.77 cm per year, respectively) than among men who retired from sedentary jobs (0.08 kg per year and 0.23 cm per year, respectively).

Heavy work-related activity in Chinese adults was associated with reduced risk of weight gain[49] and greater levels of exercise endurance were significantly correlated with lower rates of weight gain in a small group of premenopausal women.[84] A high-fat diet combined with a sedentary lifestyle predicted weight gain in women but not a high-fat diet combined with higher levels of activity.[55] Decreased fitness during young adulthood was strongly associated with increased weight [54] and men who stopped exercising had larger increases in BMI than regular exercisers.[51]

Other factors associated with lower weight gain included lower anxiety scores[60] and low dietary restraint and higher self-esteem.[85] A 7-year follow-up of young US adults showed that parents' body size was positively associated with a participant's BMI and father's education was inversely associated with BMI.[53]

Viner (2005)[16] UK conducted an analysis of the 1970 British Birth cohort of over 8000 subjects followed up at 5, 10 and 30 years (30 year follow-up self-reported) examining the relationship between television viewing and BMI change. Weekend but not weekday TV viewing in early childhood independently predicted increased adult BMI. Each additional hour of TV watched on weekends at 5 years increased risk of adult obesity by 7%.

6.5 Sub questions

6.5.1 Variation by gender, age, ethnicity, religious practices or social group

6.5.1.1 Gender

Two studies among children suggest gender differences; Berkey and coworkers[68] reported larger annual increases in BMI in girls than in boys who reported a higher calorie intake and less physical activity in the year between BMI measurements. Datar and Sturm[15] reported that additional physical education in primary school was associated with reduced BMI in overweight girls but not boys. Among adults, one small study suggests gender differences in the rate of weight change following change in marital status such that women but not men experienced greater weight change following marriage and lost less weight than those who remained married.[37]

6.5.1.2 Age

Among adults, one cohort of men found that 'super gainers' of weight during smoking cessation tended to be younger in age.[32] Two cohorts reported that adults tended to gain weight with age.[86,87] Tremblay and coworkers[87] noted that lifestyle changes observed during (12-year) follow-up should have favoured body weight maintenance but adiposity significantly increased with ageing suggesting age-related effects on fat balance largely dominated lifestyle changes that should have promoted fat loss.

6.5.1.3 Ethnicity

Among children, two cohorts examined ethnicity and weight change, with one reporting that only 0.3% variation in follow-up BMI was explained by ethnicity.[17] Ambrosius and coworkers[88] reported that the rate at which BMI increased in black children was significantly greater than in the white children ($p < 0.0001$).

Among adults, no study specifically assessed the effects of ethnicity. However, the findings available suggest that ethnicity appears to be a risk factor for weight gain for some women during/following pregnancy, as shown in studies of Caucasian and African American women.[23,53] At each level of parity, black women demonstrated greater adverse changes in adiposity than did white women.[53] This was supported by results of parity from women in the NHANES I and NHEFS.[24]

One cohort found that Mexican Americans compared to non-Hispanic whites had greater risk of weight gain with smoking cessation but this racial difference contributed only slightly to overall contribution to weight gain.[35] Another cohort found that black non-Hispanic fire-fighters/paramedics gained 7.1 kg (15.7 lb) compared with white Hispanics who gained 4.0 kg (8.9 lb) and white non-Hispanics who gained 3.0 kg (6.7 lb) ($p < 0.001$).[32]

Spiegelaere reported that adiposity rebound before age 5 was inversely related to body mass at age 3 and was independent of social status.[89] Among adults, low family income may be related to excessive gestational weight gain but is not as influential as increasing food intake.[53] Lower job control was associated with increased weight gain in the Whitehall II study.[46] Low socioeconomic status also associated with 'super gainers' of weight during smoking cessation in men.[33] Kahn and Williamson[36] reported a significant increase in mean BMI change for American men with lower education levels compared with those who had gone beyond 12th grade education.

6.5.2 Influence of previous weight loss

No data were identified regarding weight history of children and few data were available in adults. Previous weight change is a potential confounder of the relation between diet and subsequent weight change in prospective observational studies. The Nurses Health Study II[47] reported that women who lost greater than or equal to 10% of their weight between 1989 and 1991 subsequently gained more weight between 1991 and 1995 than their peers who did not lose weight.

6.5.3 Potential negative impact

None were reported.

6.6 Limitations of the review

Time limitations in the preparation of this review necessitated pragmatic decisions regarding the search strategy. It is difficult to limit a search to identify only cohort designs and so the review was limited to cohorts where the main focus of the paper was on the physiology of weight gain. It is possible that key cohorts may have been excluded by the search strategy if the paper used different terms for weight gain (for example, cohorts that explored the determinants of increases in BMI). A high-quality systematic review of observational cohorts exploring the relation between various behavioural factors and weight has been commissioned by the WCRF and will be published in 2006.

Studies assessing associations between menopause and changes in weight had a maximum 6-year follow-up despite the fact that menopause may span up to 8–10 years.

At times it was difficult to ascertain which data were longitudinal and which were cross-sectional (and therefore weaker). As large cohorts were sometimes used for various analyses and reported in multiple publications, it was sometimes difficult to marry up publications pertaining to the same cohort.

Cohort studies can only examine associations, which may not be causal in direction. All cohorts report outcomes at latest follow-up, and in some studies with follow-up over long period (that is, 15 years) with little interim measurement, it is difficult to ascertain if the correlations between dietary and physical activity variables are linear. It might be the case that issues within the design of cohorts produces inconsistent results and results that intuitively do not make sense (that is, increased physical activity or lower calorie intake associated with weight gain). Furthermore, many cohorts rely on self-reported data, which are fraught with bias.

7 Prevention evidence summary: interventions to raise awareness

The following is based on an evidence review produced by the University of Teesside. Detailed evidence tables and supporting information are in Appendix 5.

7.1 Evidence statements (Table 7.1)

Table 7.1 Evidence statements and grading

No.	Statement	Grade	Evidence
Weight outcomes			
1	There is limited evidence to show that a multi-component intervention including a public health media campaign, can have a beneficial effect on weight management, particularly among individuals of higher social status	2+	One 2+ (Wardle et al. 2001[90]) One 2– showing no effect but concerns about validity (Tudor-Smith et al. 1998[91]
2	The effectiveness of promotional campaigns focusing on education alone remains unclear	1+	One RCT 1+ (O'Loughlin et al.[92]) in low-income, low-literacy volunteers in Canada suggest education alone ineffective
Diet outcomes			
3	There is a body of evidence that promotional campaigns including media interventions can increase awareness of what constitutes a healthy diet and may subsequently improve dietary intakes	2+	Five studies: O'Loughlin et al. 1998[92] (1+), Department of Health 2003[93] (2±), Wardle et al. 2001[90] (2+), Tudor-Smith et al. 1998,[91] (2–) Van Wechem 1997[94] (2–)
4	There is a body of evidence that food promotion can have an effect on children's food preferences, purchase behaviour and consumption. The majority of food promotion focuses on foods high in fat, sugar and salt and therefore tends to have a	2+	One systematic review 2+ (Hastings et al. 2003[95])

No.	Statement	Grade	Evidence
	negative effect. However, food promotion has the potential to influence children in a positive way		
Physical activity outcomes			
5	It remains unclear whether media interventions can influence participation in physical activity. There is some evidence that interventions may be more successful if they target motivated subgroups	2++	One systematic review of CBAs (Cavill and Bauman 2004[96] [2++]) plus one RCT (O'Loughlin 1998[92] [1+]), 2 BAs grade (2+) (Huhman et al. 2005,[97] Merom 2005 et al.[98]) and a BA grade 2– (Tudor-Smith et al. 1998[91])
6	Promotional campaigns including media interventions can improve knowledge, attitudes and awareness of physical activity. Levels of awareness are likely to vary according to type of medium used and the scale of the campaign	2++	One systematic review of CBAs (Cavill and Bauman 2004[96] [2++]) plus one RCT (O'Loughlin 1998[92] [1+]), two BAs (2+) (Huhman et al. 2005,[97] Merom 2005 et al.[98]) and a BA grade 2– (Tudor-Smith et al. 1998[91])
Generalisability			
7	The majority of the identified interventions are generalisable to the UK	2+	Hillsdon et al. 2001[99] (2+), Wardle et al. 2001[90] (2+), Wimbush et al. 1998[100] (2–), Tudor-Smith et al. 1998[91] (2–), Department of Health 2000[93] (2$\pm$)
8	There is a paucity of evidence on the effectiveness of interventions among lower socioeconomic groups and BMEGs	N/A	N/A
9	There is a paucity of evidence in children and young people; the generalisability of evidence in adults to children and young people remains unclear	N/A	N/A
10	The effectiveness of	2+	Wardle et al. 2001[90] (2+),

No.	Statement	Grade	Evidence
	interventions vary by age, gender, social status and ethnicity		Hillsdon et al. 2001[99] (2+), Huhman 2005[97] (2+)
Implementation			
11	Parents are important role models for children and young people in terms of behaviours associated with the maintenance of a healthy weight	3	One survey (McCullough 2004[101])
12	Books, magazines and television programmes are an important source of information and actively involving media providers may improve the effectiveness of interventions	3	One survey ('Family food survey' 2003[102]), one CBA (2+) (Wardle et al. 2001[90])
13	A significant proportion of parents may not recognise that their child is overweight and may have a poor understanding of how to translate general advice into specific food choices	3	One survey (Jeffery 2005[103])

BA, before-and-after study; BMEGs, black and minority ethnic groups; CBA, controlled before-and-after study; N/A, not applicable; RCT, randomised controlled trial.

See Appendix 5 for associated evidence tables.

7.2 Methodology

Database searches were carried out in September 2005 for papers published from 1990 onwards (1995 onwards for systematic review level evidence). A final update search was completed on 1 December 2005 on a reduced number of databases. The inclusion and exclusion criteria for the review adhered to the standard public health review parameters. Priority was given to systematic reviews and to studies conducted within the UK. From an initial 3147 hits, 66

papers were assessed in detail of which 20 papers met the critical appraisal criteria for inclusion in evidence tables. In line with the review parameters, studies considering knowledge, attitudes and awareness were only included if they also had a measure of weight, diet and/or activity. However, findings on knowledge, attitudes and awareness per se were considered in the studies identified. Towards the end of the reviewing process an additional review conducted for *Safe*food, the Food Safety Promotion Board, Island of Ireland, on the impact of social marketing interventions and knowledge, perceptions and behaviour in relation to nutrition and food safety (McDermott, unpublished data, 2006) was received. Although the findings were considered (and are noted below), because of time constraints, the review could not be fully appraised alongside the other identified papers. However, the review did not include any additional studies that met the agreed review parameters.

7.3 Weight outcomes

Three studies were identified with weight outcomes: one short, but good-quality randomised controlled trial (RCT) of an education-only intervention in Canada[92] and two UK-based multi-component before-and-after studies – Fighting Fat, Fighting Fit campaign (FFFF)[90] and Health Promotion Wales in the Heartbeat Wales campaign.[91]

The FFFF campaign[90] aimed to raise public awareness of the need for obesity prevention, healthy eating and increased physical activity among UK adults. The campaign was broadcast during peak and daytime programming across BBC 1 and BBC 2, BBC radio 1 and local BBC radio programmes, and was supported by a website, Ceefax, book, video, telephone lines and national and regional press coverage.

The Welsh-based community intervention aimed to prevent cardiovascular disease by modifying smoking, diet and exercise. It consisted of public health education campaigns, including specially developed television programmes, catering awards and a worksite health promotion programme.[91]

All three studies were in adults and used self-reported data. Research staff provided the intervention in all three studies alongside the BBC education department in the FFFF campaign[90] and Health Promotion Wales in the Heartbeat Wales campaign.[91]

7.3.1 Education only

The low-intensity education-only intervention, providing pamphlets to Canadians households, with the aim of raising awareness of healthy weight and healthy eating, did not show an effect on body mass index (BMI) at 10 weeks.

7.3.2 Multi-component interventions

One of the two multi-component before-and-after studies – FFFF – found that the 7-week intervention to raise public awareness of the need for obesity prevention, healthy eating and increased physical activity had a positive effect on weight 3 months after the intervention.[90;104] The campaign demonstrated an average post-campaign weight of 2.3 kg lower than before the campaign for the full random sample (people who requested an information pack and returned the baseline questionnaire, assuming non-completers of follow-up questionnaire returned to baseline weight) and 4.2 kg lower for completers only ($p < 0.001$). Forty-four per cent of the full sample and 78% of completers lost weight. Although the campaign aimed to target groups with higher prevalence of obesity (those in socioeconomic groups III M and IV), participants were more likely to be female, obese and higher socioeconomic status compared with the British adult population.

The Heartbeat Wales campaign did not show a positive change in overweight, with a 2.5 percentage point change in Welsh adults compared with a 1.1 percentage point change in the control community at 5-years' follow-up for BMI (at least 24 for women and 25 for men). However, this study was of poor quality, with evidence that there was contamination in the control area.

The studies with a weight outcome considered by the Food Safety Promotion Board (McDermott, unpublished data, 2006) are considered within other public health evidence reviews (principally pre-school, school and community reviews).

7.3.3 Evidence of corroboration

One UK-based cross-sectional study considered awareness of weight issues in UK parents (with children of mean age 7.4 years).[103] The results suggest that general awareness of the importance of healthy weight among adults and their children in the UK is low. Among overweight parents, 40% of mothers and 45% of fathers judged their own weight 'about right' and 27% of mothers and 61% of fathers were unconcerned about their weight. Only a quarter of parents recognised overweight in their child. Parents were less likely to identify overweight in sons than in daughters. More mothers than fathers correctly assessed their child's weight. Maternal weight status did not affect mothers' awareness of children's weight but only 74% of overweight fathers compared with 85% normal weight fathers were correct. Of parents who were unaware their child was overweight, 86% were also unconcerned. Parents' perception of their child's weight did not vary by socioeconomic status.

7.4 Diet and activity outcomes

One RCT[92] and three before-and-after studies,[90,93,94] which reported dietary outcomes in adults, were identified. Three of the studies – FFFF, Heartbeat Wales and the 5 A DAY[93] pilot to increase awareness and consumption of fruit and vegetables – were UK based. With the exception of one study, an education-only programme,[92] the interventions were multi-component.

One high-quality systematic review[96] of mass media campaigns with an explicit focus on physical activity was identified. The 15 studies identified in the systematic review were predominantly before-and-after studies. Follow-up ranged from a few weeks to 7 years. Three of the 15 studies were conducted in the UK: a walking campaign in Scotland,[92;100] the Active for Life campaign in England promoting moderate physical activity[99] and the FFFF campaign.[90] The

studies included in the review varied considerably in their focus (some targeting whole populations, other subgroups) and content (with five considered multi-component interventions). A range of ages were included although the majority were targeted at adults. Two additional studies in adults were identified.[91,92] Two additional studies in children were also identified; the US-based VERB campaign,[97] aiming to increase awareness of physical activity among 9–13-year-olds, and an Australian Walk Safely to School Day campaign.[105]

Providers of the interventions with diet and activity outcomes were research staff often in collaboration with government, health promotion and/or media bodies.

7.4.1 Diet

The findings of all identified studies suggest that interventions can result in improvements in various dietary outcomes, including a decrease in high fat consumption, increase in fruit and vegetable intake, and decrease in fried foods and snacking.

7.4.1.1 Education only

The RCT on healthy weight/eating pamphlets[106] reported that the frequency of consumption of high-fat foods decreased in the intervention group but remained stable in the control group ($p = 0.02$) 2 weeks after the 8-week campaign. Intervention participants also reported more improvements in their eating habits than the controls ($p = 0.02$).

7.4.1.2 Multi-component campaigns

The UK-based FFFF campaign demonstrated statistically significant improvements in diet 5 months after the campaign in a random survey of people who registered for more information (1% of the cross-sectional population survey, therefore limiting generalisability).[90;104] Significant improvements ($p < 0.001$) were reported in fruit and vegetable intake (increased by 0.8 [1.3] portions/day), 13% increase in respondents eating the recommended five portions a day and 16% increase in participants eating fried food less than once a week. Significant

improvements ($p < 0.001$) were also observed in consumption of fat spreads, lower fat milk, removal of fat from meat, snacking and consumption of starch-based meals.

One-year follow-up of the community-based five-a-day pilot projects[93] demonstrated that the intervention had stemmed a fall in fruit and vegetable intake against the national trend. Overall the intervention had a positive effect on people with the lowest intakes. Those who ate fewer than five portions a day at baseline increased their intake by one portion over the course of the study. In contrast, those who ate five or more portions a day at baseline decreased intakes by about one portion per day.

The 'Fat Watch' campaign in the Netherlands reported no significant difference in fat consumption between the intervention and control community at approximately 8 months' follow-up.[94] However, more respondents in the intervention community (32%) than in the control community (24%) reported that they had tried to lower their dietary fat intake in the past 6 months ($p < 0.01$). In the intervention community, a small but significant decrease (3%) in fat consumption was found ($p < 0.04$) between baseline and follow-up, compared to no change in the control community. The intervention was a pilot and took place within a framework of a nationwide 'fat watch' campaign, which may have confounded the results.

The one study that did not show significant differences between intervention and control (Heartbeat Wales[91]) showed improvement from baseline in both intervention and control communities with evidence of contamination in the control area.

These findings are consistent with the conclusions of the Food Safety Promotion Board review (McDermott, unpublished data, 2006) that there is strong evidence that social marketing interventions can bring about dietary improvements. Twenty-three of the 28 included studies reported at least one significant dietary improvement. The review reported that:

- There is strong evidence that social marketing interventions can improve outcomes associated with fruit and vegetable intake.

- There is moderate evidence that social marketing interventions can improve outcomes associated with fat intake. However, when the results of a subset of five studies which compared both fruit and vegetable intake **and** fat intake outcomes were examined, there was evidence that interventions could be as effective in terms of fat outcomes as they were in relation to fruit and vegetable outcomes.

- There is strong evidence that social marketing interventions can improve other dietary behaviours (identified studies included consumption of water, dairy products, 'unhealthy foods' and sweets).

- There is some evidence that social marketing interventions can have an effect on diet-related health but in limited circumstances.

7.4.1.3 Evidence of corroboration

A systematic review by Hastings and coworkers[95] considered the effectiveness of food promotion to children. The review included both experimental and cross-sectional designs of various durations, the majority of which were conducted in North America; no UK-based studies were identified. Although the included studies did not meet the criteria for inclusion for effectiveness, it was agreed that the review be included for evidence of corroboration.

The review concluded that food promotion can have and is having an effect on children, particularly in the areas of food preferences, purchase behaviour and consumption. Most studies uncover an effect that will be harmful. However, there is evidence that promotion can have a beneficial effect. Food promotion has the potential to influence children in a positive way. The review found that:

- All seven studies identified found that exposure to food promotion had an influence on, or was significantly associated with, the specific purchase-

related behaviour measured in each study (for example, sales, household purchase).

- Eleven studies investigated the effects of exposure to food promotion on children's food consumption behaviour. Overall the studies provide evidence of an effect of food promotion on consumption behaviour. Effects were sometimes inconsistent and were not found in all the studies, but were found in sufficient studies to suggest that food promotion influences children's food consumption.

- Studies suggest that food promotion or television viewing significantly influences children's food behaviour and diet independently of other factors known to influence children's food behaviour and diet. However there is little evidence to show whether the influence of food promotion on children's food behaviour and diet is greater or lesser than that of other factors.

Additional UK surveys suggest that although there are high levels of general awareness of healthy eating – and parents rate it as an important issue – there is poor understanding of how general advice translates into specific food choices.[92,101;102;107,107,108] Parents are an important source of information on nutrition for children and parents themselves have reported that doctor/health professional was their main source of information on nutrition.[101] However, in another survey 43% of parents said that their main source of nutrition information was from books and magazines and 15% relied on family and friends.[102]

7.4.2 Physical activity

A systematic review of mass media campaigns with an explicit focus on physical activity reported that 5 of 15 studies showed significant increase in physical activity at the population level.[96] Whereas 10 of the 15 identified studies reported no significant increases in measures of physical activity at the population level, 4 reported significant increases in activity among subgroups. Of the three UK-based campaigns included in the review only one (FFFF) showed significant improvements in physical activity; overall 39% of full sample and 74% of

completers increased their activity levels and the proportion undertaking regular moderate exercise increased from 29% to 45% (29–60% for completers only).[90]

The authors of the systematic review were unable to determine reliably the extent to which many of the studies represented true 'community-wide' campaigns and as a result it is difficult to separate out the effect of the mass media component in addition to any community activity. The scale of the 'dose' of the intervention (expenditure, media exposure or outputs for the campaigns) was unclear in 10 of the 15 campaigns. It was also difficult to ascertain how much attention was paid to the physical activity component in the five studies that covered factors other than physical activity (notably healthy eating). The authors note that for instance in the Stanford 5 City project physical activity messages appeared only once every 6 weeks on average and in the Minnesota Heart Health programme physical activity was included alongside prevention of hypertension, healthy eating and non-smoking. Therefore the authors were unable to explore any potential relations between dose, number of components included in the campaign, community and media elements, and effectiveness.

Many of the included campaigns were single events, others were integrated parts of community-wide cardiovascular education, and few were sustained and focused physical activity initiatives over a number of years. The authors identify a range of mass media and communications strategies employed, including paid television commercials, public service announcements, radio, newspaper and unpaid media publicity techniques. All campaigns mentioned link to other activities but it is not possible to ascertain the extent to which these were truly 'community wide' and the authors were unable to separate out the effect of the media component from any community activity.

The two additional studies in adults reflect these mixed results. The RCT of healthy weight/eating pamphlets demonstrated that intervention participants were 2.7 times more likely than control to change from reporting no exercise at baseline to exercising once or more a week at follow-up (2 weeks after the

8-week campaign).[92] In contrast, 'Heartbeat Wales' demonstrated no significant difference between intervention and control communities for physical activity outcomes.[91] The problems with this RCT have been noted previously.

Among children, the VERB campaign found that levels of activity increased in line with awareness of the campaign. Those 9–10-year-olds who were aware of the campaign engaged in 34% more free-time physical activity sessions per week than those who were unaware. However, no overall effect on free-time physical activity sessions was detected at the population level.[97] The Australian Walk Safely To School Day attributed a relative, short-term increase of 31% among children walking to school to the campaign; on a population level this equates to a 6.8% increase in walking to school.[98,105]

7.5 Knowledge, attitudes and awareness

Five campaigns and one systematic review provide equivocal evidence that awareness is translated into action in terms of diet and exercise. The majority of studies reported good awareness of campaigns but the impact on behaviour change is unclear. However, it has been suggested that people who are more motivated and active at baseline may be more likely to become more active following an awareness-raising campaign.[99]

7.5.1 Diet

The UK-based 5 A DAY campaign resulted in a 17% increase in the proportion of the intervention group that correctly reported that five portions a day was the optimal fruit and vegetable intake compared with 8% in the control areas.[93] In the Dutch 'Fat Watch' campaign there was no significant difference ($p > 0.05$) between the intervention and control community in the proportion of respondents that referred to the campaign as a reason for their behavioural change.[94] However, more of the intervention group (20%) than the control group (12%) intended to eat lower-fat foods in the following 6-month period ($p < 0.01$). Of those respondents who intended to eat lower-fat foods, significantly more

intervention respondents (29%) than controls (11%) referred to the campaign as a motive for this intention ($p < 0.01$).

The systematic review by Hastings and coworkers[95] concluded that food promotion influences children's food knowledge and preferences. The findings of the review were:

- Studies that have considered the influence of food advertising on nutritional knowledge provide modest evidence of an effect of food advertisements on children's nutritional knowledge. Four of the identified studies found that exposure to food promotion had a significant impact on, or was associated with, differences in nutritional knowledge.

- Fourteen studies suggested, on balance, that food promotion influences children's brand and product preference. Six of the nine high- and medium-quality studies found that promotion had significant effects on children's product and brand preferences and children were more likely to choose foods with high fat, salt or sugar than alternative 'healthy' products after viewing food adverts.

The Food Safety Promotion Board review (McDermott, unpublished data, 2006) reported that when the results from the studies were examined in terms of level of effect, it was apparent that social marketing interventions were strongly and equally effective at influencing behaviour, knowledge and psychosocial variables such as self-efficacy, attitudes and perceptions of the benefits of eating more healthily. Social marketing interventions appeared to be moderately effective at influencing stage of change in relation to diet, and to have a more limited effect on diet-related physiological outcomes such as blood pressure, body mass index and cholesterol.

7.5.2 Physical activity

A systematic review of physical activity campaigns reported outcomes in terms of awareness of campaign messages and awareness of knowledge, attitudes or

beliefs about physical activity.[96] Campaigns achieved high recall with a median 70% (range 38–97%) of target group aware of the campaign. Six of 15 studies reported measures of knowledge or beliefs, of which three found significant increases in measures. Intention to be more active was measured in seven campaigns, with three finding an increase in intention to be active against four that found no change or a decrease. One of the campaigns included in the systematic review[109] reported that 'advice from social network and mass media' was related to trying to be more active ($p < 0.001$). The UK Active for Life campaign included in the review reported that those aware of the campaign at 1 year had been more active at baseline than those not aware of the campaign.[99] The walking campaign in Scotland reported that, at a population level, the campaign had a notable impact on knowledge about walking but had little impact on behaviour.[100]

The additional VERB campaign targeted at 9–13-year-olds found that 90% of children who were aware of VERB also demonstrated understanding of the messages. A significant positive relation was detected between the level of awareness of VERB and weekly median sessions of free-time physical activity ($p < 0.05$).[97]

7.6 Sub questions

7.6.1 Variation by gender, age, ethnicity, religious practices or social group

The results suggest that the effectiveness of campaigns to raise awareness may vary by age, gender, ethnicity and social status. The findings of the general population survey following the BBC's 'Fighting fat, fighting fit' campaign suggest that men, people under 25 years, lower socioeconomic status groups and black and minority ethnic groups (BMEGs) may require specifically targeted campaigns as significantly fewer participants in these groups failed to complete the follow-up survey (registrants survey). These findings are reflected in the 'Active for life' campaign where greatest awareness was found among 16–24-year-olds (65%)

and lowest awareness among 65–74-year-olds (25%).[99] Men were more aware than women as were those with children living at home and those from lower social grades. Changes in the proportion of participants who knew about the recommendations were higher in women, older age groups and social grades C II/DE. The VERB campaign aimed at 9–13-year-olds was found to be more effective for younger children, girls, white children (compared with Latino/Hispanic and black children from lower-income households and children living in high-density urban areas.[97]

The Food Safety Promotion Board review (McDermott, unpublished data, 2006) also reported that there was some evidence that particular population subgroups (for example, males and females, different age groups, different ethnic groups) respond in different ways to social marketing interventions. However, no clear picture emerged, and there were too few studies to examine differential impact more rigorously. The review concluded that interventions with more specifically defined target groups appeared to be more effective than those with more broadly defined target groups.

7.6.2 Influence of previous weight loss

It was not possible to answer this question from the evidence identified.

7.6.3 Source and mode of delivery

No evidence of effectiveness was identified to answer how best to engage people. Many of the other campaigns identified could be generalisable to the UK, particularly for motivated Caucasian females of higher socioeconomic status.

The systematic review of 15 mass media campaigns with an explicit focus on physical activity found that levels of awareness are likely to vary according to type of medium used and scale of the campaign.[96] The importance of measuring the dose of the intervention was highlighted, as there is a strong relation between amount of media exposure of a campaign message and the resulting level of awareness. The scale of expenditure, media exposure or outputs from the

campaigns was unclear in 10 of 15 campaigns studied. Of the UK studies included in the review, both the Health Education Board for Scotland and the FFFF campaigns found that awareness was greater for associated television programmes than radio programmes. For example, in the FFFF campaign, 87% of respondents said they were introduced to the campaign through television compared with 14% by radio.[90;96,104] The FFFF campaign was organised by media providers themselves rather than media space purchased at commercial rates which may have had an impact on the success of the campaign.

The Food Safety Promotion Board review (McDermott, unpublished data, 2006) concluded that interventions could be effective in all settings identified but it was not possible to explore any relation between setting type and effectiveness. Effectiveness seemed to be improved where the choice of setting appeared to have been carefully considered and was integral to the intervention strategy as opposed to being selected with little strategic purpose. These results suggest that the effects of social marketing interventions are likely to be enhanced if careful consideration is paid to the choice of setting and features of the setting are harnessed to add value to the intervention.

7.6.4 Potential negative impact

The systematic review of the effectiveness of food promotion to children concluded that food promotion can have and is having an effect on children, particularly in the areas of food preferences, purchase behaviour and consumption.[95] Most studies uncover an effect that will be harmful (because foods promoted are predominantly high in fat, salt and/or sugar) but there is evidence that promotion can have a beneficial effect.

7.7 Limitations of the review

The major limitation to the review was the design of the studies. There were few controlled before-and-after studies (CBAs) and many of these were evaluated cross-sectionally. Also the data pertaining to weight and behaviour are self-reported, which gives cause for concern regarding bias.

A range of large studies have not been included in this review due to a lack of evaluation or evaluation that did not meet the parameters of this review, including ‘The big fat problem’ and ‘Walking way to health’.

8 Prevention evidence summary: interventions for pre-school children and family-based interventions ('early years')

The following is based on an evidence review produced by the University of Teesside. Detailed evidence tables and supporting information are in Appendix 6.

8.1 Evidence statements (Table 8.1)

Table 8.1 Evidence statements and grading

No.	Statement	Grade	Evidence
Weight outcomes			
1	There is limited evidence that interventions which focus on the prevention of obesity through improvements to diet and activity appear to have a small but important impact on body weight that may aid weight maintenance	1+	Five RCTs, three of which prevented gain (Fitzgibbon et al.[110–111] [Hip-Hop; 1+], He 2004[112] [1+], STRIP[113–114] [1+]) and two found no difference between intervention and control (Healthy Start[115–116] [2++], Dennison et al. 2004[117] [1+])
2	Improvements in the food service to pre-school children can result in reductions in dietary intakes of fat and improved weight outcomes	1+	Body of evidence 1+: one systematic review (Worsley 2004[118])
3	No family studies were identified among children under 5 years of age	N/A	N/A
4	Family-based interventions that target improved weight maintenance in children and adults, focusing on diet and activity, can be effective, at least for the duration of the intervention	1++	Body of evidence 1++: one systematic review (MCLean et al. 2003[119] [1++]) and one RCT (Hopper 1996[120] [1+])

No.	Statement	Grade	Evidence
5	The effectiveness of interventions tends to be positively associated with the number of behaviour change techniques taught to both parents and children	1++	Body of evidence 1++: one systematic review (McLean et al. 2003[119])
6	It remains unclear whether the age of the child influences the effectiveness of family-based interventions compared with individual interventions	N/A	One study (Brownell et al. 1983[121]) in a systematic review (McLean et al. 2003[119] [1++]) suggested that more family interventions may be more effective in younger children
Diet and activity outcomes			
7	Interventions which do not identify favourable changes in weight outcomes may identify favourable changes in diet and/or activity outcomes (where recorded). The reasons for this are unclear	1+	Body of evidence, majority 1+: seven of the nine studies (Dennison et al. 2004[117] [1+], He 2004[112] [1+], Healthy Start[115–116] [2++], Koblinsky et al. 1992[122] [2+], McGarvey et al. 2004[123] [2+], Reilly and McDowell 2003[124] [grade to be checked on publication of full study], STRIP[113–125] [1+]) reporting significant effects, concurrent with conclusions of systematic review (Worsley 2004[118] [1+]). One study showed mixed results (Hip-Hop[110–111] [1+])
8	There is some evidence that interventions which do not focus on preventing obesity, but aim to bring about modest changes in dietary	2+	Healthy Start[115– 116] (2++) and Dennison et al. 2004[117] (1+) (Although STRIP[113–125]

No.	Statement	Grade	Evidence
	and physical activity behaviour, are unlikely to demonstrate an impact on body weight. However, there is evidence from cohort studies that people who habitually eat healthy diets and are physically active are more likely to maintain their weight over the long term		[1+] – aimed to improve cardiovascular disease – showed positive results for weight for girls) See energy balance statements with regard to cohort studies
9	There is evidence for small but important beneficial effects of interventions that aim to improve dietary intake (such as videos, interactive demonstrations, and changing food provision at nursery school) so long as these interventions are not solely focused on nutrition education alone	2+	Eight of the nine studies (Dennison et al. 2004[117] [1+], He 2004[112] [1+], Healthy Start[115–116] [2++], Hip-Hop[110–111] [1+], Koblinsky et al. 1992[122] [2+], McGarvey et al. 2004[123] [2+], Reilly and McDowell 2003[124] [1+], STRIP[113–125] [1+]) One CBA on education alone showed no effect (Horodynski et al. 2004[126] [2–])
10	The provision of regular meals in a supportive environment free from distractions may improve dietary intakes	4	Opinion of GDG
11	There is limited evidence that structured physical activity programmes within nurseries can increase physical activity levels	Grade pending	One RCT: 1+ (Reilly and McDowell 2003[124]) (grade to be checked on publication of full study)
12	Interventions which involve parents in a significant way may be particularly effective and can improve parental engagement in active play with children and a child's dietary intake	2+	Body of evidence 2+ (majority of studies included parents but McGarvey et al. 2004[123] [2+] Koblinsky et al. 1992[122] [2+]) specifically

No.	Statement	Grade	Evidence
			aimed at parents)
Generalisability			
13	The majority of interventions identified were conduced in the USA. However the findings are likely to be generalisable to the UK population	4	Opinion of reviewers and GDG
14	Interventions should be tailored as appropriate for lower-income groups	1+	Body of evidence 1+ and 2++: two RCTs (Dennison et al. 2004[117] [1+], Hip-Hop[110–111] [1+]) and one CCT (Healthy Start[115–116] [2++])
15	2–5 years is a key time to establish good nutritional habits especially when parents are involved.	1+	Body of evidence 1+: one systematic review (Worsley 2004 [118])
Implementation			
16	Interventions require some involvement of parents or carers	1+	Body of evidence 1+: virtually all included RCTs involved parents
17	There is limited evidence that interventions to increase opportunities for children to be active can be incorporated into nurseries and implemented by nursery staff	Grade pending	One RCT 1+ (Reilly and McDowell 2003;[124] grade to be checked on publication of full study)

CBA, controlled before-and-after study; CCT, controlled clinical trial; GDG, Guidance Development Group; N/A, not applicable; RCT, randomised controlled trial; STRIP,Turku Coronary Risk Factor Intervention Project for Children.

See Appendix 6 for associated evidence tables.

8.2 Methodology

Database searches were carried out in December 2004 for papers published from 1990 onwards (1995 onwards for systematic review level evidence). A final update search was completed on 1 December 2005 on a reduced number of databases. The inclusion and exclusion criteria for the review adhered to the standard public health review parameters. From an initial 5487 hits, 106 papers were assessed in detail of which 13 papers met the critical appraisal criteria for inclusion in evidence tables.

8.3 Weight outcomes

8.3.1 2–5-year-olds

Five interventions were identified among 2–5-year-old children and their families which reported a weight outcome. Of these, only two studies were designed specifically for the prevention of obesity.[110,112] Five of the six studies were/are being conducted in a nursery or childcare setting, but all had/have some degree of family involvement. The STRIP (Turku Coronary Risk Factor Intervention Project for Children) study was conducted in well-infant clinics in Finland.[113] Due to the limited evidence available on 2–5-year-olds, the paper by He[112] was included despite the fact that the children were overweight at baseline (the paper met the other inclusion criteria for this review).

Three[110–113] of the five studies found some evidence that the intervention prevented unhealthy weight gain leading to obesity, compared with controls. Ethnic minority children in Head Start programmes in Chicago who received a 14-week diet and physical activity intervention had significantly smaller increases in body mass index (BMI) compared with control children at 1-year ($p = 0.01$) and at 2-year ($p = 0.02$) follow-up (after adjustment for baseline age and BMI).[110] Girls (but not boys) who received the intervention in the Finnish STRIP study gained significantly less weight between the ages of 2 and 3 years compared with controls.[113] Chinese children who received the highly intensive intervention in the study by He[112] gained much less weight over time compared with controls.

Two US-based studies reported no significant differences in weight between intervention and control children.[115–116]

8.3.2 Family-based interventions for 5–18-year-olds

One systematic review[119] and one additional randomised controlled trial (RCT)[120] considered the efficacy of interventions targeted at 5–18-year-olds, and their families/carers, in terms of helping children maintain a healthy weight/prevent overweight or obesity.

The systematic review found that in children aged 5–12 years, five of the seven interventions reported no significant difference in weight outcomes at follow-up ranging from 1 to 5 years.[119] The effectiveness of interventions tended to be positively associated with the number of behaviour change techniques taught to both the parents and children. The additional RCT reported that two school-based studies, one among children aged 9 years and one among children aged 12 years, resulted in no significant differences between groups in post-intervention weight or skinfold thickness at 6 and 8 weeks follow-up.[120]

Among adolescents, one study reported that treating the mother and child separately appeared to be more effective than treating them together, or treating the child alone.[121]

8.4 Diet and activity outcomes

8.4.1 2–5-year-olds

The five studies with weight outcomes among 2–5-year-olds also reported diet and/or physical activity outcomes. Four additional studies assessing dietary and physical activity outcomes among 2–5-year-olds were also identified, all of which were conducted in a nursery or childcare setting, and had a degree of family involvement.[122–126]

Eight of the nine identified studies reported that a range of self-reported diet and physical activity outcomes improved following intervention. It is of note that

although all five of the studies with weight outcomes reported improvements in some indicators of diet and/or physical activity following intervention only three reported improvements in weight outcomes.[110,112,113] The reason for this disparity remains unclear.

8.4.1.1 Diet

Mean fat intake at 5 years of age was significantly lower in the intervention group of the STRIP study compared with the control group.[113] Similarly, the Hip-Hop to Health Jr. study demonstrated significant difference in per cent of calories from saturated fat at 1-year follow-up between intervention and control children (11.6% vs 12.8%, p = 0.002).[110–111] Differences were not observed for the other dietary variables assessed.

Koblinsky and coworkers[122] reported that a US-based parent education programme focusing on nutrition-related behaviour resulted in the intervention group consuming significantly more fruits, vitamin C rich fruits, green vegetables, breads, rice/pasta and orange vegetables than the control group.

McGarvey and coworkers[123] reported that attending educational sessions significantly improved the frequency of parents offering their child water. The results of a systematic review[118]) support the results of these individual studies. Two of the five studies of relevance showed beneficial effects on nutritional content of daycare menus[127] and dietary fat intake was significantly reduced in the intervention group of the STRIP study[113] (included in both systematic review and individual studies).

The only study that reported no effectiveness of the intervention[126] focused solely on nutrition education; the authors concluded that a change in knowledge and attitudes is insufficient to change eating habits.

8.4.1.2 Physical activity

The UK-based MAGIC (Movement and activity Glasgow intervention in children) pilot study reported that a nursery-based structured physical activity programme

resulted in a significant improvement in children's physical activity level (based on accelerometry output). McGarvey and coworkers[123] reported that attending educational sessions significantly improved the frequency of parents engaging active play with their child. The UK-based study by Dennison and coworkers[117] was successful in significantly reducing television viewing (the primary aim of the study) but did not show significant improvements in snacking or watching television during dinner (specific findings not reported).

8.4.2 Family-based interventions for 5–18-year-olds

Hopper[120] reported the findings of two interventions. Both treatment groups in the first intervention scored significantly higher than the control group on exercise knowledge and obtained a lower proportion of their energy from fat. In the second intervention, the treatment group scored higher than the control group on post-intervention fitness and nutrition knowledge as well as consuming more servings of fruit and vegetables. Within the treatment group a measure of the degree of family involvement significantly correlated with a reduction in intake of fat and cholesterol.

8.5 Sub questions

8.5.1 Variation by gender, age, ethnicity, religious practices or social group

The included studies provided little information on how the effectiveness of interventions varied by gender, age, ethnicity or socioeconomic status of the children or families. Three studies were conducted with low-income families, and the interventions were tailored accordingly.[110,115,117] Two studies reported no significant differences by gender[110,115] and one study reported no significant differences by age.[110–111] One study considered effectiveness by ethnicity and reported that there was a significant difference in weight-to-height ratio for white participants but not for African American or Hispanic participants.[115]

8.5.2 Influence of previous weight loss

It was not possible to answer this question from the evidence identified.

8.5.3 Source and mode of delivery

The evidence identified suggests that many of the interventions cited could be implemented in the UK. It seems reasonable to assume that such interventions could be implemented within the existing programmes and services. However, the evidence identified does not provide a firm answer on the most effective source of delivery. The majority of interventions took place in daycare or clinic settings. The data suggest that interventions work best where they are focused on preventing obesity (rather than simply improving diet and levels of physical activity) and delivered by researchers. In terms of the mode of delivery, the evidence identified suggests that intensive interventions work best and education alone is ineffective.

8.5.4 Potential negative impact

None of the identified papers reported negative impacts/harms.

8.6 Limitations of the review

There is a dearth of controlled studies that met the inclusion criteria for this review and no UK studies with weight and height outcome data were identified (one study [MAGIC] is expected to be published by May 2006). Potentially useful corroborative data from national programmes which are implemented locally, such as Sure Start, were not identified.

9 Prevention evidence summary: school-based interventions

The following is based on an evidence review produced by the University of Teesside. Detailed evidence tables and supporting information are in Appendix 7.

9.1 Evidence statements (Table 9.1)

Table 9.1 Evidence statements and grading

No.	Statement	Grade	Evidence
Weight outcomes			
1	The evidence on the effectiveness of multi-component school-based interventions to prevent obesity (addressing the promotion of physical activity, modification of dietary intake and reduction of sedentary behaviours) is equivocal. Some identified interventions demonstrated a reduction in mean BMI and the prevalence of obesity while the intervention was in place, but this finding was not universal. UK-based evidence in particular is lacking	2+	Four studies, two 1+ RCTs (Sallis et al. 2003[128] [boys; girls NS], Gortmaker et al. 1999[129] [girls; boys NS]) and two 2+ CCTs (Graf et al. 2005,[130] Kain et al. 2004[131] [boys; girls NS]) Six did not show significant improvements in weight/BMI (Warren et al. 2003 [132] [1+], Sahota et al. 2001[133][1+], Caballero et al. 2003[134] [1+], Donnelly et al. 1996[135] [2+], Neumark-Sztainer et al.[136] 2003 [2+], Story et al. 2003[137] [1+])
2	School-based physical activity interventions (physical activity promotion and reduced television viewing) may help children maintain a healthy weight		Flores 1995[138] (1+), Robinson 1999[139] and one CCT (2+) (Stephens 1998[140]) Six physical activity studies did not show improvement in weight (Pate et al. 2005[141] [1+], Schofield et al. 2005[142] [2+], Jamner et al. 2004[143] [2+], Sallis et al. 1993/7 [144,145] [1+], Pangrazi et al. 2003[146] [2+], Trudeau et al. 2000/1[147,148] [2–]) one showed trends in improvement with age in BMI

No.	Statement	Grade	Evidence
			in girls (Mo-suwan et al.[149] 1998 [1+])
3	There is limited evidence from one UK-based study to suggest that interventions to reduce consumption of carbonated drinks containing sugar may have a role in reducing the prevalence of overweight and obesity	1++	One 1++ RCT (James et al. 2004[150])
Diet and activity outcomes			
4	There is a body of evidence that school-based multi-component interventions addressing various aspects of diet and/or activity in the school, including the school environment are effective in improving physical activity and dietary behaviour, at least while the intervention is in place. However, UK-based evidence to support multi-component interventions (the 'whole-school approach') is limited	1+	Eight studies 1+: Simon et al. 2004,[151] Pate et al. 2005,[141] Caballero et al. 2003,[134] Leupker et al. 1996,[152] Trevino et al. 2004/5,[153,154] Sahota et al. 2001,[133] Warren et al. 2003,[132] Vandongen et al. 1995 [155] Four studies 2+: Donnelly et al. 1996,[135] Manios 1998/99/2002,[156–157] Anderson 2000 from Woolfe and Stockley 2005 review[158] (2+)
5	There is a body of evidence to suggest that short- and long-term school-based interventions to improve children's dietary intake may be effective, at least while the intervention is in place. This includes interventions aiming to increase fruit and (and to a lesser extent) vegetable intake, improve school lunches and/or promote water consumption	1+	Two non-systematic reviews (French and Wechsler 2004[159] [2+], Woolfe and Stockley 2005[158] [2+]) Ten RCTs 1+: James et al. 2004.[150] Perry et al. 2004,[160] Caballero et al. 2003,[134] Sallis et al. 2003,[128] Sahota et al. 2001,[133] Warren et al. 2003,[132] Leupker et al. 1996,[152] Vandongen et al. 1995,[155] Gortmaker et al. 1999,[129] Trevino 2004/5 et al.[153,154] Four studies 2+: Bere et al. 2005,[161] Loughridge and Barratt 2005,[162] Donnelly et al. 1996,[135] Manios et al. 1998, 1999, 2002[156–157]

No.	Statement	Grade	Evidence
			One study 2–: Horne et al. 2004[163]
6	UK-based evidence suggests that school children with the lowest fruit and vegetable intakes at baseline may benefit more from the school-based interventions than their peers	2+	Bere et al. 2005[161] (2+), Horne et al. 2004[163] (2–), Woolfe and Stockely 2005 review[158] (2+)
7	There is evidence from multi-component interventions to suggest that both short- and long-term physical activity focused interventions may be effective, at least while the intervention is in place	1+	Six multi-component studies supportive Five studies 1+: Simon et al. 2004,[151] Pate et al. 2005,[141] Caballero et al. 2003,[134] Leupker et al. 1996,[152] Trevino et al. 2004/5[153,154] One study 2+: Manios et al. 1998/9/2002[156–157]
Other outcomes			
8	No negative outcomes were reported in the identified studies. One multi-component study showed that measures of extreme dieting behaviour remained unchanged	1+	Two papers (both 1+) from one study: Gortmaker et al. 1999[129] and Austin et al. 2005[164]
Generalisability			
9	Most of the evidence for school-based interventions is non-UK based. However, it is likely that the findings are generalisable to the UK	4	GDG and reviewers' opinion
Implementation			
10	There is limited UK evidence to indicate that in terms of engaging schools it is important to enlist the support of key school staff	2+	One paper (Anderson 2000, 2+) included in review by Woolfe and Stockley 2005[158] (2+)
11	There is a body of evidence to suggest that young people's views of barriers and facilitators to healthy eating indicated that effective interventions would (i) make healthy food choices accessible, convenient	1++	EPPI-[165,166]

No.	Statement	Grade	Evidence
	and cheap in schools, (ii) involve family and peers, and (iii) address personal barriers to healthy eating, such as preferences for fast food in terms of taste, and perceived lack of will-power		
12	There is a body of evidence to suggest that young people's views on barriers and facilitators suggest that interventions should (i) modify physical education lessons to suit their preferences, (ii) involve family and peers, and make physical activity a social activity, (iii) increase young people's confidence, knowledge and motivation relating to physical activity, and (iv) make physical activities more accessible, affordable and appealing to young people	1++	EPPI[167,168]

BMI, body mass index; CCT, controlled clinical trial; EPPI, ; GDG, Guidance Development Group; NS, not significant; RCT, randomised controlled trial; EPPI: Evidence for Policy and Practice Information and Co-ordinating Centre.

See Appendix 7 for associated evidence tables.

9.2 Methodology

Database searches were carried out in October 2004 for papers published from 1990 onwards (1995 onwards for systematic review level evidence). A final update search was completed on 1 December 2005 on a reduced number of databases. The inclusion and exclusion criteria for the review adhered to the standard public health review parameters. A range of UK government, government agency and non-governmental organisation websites were also searched.

From an initial 9387 hits, 92 papers were assessed in detail, of which 40 papers met the critical appraisal criteria for inclusion in evidence tables.

9.3 Weight outcomes

Twenty-five studies were identified which reported weight outcomes among school children aged 4.5–15.8 years. The majority of studies were conducted in primary school children; only eight were definitely conducted in secondary school children.[129,136,138,141–144,155] The majority of the studies were conducted in America; three were conducted in UK primary schools.[132,133,150]

The results suggest that such interventions may have the potential to prevent excess weight gain and obesity in children. Interventions may be more effective in primary school children than older children. Although the evidence from UK-based studies is limited many of the identified non-UK-based interventions could be generalisable to the UK.

9.3.1 Dietary interventions

One high-quality, UK-based randomised controlled trial (RCT) that aimed to help 7–11-year-old children reduce their consumption of carbonated drinks reported a 7.5% increase in overweight and obesity in the control group at 12 months compared with a 0.2% decrease in the intervention group.[150] No difference was observed in mean body mass index (BMI).

9.3.2 Physical activity interventions

Ten interventions, five RCTs and five controlled clinical trials (CCTs), aimed to increase physical activity levels.[138–141;144,147–149] No UK-based interventions were identified, with the majority undertaken in the USA. The evidence suggests that such interventions may help children maintain a healthy weight by preventing them from becoming overweight, but the evidence is inconsistent. The results suggest that interventions appear more successful in primary school children than in secondary school children.

Of the 10 studies identified, 4 showed statistically significant improvements in mean BMI following a physical activity intervention.[138,139,149,169] Of these four studies, two reported significant differences for girls only.[138,149] With the

exception of Flores' study,[138] participants in these studies tended to have a mean age less than 10 years of age.

Robinson[139] reported that a 6-month intervention to encourage reduction in television watching among 9-year-olds resulted in a significant reduction in BMI, skinfold thickness, waist circumference and waist-to-hip ratio in intervention children compared with controls. Stevens and coworkers[169] reported that a 15-week physical activity intervention in low-income, minority school children (approximately age 8) demonstrated significantly more weight gain among controls and significant decreases in skinfold thickness among intervention children. Flores[138] reported that a 12-week aerobic dance programme significantly reduced BMI but only among 10–13-year-old girls. Mo-suwan and coworkers[149] reported mixed results for a 30-week aerobic exercise programme – encouraging a pre-class walk and three 20-minute aerobic sessions a week – in kindergarten children (aged 4–5 years) in Thailand. Although a reduction in BMI occurred in both intervention and control groups and was not significantly different between groups, the intervention girls had lower likelihood of having an increased BMI slope than the control girls (odds ratio: 0.32; 95% confidence interval [CI]: 0.18 to 0.56). This was not found for boys.

Six of the studies did not report significant improvements in mean BMI. Three studies among female adolescents in secondary schools – a 6-month intervention promoting a supportive school environment and programme champion,[141] a 12-week intervention targeting moderate activity (walking) in low active girls[142] and a 4-month intervention promoting additional PE classes[143] – demonstrated no difference in percentage overweight[141] or mean BMI.[142,143] Two studies among children (average age 9–10 years) – a 12-week physical activity programme supplementary to usual physical education (PE)[146] and a 2-year specialist physical activity promotion programme[144;145] – found no difference in mean BMI between control and intervention groups. One poor-quality, 22-year follow-up of a sub-sample of adults who participated in a 6-year physical activity

intervention as primary school children[147;148] showed no significant differences between groups on any anthropometric measure.

9.3.3 Diet and physical activity

Ten school-based interventions included diet and physical activity components and aimed to prevent obesity. [128,130, 131, 132,133, 134, 135 , 136, 137,129;164]

Three further studies aimed to prevent cardiovascular disease[152,155,156;157;170] and one aimed to prevent diabetes. [153;154] The findings are inconsistent, but overall suggest that such interventions may help children maintain a healthy weight by preventing them becoming overweight. It remains unclear why some of the studies were effective whereas others were not, though the range of components in the intervention, and the extent of dietary change and amount of physical activity promoted may play a role.

Four of the 10 studies, all non-UK-based, showed significant improvements in mean BMI in the intervention groups compared with the control groups. Graf and coworkers[130] reported that in the STEP 2 programme in primary school children (approximate age 8) the increase in BMI and waist circumference tended to be lower in those undergoing intervention than controls. Two interventions found significant differences in mean BMI between intervention and control groups in 11-year-old[131] and US grades 6–8[128] boys only -– Kainand coworkers[131]) following a 6-month intervention in Chile and Sallis et al.[128] following a 2-year environmental, policy and social marketing intervention in middle school (mean age not available). The 2-year Planet Health programme among US 12-year-olds, promoting physical activity, improved diet and reduction of sedentary behaviours (with a strong emphasis on reducing television viewing), resulted in a reduction in the prevalence of obesity in intervention girls (but not boys) compared with controls.[129;164]

Two of the six studies which found no significant difference in mean BMI between intervention and control children were UK based. Sahota and coworkers[133] reported that an intervention involving the whole school community (including

parents, teachers and catering staff), which aimed to improve school meals, tucks shops, the curriculum, PE and playground activities, resulted in no difference in BMI between intervention and control children at 1 year. The other UK-based intervention among primary school children was insufficiently powered to detect differences in BMI at 14 months' follow-up.[132]

Four non-UK-based studies reported that intervention had no effect on BMI. Callabero and coworkers[134]) reported that a 3-year intervention among US primary school children resulted in no significant difference in mean weight, BMI, per cent body fat or skinfold thickness. A 2-year US-based intervention showed significant increase in BMI in both intervention and control from baseline to follow-up but no significant difference between groups in a small sub-sample with complete data.[135] Two further interventions were among girls only. Neumark-Sztainer and coworkers[136] reported that a physical education programme (dance classes) incorporating (to a limited extent) personal, behavioural and nutritional elements resulted in no significant difference in mean BMI at 8-month follow-up. A short-term feasibility study in African American girls – lunchtime clubs promoting nutrition and physical activity – showed no significant differences in anthropometric measures between intervention and control.[137]

Three additional school-based interventions focused on dietary intake and physical activity to improve cardiovascular health. One high-quality Greek-based CCT demonstrated significant improvement in mean BMI and skinfold at 3 years ($p < 0.005$) and 6 years ($p < 0.05$) follow-up.[156;157;170] Conversely, two RCTs[155,152]) found no significant different in mean BMI between intervention and control at 1- and 3-year follow-up, respectively). One additional study aimed to improve physical fitness and prevent diabetes in low-income Mexican American 9-year-olds included a parent education and involvement programme, a classroom health and physical education curriculum, a student after school health club and a school cafeteria programme.[153;154] No difference in per cent body fat was observed at 8 months (interim follow up for on-going study).

9.4 Diet and activity outcomes

Two systematic reviews and 18 RCTs/CCTs reported diet outcomes and 18 RCTs/CCTs reported activity outcomes. The age of children within the studies ranged from 4.5 years to 15.8 years, with the majority of studies being undertaken among children 12 years and under. The majority of studies could be considered multi-component, aiming to address a range of dietary and/or activity measures. The majority of identified studies were not undertaken in the UK but the results are likely to be generalisable to the UK.

The majority of interventions were shown to be effective. The results suggest that both short- and long-term interventions are effective, including multi-component interventions, although the effects may not be maintained once the intervention has ended.

9.4.1 Diet

9.4.1.1 Fruit and vegetable intake

All but one study in a review of five high-quality US-based CCTs over a minimum of 1 year[159] reported significant increases in daily fruit and vegetable intake in intervention versus control school children (of various ages). Increases in fruit intake ranged from 0.2 to 0.6 servings per day and vegetable intake from 0 to an increase of 0.3 servings per day. A further review of five school-based multi-component interventions to increase fruit and vegetable intake in UK-based primary and secondary schools showed positive and significant increases in intake, especially of fruit, in primary school children.[24] Children with the lowest intakes at baseline appeared to benefit the most from the intervention.

The results of the two reviews are mirrored in the additional studies that focused solely on fruit and vegetable consumption.[160,161,163,171] Analysis of the UK national school fruit scheme[171] showed that 4–6-year-old children receiving school fruit had a significantly higher daily intake than controls (117 g/day compared to 67 g/day, respectively) but this difference was not maintained 2 years after

intervention when free fruit was no longer available. Similarly, children receiving free fruit through the Norwegian School fruit scheme consumed significantly more fruit and vegetables at 9-month follow-up, with the strongest effects observed in children with the lowest intakes at baseline.[161] No significant differences were observed between children in paid and the no fruit groups. A 2-year cafeteria-based intervention aimed at primary school children significantly improved children's total fruit and vegetable intake, predominantly due to increases in fruit consumption (no significant increases juices or vegetables was observed).[160] The poor quality UK-based 'Food dudes' video intervention among socially deprived primary school children demonstrated that the 16-day intervention resulted in significant improvements in fruit and vegetables intake at 4-month follow-up compared with the controls.[163]

A US-based intervention[172] focusing on nutrition lessons for adolescents, newsletters for parents and some school modification to increase consumption of fruit and vegetables and low-fat foods, reported no significant differences in intake between control and intervention schools at 2-years' follow-up.

9.4.1.2 School lunches and associated food provision

Three large-scale interventions aimed to modify school lunch provision: one significantly reduced children's total energy and fat intake;[152] one reduced children's fat intake but not total energy intake in school lunch observations[134]) and the last showed no difference in fat intake.[135] One additional study within the fruit and vegetable intervention review showed that reducing relative prices on low-fat snacks was effective in promoting lower-fat snack purchases from vending machines in adolescents over 1 year.[159]

A review of five UK school-based interventions concluded that all five interventions considered (fruit tuck shops, CD-ROM, art/play therapy, whole-school approach and a family-centred school-based activity) have the potential to be incorporated into a health promoting school approach and could be more

effective than stand-alone interventions.[158] The authors highlighted the importance of actively engaging schools for the success of the intervention.

9.4.1.3 Water

Two UK-based interventions focused on water intake were identified, one aiming to reduce consumption of carbonated drinks in primary schools over 12 months[150] and the other comparing access of cooled filtered water with and without associated promotion over 3 months in secondary schools.[162] The findings suggest that such interventions can significantly increase water intake, particularly when actively promoted. The authors reported that the children enjoyed the cooled filtered water and that the intervention was relatively inexpensive and sustainable.

9.4.1.4 Multi-component studies

Eight of the 11 studies considering multi-component interventions demonstrated some significant improvements in dietary behaviour (either total energy intake or fat intake).

Two UK-based multi-component interventions were identified. Sahota et al.[133] reported that 7–11-year-old children in schools adopting a whole-school approach were consuming significantly more vegetables at 1-year follow-up (weighted mean difference 0.3 portions/day, 95% CI 0.2 to 0.4).

Warren and coworkers[132] reported that 5–7-year-old children in the intervention group consumed significantly more vegetables ($p < 0.05$) and fruit (girls only) ($p < 0.01$). No significant differences were observed in children's consumption of confectionary or crisps or their parents' diet (as measured by food frequency questionnaire).

Two US-based multi-component interventions focused on modification to school lunches. A large 3-year intervention[134] in American Indian primary school children resulted in significantly lower total daily energy intake (1892 kcal vs 2157 kcal) and percentage energy from fat (31.1% vs 33.6%) in intervention versus control.

Donnelly and coworkers[135]) reported that a 2-year US-based intervention resulted in lunches containing significantly less fat and sodium and more fibre but 24-hour recall showed significant differences in actual intake between groups for sodium only.

A 2-year US-based intervention promoting modification of dietary intake, physical activity and a reduction of sedentary behaviours (with a strong emphasis on reducing television viewing) among 11–12-year-old children reported significant increases in fruit and vegetable consumption and reduced total energy intake among intervention girls only.[129]

Three large, long- to medium-term studies aimed at reducing therisk of cardiovascular disease demonstrated significant reductions in energy and fat intake. A 6-year intervention among 5–7-year-olds in Crete resulted in intervention children consuming significantly less total energy intake, total fat and total saturated fat compared with control children ($p < 0.05$ for all).[156;157;170] Similarly, Luepker and coworkers[152]) reported that, among 8–9-year-old American children, significant reductions in the percentage of fat and energy in lunches resulted in self-reported energy intake ($p < 0.01$) and per cent energy from fat (32.7% to 30.3%) ($p < 0.001$) being significantly lower among intervention children compared with control at 3-year follow-up. A 1-year Australian programme focusing on school- and home-based interventions among 10–12-year-olds resulted in a significant decrease in saturated fat intake (girls only).[155]

Three interventions did not appear to be effective in terms of dietary intake. A 2-year US-based environmental, policy and social marketing intervention in middle school students showed no differences in fat intake at the school level but no actual data was reported.[128] An intervention encouraging reduction in television watching did not produce a significant difference in daily servings of high-fat foods between the intervention and control groups at 6 months.[139] An ongoing intervention among low-income Mexican American 9-year-olds aiming to improve

physical fitness and prevent diabetes and incorporating a dietary component reported that dietary fat intake did not differ between groups (p = 0.52) at 8-month interim follow-up.[153;154]

9.4.2 Physical activity

9.4.2.1 Active play

Two studies aimed to increase active play. A 12-week, high-quality US-based intervention promoting active play supplementary to usual PE among 9-year-olds showed significant improvements in the intervention children compared with the controls, particularly among girls (p < 0.001).[146] Similarly, Warren and coworkers[132]) reported that a small but high-quality intervention over 14 months resulted in 5–7-year-old children in the intervention group being more active in the playground than the control group children.

9.4.2.2 Pedometers

A pilot study among inactive 15–16-year-old girls in Australia reported that mean 4-day step count was significantly higher in the pedometer group versus control at 12 weeks' follow-up (p = 0.03).[142] There were no significant changes in moderate or vigorous physical activity.

9.4.2.3 PE classes

Four studies promoted additional structured activity in schools. Of these, one reported significant increases in activity levels,[143] two reported equivocal findings[135,136]) and one reported no effect.[144;145]

Jamner and coworkers [143] reported significant increases in moderate physical activity among female adolescents (p = 0.007), particularly 'lifestyle' activity, at 4-month follow-up, following the promotion of 60-minute PE classes 5 days a week and associated education classes.

Two interventions reported equivocal results. Donnelly and coworkers[135] reported that although structured 30–40-minute activity classes three times a week for 9-

year-olds resulted in intervention children being 6% more active in the classroom at 2 years' follow-up, outside the classroom, the intervention children's activity levels were 16% less than the control group. However, overall change in physical activity was not reported. Neumark-Sztainer and coworkers[136] reported that an obesity programme for adolescent girls, focusing on the replacement of usual low-impact PE classes with high aerobic dance classes, resulted in a progression in physical activity stage based on the Stages of Change Model ($p = 0.004$) at 8-month follow-up. However, there were no significant differences between intervention and control in actual physical activity level or sedentary behaviour.

A 2-year physical education intervention among 9–10-year-old children promoting three 30-minute activity sessions a week, parental newsletters and weekly 30-minute 'self-management' training, reported no significant groups differences on physical activity level outside school.[144;145]

9.4.2.4 Television viewing

Two US-based interventions aimed to reduce television viewing. A 2-year multi-component intervention among 11–12-year-olds with a focus on sedentary activities resulted in a significant reduction in television viewing.[129] However, no information was provided on overall changes in activity levels. A 6-month intervention among 9-year-olds significantly decreased children's reported television viewing but did not significantly increase daily physical activity levels (although the intervention did not appear to promote alternative activities).[139]

9.4.2.5 Multi-component interventions

Eight of the identified studies could be considered as multi-component and focusing on various aspects of the school (and home and/or wider community) environment. The majority (six) of these interventions demonstrated significant increases in physical activity levels in the intervention compared with control.[134;141;151-154;157;170;173]

A large 3-year physical activity and dietary intervention in American Indian primary school children, including structured activity sessions, exercise break

time between lessons and class room curriculum as well as dietary intervention, resulted in self-reported physical activity levels being significantly higher among intervention compared to control.[134] Two studies aiming to improve cardiovascular health also provide long-term results. An intervention among children in Crete, including class room curriculum and two 45-minute structured physical activity sessions per week, showed a significant increase in reported time spent in leisure time physical activity in intervention children than controls ($p < 0.05$).[156;157;170] Similarly, a large 3-year US-based intervention among 8–9-year-olds, including both a school and home element, with enhanced PE at school, curriculum information, training of teachers and family education packs, resulted in significantly more daily vigorous physical activity reported by intervention children than controls ($p < 0.003$).[152]

There is evidence that interventions are also effective over shorter time periods. Pate and coworkers[141] reported that a high-quality, US-based intervention among adolescent girls, which included a supportive school environment for physical activity and a programme champion, demonstrated a significant increase in self-reported vigorous activity among intervention girls compared with control girls at 6 months. Simon and coworkers[151] reported that a whole school/community intervention among French 11–12-year-olds resulted in a significant reduction in the proportion of intervention children not engaging in physical activity, significant increase in leisure time activity and significant reduction in sedentary activities, in both boys and girls at 6-month (interim) follow-up. A study among low-income Mexican American 9-year-olds, which aimed to improve physical fitness and prevent diabetes, reported that pre- and post-intervention physical fitness score was significantly different between intervention and control at 8-month (interim) follow-up.[153;154]

Two interventions were largely ineffective. A study of a US-based 2-year environmental, policy and social marketing intervention in middle school students reported that although intervention schools increased physical activity over time at a greater rate than control schools, survey data of a sample of individual

children suggested that the intervention had no significant impact on reported physical activity or participation in sedentary behaviours.[128] A UK-based RCT considering a 'whole-school approach' to obesity among 7–11-year-olds found that a whole-school approach resulted in no significant difference in sedentary behaviour or physical activity at 12 months.[133]

9.4.2.6 Corroborative evidence

Corroborative evidence is available from four large-scale systematic reviews that evaluated barriers and facilitators to healthy eating and physical activity among children and adolescents.[165-168] Only some of the included studies were conducted in the UK.

Diet

Young people's views of barriers and facilitators to healthy eating indicated that effective interventions would (i) make healthy food choices accessible, convenient and cheap in schools, (ii) involve family and peers, and (iii) address personal barriers to healthy eating, such as preferences for fast food in terms of taste, and perceived lack of will-power.[165] The success of school-based interventions[166] appeared to depend to a large extent on the enthusiasm of staff and parents. Interventions were well-received in most cases, although a recurring theme was that schools lacked the time and resources for such projects. One of the identified interventions met with resistance from teachers and waning enthusiasm from students and parents. In this case, more training for the teachers might have provided more motivation, enthusiasm and skill. One study noted that young women tended to enjoy the intervention more than young men, and that peer leaders were particularly well received.

In general teachers found it difficult to fit nutrition education in to the curriculum and were concerned that they lacked the skills, training and support to deliver high-quality nutrition lessons. Fruit tuck shops were considered valuable to other areas of learning, such as English and art through promotion exercises, and maths via the handling of money.

Activity

The main barrier identified by staff developing school-based interventions was a lack of time, resources and adequate training. Young people's views on barriers and facilitators suggest that interventions should:

- modify PE lessons to suit their preferences
- involve family and peers, and make physical activity a social activity
- increase young people's confidence, knowledge and motivation relating to physical activity
- make physical activities more accessible, affordable and appealing to young people.[166;166-168]

Interventions should address the barriers and facilitators to participation in physical activity identified by children:

- providing activities that are enjoyable, in a social atmosphere, giving children some choice, and making children aware of how sedentary activities such as television watching are
- involving parents in interventions
- improving children's access to physical activity opportunities.

Three additional studies provide corroborative evidence. A cross-sectional analysis in urban primary schools reported that being driven to school did not affect the overall physical activity levels of 5-year-olds.[166;174] However, the generalisability of these findings is limited given that the time spent walking to school at 5 years of age is likely to be a very small proportion of overall activity levels. The authors reported that social status was not a confounding factor (but data were not presented). A randomised trial of advice on school travel plans[175] (which did not meet inclusion criteria for efficacy but are included for corroboration) showed that at 1-year follow-up the proportion of children walking,

cycling or using public transport on the school journey was similar in intervention and control schools. One small-scale short-term study in UK schools evaluated the effects of painting a school playground with bright and colourful markings on physical activity in primary school children.[176] Although the markings successfully increased activity levels in intervention children, the results are confounded by the fact that the control school also increased availability of skipping ropes and balls.

9.5 Essential elements of a 'whole-school' approach

The National Healthy Schools Programme (NHSP) advocates that a whole-school approach addresses:

- leadership, management and managing change
- policy development
- curriculum planning and resourcing including external agencies
- teaching and learning
- school culture and environment
- giving pupils a voice
- provision of pupils' support services
- staff professional development needs, health and welfare
- partnerships with parents/carers and local communities
- assessing, recording and reporting pupils' achievements.

The NHSP has only recently recognised the potential contribution of the whole-school approach to obesity prevention and so far there is little formal evaluation of this approach. Caution has been taken in retrospectively assessing any of the schools studies using a definition of 'whole-school approach'. However, many of

the interventions identified could be considered as taking a whole-school approach (particularly those which were multi-component and addressing elements of the whole of the school [and in some instances wider community] environment).

Only one UK-based study explicitly reported adopting a whole-school approach to implementing a diet and physical activity intervention.[133] The intervention was underpinned by the Health-Promoting Schools philosophy and the intervention involved the whole school community including parents, teachers and catering staff. At 1 year, there was no difference in change in BMI between the children in the two groups. Two UK-based studies, one study aiming to increasing fruit and vegetable consumption (Anderson in Woolfe and Stockley's review[158]) and one study aiming to provide 'healthier' vending[158;177] were shown to be effective. However, the elements of the approach which contributed to effectiveness were not identified.

9.6 Sub questions

9.6.1 Variation by gender, age, ethnicity, religious practices or social group

There appears to be a trend for primary school girls to do better regarding weight outcomes in physical activity interventions and for boys to do better in diet and physical activity interventions to prevent obesity. Further unpicking of the type of interventions that appeal to boys and girls is warranted.

The findings suggest that interventions may be effective in lower income ethnically diverse groups although the data are limited. The majority of interventions were in Caucasian children although six US-based studies were conducted in an ethnically diverse sample,[129;138;140;141;143;152;158;177] one in low-income African American girls,[137] one in American Indian primary school children, [134] and one in low-income Mexican American school children.[153;154] One study also stated it took place in a low-income population[169] and in another three studies[131;135;144] at least one third of the children received free school lunches.

Additional evaluation of UK school breakfast clubs[178] reported that the positive impact of the intervention (including small but important beneficial effect on dietary intake, social interaction and learning) is reaching many families whose members are at risk of, or are actually experiencing, social exclusion.

9.6.2 Influence of previous weight loss

It was not possible to answer this question from the evidence identified.

9.6.3 Source and mode of delivery

An overview of five school-based UK dietary interventions indicated that in terms of engaging schools it was important to list the support of school gate keepers (secretaries).[158] The commitment of schools affects the success of projects and this was particularly demonstrated with tuck shop interventions. A hindrance to engaging schools is the design of research interventions where there is selection to control. If schools are asked to 'buy-into' future initiatives this may lead to increased commitment compared to a research scenario. A feasibility study by the Health Education Trust[177] suggests that children will choose healthier options from vending machines even when 'healthier' products are set alongside usual provision. The key to success appears to be pupil involvement, positioning the vending machine close to the dining area, and continuity of provision.

9.6.4 Potential negative impact

Gortmaker and coworkers[129]) and Austin and coworkers[164]) reported that analysis of girls only using self-report showed a reduced risk of using self-induced vomiting, laxatives or diet pills to control weight within the previous 30 days. An additional 12-month weight maintenance intervention among adolescent girls[179] resulted in significantly greater decreases in bulimic symptoms compared with controls at 12 months ($p = 0.004$) despite demonstrating significant increases in healthy eating at 12 months and exercise intensity at 6 months ($p < 0.001$) among intervention compared with control.

9.7 Limitations of the review

It remains questionable whether some of the studies were adequately powered to detect differences between the intervention and control groups. It also remains questionable whether some of the interventions would be sufficient to produce a change weight/BMI, total activity levels or per cent dietary energy and/or fat intake (for example, included interventions promoting 3 × 30-minute physical activity sessions a week and/or one additional piece of fruit each day).

The majority of studies were conducted outside the UK although many are generalisable to the UK setting. There were more data for primary school children than secondary school children. No evidence of effectiveness was identified regarding strategies to engage schools to undertake interventions, nor whether effectiveness varied by ethnicity, religious practices or social group – although some studies did include mixed groups and reported being beneficial for all.

Only one study was included to address the question on the whole-school approach as there is currently a lack of evidence prospectively assessing the use of a whole-school approach in the field of obesity prevention. However, many of the interventions identified could be considered as taking a whole-school approach (particularly 'multi-component' interventions addressing the whole of the school environment).

10 Prevention evidence summary: workplace interventions

The following is based on an evidence review produced by Cardiff University. Detailed evidence tables and supporting information are in Appendix 8.

10.1 Evidence statements (Table 10.1)

Table 10.1 Evidence statements and grading

No.	Statement	Grade	Evidence
Weight outcomes			
1	Worksite behaviour modification programmes, that include health screening with counselling/education can result in short-term weight loss. Weight loss may be regained post intervention	1+	Body of evidence variable but largely supportive: 10 RCTs and 1 CCT. Majority 1+ Five RCTs (all 1+): Proper et al. 2003,[180] Gomel et al. 1993,[181] Shannon 1987 (data from Hennrikus and Jeffery 1996[182]), Erfurt et al. 1991,[183] Brownell et al. 1985[184] One CCT (2+): Cockcroft et al. 1994[185] support Three RCTs show positive trend (all 1+): Gemson 1995,[186] Peterson et al. 1985,[187] Rose et al. 1983[188] Twp RCTs do not support: Hanlon et al. 1995[189] (1++), Braeckman 1999[190] (1+)
2	Payroll incentive schemes (such as free gym membership) are either only effective in the short term (during the period of the intervention) or ineffective for weight control	1+	Body of evidence variable: three RCTs (all 1+) Forster et al. 1985,[191] Jeffery et al. 1985[192] effective in short term Jeffery et al. 1993[193] ineffective

No.	Statement	Grade	Evidence
3	There is inconclusive evidence for the effectiveness of workplace-based physical activity interventions on weight outcomes	N/A	Body of evidence variable: four RCTs (all 1+) and one CBA (2++) One RCT supports: Pritchard et al. 1997[194] (1+) One RCT shows trend: Grandjean et al. 1996[195] (1+) Two RCTs (both 1+) (Grønningsater et al. 1992,[196] Lee and White 1997[197]) and one CBA (2++) (Cook et al. 2001[198]) do not support but amount of activity prescribed in interventions considered insufficient
4	The effectiveness of healthier food provision in workplaces on weight outcomes remains unclear	2++	One CBA (2++) found no significant effect: Cook et al. 2001[198]
5	No studies were identified which considered the provision of water in the workplace, active travel schemes and stair use on weight outcomes	N/A	N/A
Diet and activity outcomes			
6	Worksite behaviour modification programmes, such as health screening followed by counselling and, sometimes, environmental changes, can lead to improvements in nutrition and physical activity while the intervention is in place	1+	Body of evidence variable but largely supportive: one systematic review and six RCTs (majority 1+) One systematic review (1+) (Janer et al. 2002[199]) supports for diet and physical activity Four RCTs for diet – three support: Sorensen et al. 1996[200] (1+), Sorensen et al. 1999[201] (1+), Sorensen

No.	Statement	Grade	Evidence
			et al.1998[202] (1±); one does not support: Sorensen et al. 2002[203] (1+) Two RCTs for physical activity (one supports: Emmons et al. 1999[204] (1+); and one does not support: Nichols et al. 2000[205] (1±)
7	There is a body of evidence that the provision of healthier food choices can encourage consumption of a healthier diet	2++	Body of evidence variable but largely supportive. One systematic review and two RCTs One systematic review (2++) (Seymour et al. 2004[206]) and one RCT (1+) (Beresford et al. 2001[207]) support One RCT (1±) (Steenhuis et al. 2004[208]) does not support
8	Workplace physical activity programmes can have a positive effect on physical activity	1++	Body of evidence from single 1++ systematic review (Proper et al. 2003[209]) supports
9	Environmental improvements in stairwells, such as decoration, motivational signs and music may increase stair use. Posters alone may be ineffective or effective only while the posters are in place	2+/++	Body of evidence variable. Two ITS and one BA One ITS supports: (Kerr et al. 2004[210] (2++); one BA of posters plus email supports in the short term only: Vanden Auweele 2005 et al.[211] (2+) One ITS of posters alone does not support: Kerr 2001[212] (2++)
10	No studies were identified which considered the provision of water in the workplace on	N/A	N/A

No.	Statement	Grade	Evidence
	diet or activity outcomes		
11	It is unknown whether incentive schemes improve dietary intakes or increase physical activity levels	2+	One CBA only considering diet (2+ quality): French et al. 2001[213]
Generalisability			
12	It remains unclear whether the effectiveness of interventions varies by age, gender, socioeconomic or ethnic group	N/A	Of 63 studies identified only one RCT (Braeckman 1999[190] [1+]) and one cross-sectional survey (Fleming et al. 1997[214] [3+]) considered social status and gender, respectively
Implementation			
13	There is little evidence on the most effective strategies for attracting workplaces to invest in the heath and activity of their staff, with the exception of weak evidence of reduced sick leave as a result of physical activity programmes	N/A	One CBA (2++) found reduced sick leave: Kerr 1993 [215] One RCT (1++) showed no difference: Nurminen 2002[216]
14	A body of UK-based case studies suggests that factors most likely to make a canteen-style five-a-day intervention work are: commitment from the top, enthusiastic catering management, a strong occupational health lead, links to other on-site health initiatives, free or subsidised produce and heavy promotion and advertisement at point of purchase	3	Two sets of case studies: Healthlinks 2003,[217] Holdsworth et al. 2004[218]
15	A body of UK-based case studies suggests that the more successful behaviour modification/education techniques include an	3	Body of 16 case studies (3): Health Development Agency 2002[219]

No.	Statement	Grade	Evidence
	interdisciplinary approach with broad representation including health and safety and human resources, and implementers from high grades and strategic positions; initiatives integrated into worksite objectives; staff involvement, communication and realistic objectives; activities that go beyond the superficial and address root causes		
16	A UK-based survey of Heartbeat Award schemes, recommended improved promotion and better integration with other health programmes	3	One cross-sectional survey: The Research Partnership 2000[220]

BA, before-and-after study; CBA, controlled before-and-after study; CCT, controlled clinical trial; ITS, interrupted time series; N/A, not applicable; RCT, randomised controlled trial.

See Appendix 8 for associated evidence tables.

10.2 Methodology

Database searches were carried out in October 2004 for papers published from 1990 onwards (1995 onwards for systematic review level evidence). A final update search was completed on 1 December 2005 on a reduced number of databases. The inclusion and exclusion criteria for the review adhered to the standard public health review parameters. From an initial 16695 hits, 298 papers were assessed in detail of which 61 papers met the critical appraisal criteria for inclusion in evidence tables.

10.3 Weight outcomes

10.3.1 Worksite behaviour modification programmes

Evidence from 10randomised controlled trials (RCTs) and one controlled non-randomised trial (CCT) suggests that worksite behaviour modification programmes, such as a 'health check' followed by counselling can result in short-term weight or body fat loss although there was a tendency for weight regain after the intervention. Eight of these RCTs and one CCT noted reductions in body mass/body fat relative to control with five RCTs and the CCT noting statistically significant reductions[180–185] and three RCTs recording a positive trend.[186–188] There were a wide range of results for the amount of weight lost.

A recent UK-based individual RCT looking at a single health check with 5-month follow-up found no significant difference in body mass index.[189] Another UK-based RCT looking at workplace-supported dietary approaches found that, although there was no difference in weight loss between the diets, a daily energy deficit diet (reduction of 600 kcal) might be considered preferable to a more demanding low-calorie diet (1500 kcal) since compliance was better.[221]

A weak RCT among male blue collar workers in Belgium resulted in an increase in body mass index (BMI) in the intervention compared with the control group despite a reported reduction in calorie and per cent fat intake.[190]

10.3.2 Healthier food provision

One controlled before-and-after study (CBA) of nutrition displays and a monthly 30-minute workshop over 6 months found there was no significant self-reported difference in mean BMI or waist circumference at 12-month follow-up.[198]

10.3.3 Physical activity programmes

There is inconclusive evidence for the effect of physical activity interventions on body weight, BMI and body fat. Of four RCTs[194–197] and one CBA identified,[198] only one study, an RCT, found a significant difference in body weight between intervention and control groups[194] with another RCT noting a significant before

and after difference in the exercise group with no significant difference in the control group.[195] However, the amounts of exercise prescribed in the RCTs did not meet the UK recommended levels.[222]

10.3.4 Incentives

Three US-based RCTs suggested that payroll incentive schemes were either only effective in the short term (that is, during the intervention) or ineffective for weight control.[191–193] Follow-up data suggested that any weight loss was regained 6–12 months after the intervention.[191] The schemes included weigh in, health education/group sessions and the provision of self-motivating materials.

10.3.5 Other initiatives

No studies with weight outcomes were identified for stair use, water provision or active travel to and from work.

10.4 Diet and activity outcomes

There is evidence from a systematic review of trials and six additional RCTs that worksite behaviour modification programmes can lead to improvements in nutrition and physical activity. Evidence of longer-term, post-intervention benefits is limited.

10.4.1 Diet

10.4.1.1 Worksite behaviour modification programmes

A systematic review found that worksite behaviour modification programmes can show a positive effect on dietary fat intake (up to 3% decrease in percentage of energy from fat).[199] Programmes can also increase consumption of fruit and vegetables from 0.09 to 0.5 portions per day. Successful programmes included a wide range of educational interventions (such as health check followed by counselling) sometimes accompanied by environmental changes. Information about long-term effects was limited.

Of the four additional RCTs identified, three supported the findings of the systematic review. Only one trial monitored post-intervention effects 1 year after the 2-year intervention and noted significant decreases in fat intake and increases in fruit and vegetable intake.[200] It appeared from this study that longer, interactive intervention efforts (contests and classes) resulted in more positive outcomes than one-time events or more passive efforts (use of printed materials). One study found a significant improvement when a family component was added to the worksite intervention.[201]

10.4.1.2 Healthier food provision

One systematic review concluded that worksite intervention studies targeting healthier food provision by information strategies such as labelling and/or changes in food availability or cost can encourage healthier eating.[206] Two additional RCTs reported conflicting results.[207,208] The US study reported an increase in fruit and vegetable intake by 0.3 portion per day at 3, 8 and 12 months post intervention ($p < 0.05$).[207] However, the study in the Netherlands, which looked at combinations of educational and food supply programmes, found no significant effects on consumption data.[208]

10.4.1.3 Incentives

One CBA concluded that, when prices of low-fat snacks in 55 vending machines were reduced by 10%, 25% and 50%, the total number of items sold increased by 9%, 39% and 93%, respectively.[213] The effect on calorie consumption was unknown.

10.4.1.4 Other initiatives

No studies were identified on water provision.

10.4.2 Physical activity

10.4.2.1 Worksite behaviour modification programmes

A systematic review concluded that there are significant effects of workplace-based educational sessions and informative materials on levels of

physical activity.[199] Details were not provided of the type of physical activity promoted in each trial. Out of nine trials using educational sessions and informative materials, and evaluating outcomes directly related to physical activity, four reported significant changes. Two additional RCTs noted significant increases in physical activity in the intervention group[204] or significant increases in both intervention and control groups but no significant difference between groups.[205] Only the latter trial had post-intervention follow-up (6 months).

10.4.2.2 Physical activity programmes

Results from a systematic review support the implementation of worksite physical activity programmes.[209] The overall conclusion of the review, based on five RCTs (two of high quality) and three non-randomised controlled trials was that there was strong evidence for a positive effect of physical activity programmes on physical activity.

10.4.2.3 Active travel to/ from work

There is evidence from a UK-based RCT[223] and one before and after study in Finland[224] that workplace promotional strategies can increase the number of people travelling actively to work.

10.4.2.4 Increasing use of stairs

One interrupted time series (ITS) study suggests environmental improvements (such as re-decoration, motivational signs and music in the stairwell) may increase stair use.[210] Another ITS study found that posters alone were ineffective[212] but a before-and-after study that included an email reminder found a temporary improvement while the sign was in place.[211]

10.5 Sub questions

10.5.1 Variation by gender, age, ethnicity, religious practices or social group

There is little evidence comparing findings by gender, socioeconomic or ethnic groups. For behaviour modification/educational techniques, one RCT among

male blue collar workers in Belgium resulted in an increase in BMI in the intervention compared to the control group despite a reported reduction in calorie and per cent fat intake.[190] In a UK study including health checks, a lack of nutritional information was cited as a barrier to change by men whereas women predominantly cited the preferences of family members.[214] Finance was not a factor in this particular study.

10.5.2 Influence of previous weight loss

No evidence was identified.

10.5.3 Source and mode of delivery

The evidence base for strategies to influence workplaces to invest in health is inconclusive. There are some indications that sick leave is reduced in workers who have received worksite physical activity interventions.

In one UK study, individual health checks were not considered a threat for most of the participants although the results for weight loss were not significant.[225] A single set of case studies suggest that the more successful interventions include: (i) an interdisciplinary approach with broad representation including health and safety and human resources, and implementers from high grades and strategic positions; (ii) initiatives integrated into worksite objectives; (iii) staff involvement, communication and realistic objectives; (iv) activities that go beyond the superficial and address root causes.[219]

Corroborative evidence from the UK Heartbeat Award scheme reported additional data from a single set of case studies.[218] These studies found that factors most likely to make a canteen-style five-a-day intervention work are: commitment from the top, enthusiastic catering management, a strong occupational health lead, links to other on-site health initiatives, free or subsidised produce, and heavy promotion and advertisement at point of purchase.[217] The authors of a cross-sectional survey in England of Heartbeat Award managers and caterers, government and health professionals,

recommended improved promotion of the schemes and better integration with other health programmes.[220]

10.5.4 Potential negative impact

A UK-based study which aimed to increase stair use reported that posters alone caused feelings of ‘laziness’ and ‘guilt’ in many subjects.[215] An incentive study by French and coworkers[213] found that when the prices of low-fat snacks were reduced, sales of these items increased. However, it is unknown whether this had a positive or negative impact on calorie consumption.

10.6 Limitations of the review

RCTs often lacked (or failed to report) a description of the randomisation process, concealment allocation and/or an intention to treat (ITT) analysis.

According to the agreed review parameters, RCTs without ITT but 80% or more follow-up were downgraded in quality assessment but not to CCTs. Studies with no ITT and less than 80% follow-up were treated as CCTs. The lack of description of randomisation and/or concealment allocation also led to a downgrading but not automatic rejection. Where an RCT did not meet one or more of the NICE criteria, reasons are listed in the comments column of the evidence tables.

11 Prevention evidence summary: interventions led by health professionals ('Community 1')

The following is based on an evidence review produced by Cardiff University.

Detailed evidence tables and supporting information are in Appendix 9.

11.1 Evidence statements (Table 11.1)

Table 11.1 Evidence statements and grading

No.	Statement	Grade	Evidence
Weight outcomes			
1	Sustained health-professional-led interventions in primary care or community settings, focusing on diet and physical activity or general health counselling can support maintenance of a healthy weight	1+	Body of evidence variable but generally supportive One systematic review and eight RCTs mostly 1+ Systematic review supports: Asikainen et al. 2004[226] (1++) Three RCTs support: Simkin-Silverman et al.2003[227] (1++), ICRF 1995[228] (1+), Murray and Kurth1990[229] (1++) Three RCTs show trend: Fries et al. 1993[230] (1+), Jeffery 1999[231] (1±), FHSG 1994[232] (1+) Two RCTs do not support: Dzator et al. 2004[233] (1+), ICRF 1994[234] (1+)
2	Interventions which provide support and advice on physical activity and diet are more likely to be effective for weight outcomes than interventions which focus on physical activity alone. There is no reliable evidence for diet alone	1+	Body of evidence variable for physical activity alone: 11 RCTs One shows weight reduction (self-reported): Stewart et al. 2001[235] (1+) Five show trend and/or changes in body composition: Taylor et al.

No.	Statement	Grade	Evidence
			1998[236] (1+), Schmitz et al. 2003[237] (1+), Coleman et al. 1999[238] (1+), Dunn et al. 1999[239] (1+), Elley et al. 2003[240] (1++) Five do not support: Hillsdon 2002[241] (1+), Pereira et al. 1998[242] (1+), Tully et al. 2005[243] (1+), Lamb et al. 2002[244] (1+), Halbert et al. 2000[245] (1++) Limited evidence for diet alone: one RCT and one CBA CBA supports: Wrieden et al. 2002[246] (2+); RCT does not support: John et al. 2002[247] (1++)
Diet and activity outcomes			
3	Interventions which do not identify favourable changes in weight outcomes may identify favourable changes in diet and/or activity outcomes (where recorded).	1+	At least four RCTs: Dzator et al. 2004[233] (1+) and John et al. 2002[247] (1++) for diet; Pereira et al. 1998[242] (1+) and Elley et al. 2003[240] (1++) for physical activity See also statements 4 and 6
4	Behavioural/educational interventions to increase physical activity can be moderately effective, particularly for walking and non-facility-based activities, although increases may not be sustained over time	1++	Body of evidence variable but largely supportive Four systematic reviews and 12 RCTs (1++/1+) Systematic reviews had variable results with some support: Hillsdon and Thorogood 1996[248] (1++), Eden et al. 2002[249] (1++), Eakin et al. 2000[250] (1++), Morgan 2005[251] (1+) Nine of 13 more recent and/or UK-based RCTs

No.	Statement	Grade	Evidence
			support: Dzator et al. 2004[233] 1+, Simkin-Silverman et al. 2003[227] (1++), Stewart et al. 2001[235] (1+), Coleman et al. 1999[238] (1+), Dunn et al. 1999[239] (1+), Pereira et al. 1998[242] (1+), Harland et al. 1999[252] (1++), Stevens et al. 1998[169] (1+), Elley et al. 2003[240] (1++) One RCT suggests positive trend: Hillsdon 2002[241] (1+) Three RCTs do not support: Jeffery 1999[231] (1±), Lamb et al. 2002[244] (1+), Schmitz et al. 2003[237] (1+) One systematic review (3) noting high attrition in exercise referral studies: Gidlow et al. 2005[253] – (Please note that this review is treated as a review of observational studies, hence grading)
5	Limited evidence suggests that using an incentive of free access to leisure facilities is likely to increase activity levels but only during the period of the intervention	1+	One RCT: Harland et al. 1999[252] (1++)
6	Moderate- or high-intensity dietary interventions most commonly report clinically significant reductions in fat intake and an increase in fruit and vegetable intake	1++	Body of evidence supportive: one systematic review, four RCTs and two CBAs Systematic review: Pignone et al. 2003[254] (1++) RCTs: Carpenter and Finley 2004[255] (1++), Havas et al. 2003[256] (1+), Dzator et al. 2004[233] (1+), Havas et al. 1998[257] (1+)

No.	Statement	Grade	Evidence
			UK CBAs: Department of Health 2003[93] (2±), Wrieden et al. 2002[246] (2+)
7	Briefer interventions, such as brief counselling/dietary advice by GPs or other health professionals, can be effective in improving dietary intake but tend to result in smaller changes than intensive interventions	1++	Body of evidence: two systematic reviews and four RCTs (1++/1+) Systematic reviews: Pignone et al. 2003[254] (1++), Ashenden et al. 1997[258] (1+) RCTs: Delichatsios et al. 2001[259] (1+), Steptoe et al. 2003[260] (1++), John et al. 2002[247] (1++), Beresford 1997[261] (1+)
8	Interventions with a greater number of components are more likely to be effective	1++	Body of evidence (1++): one systematic review (Pignone et al. 2003[254])
Generalisability			
9	The majority of interventions identified were conducted in the USA. However, the findings are likely to be generalisable to the UK population	N/A	GDG conclusions based on full range of evidence
10	Although the majority of studies included predominantly white, higher social status and reasonably motivated individuals, there is some evidence that interventions can also be effective among lower social groups and effectiveness does not vary by age or gender	1+	Body of evidence supportive for lower social groups (four RCTs and one CBA) and for age/gender (only one study, a survey, suggested variable effect in men and women) *Lower social groups*: three RCTs (Steptoe et al. 2003[260] [1++], Havas et al. 1998[257] [1+], Havas et al. 2003[256] [1+]); one CBA (Wrieden et al. 2002[246] [2+]) *Age/gender*: only one study suggested potential variation in effect a survey (Duaso and Cheung 2002[262]

No.	Statement	Grade	Evidence
			[3])
Implementation			
11	Tailoring dietary advice to address potential barriers (taste, cost, availability, views of family members, time) is key to the effectiveness of interventions and may be more important than the setting	3	Body of survey and qualitative evidence in four RCTs and one CBA support (all grade 3) Four surveys/qualitative studies in RCTs: Anderson et al. 1998,[263] Lloyd et al. 1995,[264] John and Ziebland 2004,[265] Baron et al. 1990[266] One qualitative study in a CBA: Wrieden et al. 2002[246]
12	The type of health professional who provides the advice is not critical as long as they have the appropriate training and experience, are enthusiastic and able to motivate, and are able to provide long-term support	3	Two qualitative studies and one evaluation of case studies support (all grade 3) Qualitative studies: Hardcastle and Taylor 2001,[267] Fuller et al. 2003[268] Evaluation of case studies: Biddle et al. 1994[269] Plus: GDG conclusions based on full range of evidence
13	It remains unclear whether interventions are more effective when delivered by multidisciplinary teams	N/A	Two RCTs (Elley et al. 2003[240] [1++], Lamb et al. 2002[244] [1+]) noted no significant effect on weight when two professions combined vs one; RCT with single professional suggesting weight gain (Halbert et al. 2000[245] [1++])
14	There is some evidence that primary care staff may hold negative views on the ability of patients to change behaviours, and their own ability to encourage change	3	Three qualitative studies and one survey/case study support (all grade 3) Qualitative studies: Fuller et al. 2003[268], Coggans et al. 2000[270], Benson and Cribb

No.	Statement	Grade	Evidence
			1995[271] Case study/survey: Hopper and Barker 1995[272]
15	There is a body of evidence from UK-based qualitative research that time, space, training, costs and concerns about damaging relationships with patients may be barriers to action by health professionals (GPs and pharmacists)	3	Six qualitative studies, one cross-sectional study and one survey/case study support (all grade 3) Qualitative: Fuller et al. 2003,[268] Smith et al. 1996,[273] Keene and Cervetto 1995,[274] Ursell et al. 1999,[275] Moore et al. 1995,[276] Coggans et al. 2000,[270] Benson and Cribb 1995 [271] Cross-sectional: Vernon and Brewin 1998[277] Survey/case study: Hopper and Barker 1995[272]
16	There is some evidence from the UK that patients are likely to welcome the provision of advice despite concerns by health professionals about interference or damaging the relationship with patients	3	One qualitative (Duaso and Cheung 2002[262] and one case study (Hardcastle and Taylor 2001[267]) support
17	Tailoring physical activity advice to address potential barriers (such as lack of time, access to leisure facilities, need for social support and lack of self-belief) is key to the effectiveness of interventions	1++	Body of evidence from two reviews and corroborative evidence supports One systematic review noting attrition through problems with attendance at leisure facilities: Gidlow et al. 2005[253] (3++) One systematic review noting importance of self-belief: Keller et al. 1999[278] (3++) Three qualitative studies and three surveys also

No.	Statement	Grade	Evidence
			support (all 3) Qualitative: Hardcastle and Taylor 2001,[267] Martin and Wollf-May 1999,[279] Ashley et al. 2000[280] Survey: See Tai et al. 1999,[281] Vernon and Brewin 1998,[277] Horsefall/Wealden District Council 1997[282]

CBA, controlled before-and-after study; FHSG, Family Heart Study Group; GDG, Guidance Development Group; GP, general practitioner; ICRF, Imperial Cancer Research Fund; N/A, not applicable; RCT, randomised controlled trial.

See Appendix 9 for associated evidence tables.

11.2 Methodology for review

Database searches were carried out in January 2005 for papers published from 1990 onwards (1995 onwards for systematic review level evidence). A final update search was completed on 1 December 2005 on a reduced number of databases. The inclusion and exclusion criteria for the review adhered to the standard public health review parameters. From an initial 10227 hits, 410 papers were assessed in detail of which 67 papers met the critical appraisal criteria for inclusion in evidence tables.

11.3 Weight outcomes

A total of 22 randomised controlled trials (RCTs) and one controlled before-and-after study (CBA) were identified which provided data on weight outcomes. Of these, 12 RCTs and 1 CBA were considered general public health interventions in the community, 1 systematic review and 9 RCTs were considered primary care based (including primary care referral) and 1 RCT included a cash incentive.

In all settings, the results suggest that sustained interventions which provide support and advice on diet **and** activity or general health counselling are

marginally more likely to be effective than interventions which focus on physical activity or diet alone, although some of the evidence identifies trends as opposed to statistical significance. The evidence base is less conclusive for general public health interventions than for primary care based interventions.

11.3.1 Interventions focusing on general counseling

11.3.1.1 General public health interventions

No evidence identified.

11.3.1.2 Primary care based interventions

Three UK-based RCTs were identified providing general health advice (including diet and activity) with the intensity of intervention based on participants risk score.[228,232,234] One RCT found no effect on body mass index (BMI) at 1 year, but a 1.4% reduction in BMI in the intervention group compared with the control group at 3 years ($p < 0.005$).[228,234] The two RCTs from the same study had different control groups. The Family Heart Study Group (FHSG)[232] reported that the weight of the intervention group was lower by an average 1 kg compared with controls at follow-up and the proportion of obese patients was lower in intervention than control (significance not stated).

11.3.1.3 Incentive schemes

One low-intensity US-based RCT compared education or education with incentives (entry into a US$100 lottery) against a control group.[231] After a 3-year follow-up significant differences were reported between the intervention groups and control with a higher reported frequency in healthy weight loss practices and non-significant reduced weight gain over time. However, no differences were found between the treatment groups suggesting no additional benefit of the cash incentive.

11.3.2 Interventions focusing on diet and physical activity

11.3.2.1 General public health interventions

Of the five RCTs that addressed diet **and** activity[227,229–231,233] only one,[227] an intensive intervention delivered by behavioural psychologists and nutritionists, found a significant prevention of unhealthy weight gain. However, two low-intensity interventions[220,221] noted positive but non-significant trends and one study[219] which compared two eating management and one weight loss programme with a physical activity control group, noted greater weight reduction in the weight loss group immediately after the intervention (10 weeks post-baseline) although this benefit was lost at 1-year follow-up. The results from a large US-based individualised counselling programme also suggest that participants were more likely to maintain their weight over a 48-month period than those in the control group.[283] Only one study, a relatively small RCT of Australian couples, found no evidence that the intervention prevented unhealthy weight gain despite reporting improvements in diet.[233]

11.3.2.2 Primary care based interventions

No studies identified.

11.3.3 Interventions focusing on diet alone

11.3.3.1 General public health interventions

One CBA considered diet alone. A food skills programme in deprived areas of Scotland noted a slight but significant reduction in the post-intervention weight of intervention versus control subjects.[246]

11.3.3.2 Primary care based interventions

A health check and diet-only RCT reported no difference in weight loss between intervention and control groups ($p = 0.68$) at 6 months.[247]

11.3.4 Interventions focusing on physical activity alone

11.3.4.1 General public health interventions

One US RCT of predominantly older, higher socioeconomic status, white adults found that information and support provided by trained staff and counsellors resulted in a significant reduction in self-reported BMI, compared with no change in the control group.[235] Three US-based studies of varying intensity found no difference in weight loss between the intervention and control groups but did report significant changes to fat-free mass/percentage body fat.[237–239] Two RCTs found no evidence of effect. One of these was a low-intensity UK-based trial of middle-aged adults who received 'brief negotiation' or 'direct advice'.[241] Follow up of this study was poor. Pereira and coworkers[242] also reported no weight differences at 10-year follow-up of US postmenopausal women encouraged to walk as part of the original trial, although the intervention group continued to walk significantly more than the control group.

11.3.4.2 Primary care based interventions

None of the five activity-only RCTs[236,240,243–245] showed a significant effect for weight loss at follow-up (up to 37 weeks depending on study) although positive trends were noted in two studies,[236,240] with one (a UK-based study of general practitioner [GP] exercise referral) showing a reduction in skin folds up to 16 weeks.[236] One study showed a significant weight gain in women in the intervention group ($p = 0.01$).[245] Among the three studies providing serially reinforced advice by telephone after an initial consultation, a more positive outcome was found when interventions were delivered by facilitators from more than one discipline (GP/practice nurse and exercise specialist;[240] physiotherapist and local health walks coordinator[244]) compared with intervention which was delivered by an exercise specialist only.[245]

The systematic review of exercise training in early postmenopausal women in which some of the interventions were combined with diet, found an improved body composition in 9 of the18 included studies.[226] The best effect was in the

three studies of overweight women that combined training and diet but six of the studies with positive results included some women within the normal weight range.

11.3.5 Corroborative evidence

The findings of the majority of studies are likely to be generalisable to the UK, particularly for motivated individuals of higher social status. Although UK data were limited from general public health interventions there was body of UK-based evidence from studies conducted in primary care. [228,232,234,241,244,246,247] A range of UK-based studies addressed practical issues which could influence the effectiveness of an intervention (for example, considering concerns around taste, cost, availability and time). A systematic review of exercise referral schemes found that attendance was generally poor with approximately 80% of participants dropping out before the end of the programme.[253] More women than men took up the referral (60% vs 40%) but there was no evidence of higher attendance in women.

11.4 Diet and activity outcomes

11.4.1 Dietary outcomes

On the basis of one high-quality systematic review and one moderate-quality systematic review, eight additional RCTs and two CBAs it can be concluded that general community or primary care based public health interventions, providing brief or intensive, individualised advice, in person or by mail, can result in dietary change, particularly for fat and fruit and vegetable intake. It is unclear whether a cash incentive would result in **additional** benefits for dietary interventions.

11.4.1.1 General public health interventions

A high-quality systematic review concluded that moderate- or high-intensity interventions can reduce saturated fat intake and increase fruit and vegetable intake.[254] Briefer interventions delivered by primary care professionals were also

effective but resulted in more modest changes. However, the effect size was to some extent dependent on the number of components in the intervention.

The findings of the review were supported by four additional RCTs[233,255–257] and two UK-based CBAs.[93,246] Carpenter demonstrated improvements to diet in middle-aged women from either group meetings or advice via mail or website with a larger effect from the weekly group meetings. Dzator and coworkers also found that interactive sessions and/or advice by mail to couples over a 16week period resulted in improvements to total fat, fibre and fruit and vegetable intake at 4 months and total fat intake at 12 months' follow-up.[233] Marginal improvements were reported in the high-intensity versus the low-intensity intervention but no significance values were reported. Two multi-component personalised educational RCTs in lower socioeconomic status women in the USA,[256,257] based on social marketing strategies resulted in significant increases in fruit and vegetable intake and, also, a reduction in fat and an increase in fibre in the later study.[256]

Before and after evaluation of five-a-day pilot projects in the UK concluded that the initiatives stemmed a fall in fruit and vegetable intake against the national trend,[93] but a lack of methodological detail limit the strength of this conclusion. A community food skills programme in eight deprived areas of Scotland resulted in a significant increase of one portion a week for fruit immediately after the intervention but this was not sustained at 6 months.

Three dietary studies identified barriers to change (for example, concerns around taste, cost, availability and time) that could influence effectiveness.[246,263,264]

11.4.1.2 Primary care based interventions

A systematic review reported that dietary advice trials were very mixed in interventions employed and study populations.[258] Of four included trials directly assessing dietary change by collecting data on fat and fibre intake, one found very positive results, one found no significant difference on either measure and two found significant differences for one measure but not the other.

Four RCTs published since the systematic review all reported positive effects of intervention. The RCTs had predominantly white samples (with the exception of one[260]), two were UK based[237,260] with one based in a low-income area.[260] In two studies, physicians gave dietary advice in routine consultations[259, 261] and in two advice was provided by research nurses.[247,260] Three of the RCTs[247,259,260] reported that individually tailored intervention resulted in increases in self-reported fruit and vegetable intake at 3 months[259] six months[247] and 12 months,[260] with the reported increases between 0.6[259] and 1.4 portions per day[247] compared with control groups. Steptoe and coworkers[260] reported increased consumption (at 12 months) in both a nutrition advice and tailored behaviour intervention, but the observed increase was significantly higher in the latter (0.6 portions per day, p = 0.021). Beresford and coworkers[261] measured changes in fat intake which were significant larger at three and 12 months in the intervention group.

11.4.1.3 Incentives

One multifaceted RCT to improve dietary habits among adult primary care patients offered a $5 incentive at the baseline and final survey for those in the intervention group.[259] The intervention group reported a positive effect for fruit and vegetable consumption (an increased of 0.6 servings a day) compared with the control group. No effect was found for dairy products.

11.4.2 Physical activity

Based on 4 systematic reviews and 10 additional RCTs it can be concluded that interventions to increase physical activity levels can be moderately effective in the short to medium term, particularly for walking and non-facility-based activities. The findings are more equivocal for primary care based than general public health interventions, although interventions tailored to participant characteristics, and which offer written materials, may be more effective.

11.4.2.1 General public health interventions

One high quality systematic review identified a lack of UK-based research[248] but was able to conclude that interventions to encourage walking and non-facility-based activity are most likely to lead to sustainable increases in physical activity (up to at least 2 years). Of the nine additional RCTs, only one[237] did not support these conclusions. The majority of studies were among motivated, higher socioeconomic status groups but were undertaken among both genders, a range of age groups, and through a range of delivery methods (for example, mailed information, brief advice, structured programmes and counselling).

Although only one RCT was undertaken in the UK[241] many of the interventions could be generalisable to the UK, particularly for motivated individuals of higher social status. In terms of walking the most significant barrier was lack of time reflecting findings of RCTs that compliance was likely to be better with less time demanding interventions (that is, home rather than facility based).

11.4.2.2 Primary care based interventions

Three systematic reviews with limited overlap,[249–251] which included four UK RCTs[169,236,244,252] and one additional RCT,[240] provide some evidence that primary care based interventions can be effective.

One systematic review concluded that counselling adults in a primary care setting is moderately effective in the short term,[250] and one[249] concluded that the evidence was inconclusive. Interventions tailored to the participant characteristics and which offered written materials to patients produced stronger results. The most recent systematic review concluded that exercise referral schemes appear to increase physical activity levels in populations that are already slightly active, in older adults and in those who are overweight but not obese.[251]

The systematic reviews were ‘unpicked’ to look at the four UK studies in more detail. Physiotherapist-led advice sessions to sedentary 40–70-year-olds, encouraging group participation in lay-led walking schemes, reported no significant between-group differences in self-reported physical activity at 12

months. However, when completers-only were analysed, the intervention was more effective than advice only.[244] An incentive study [252] offering free access to leisure facilities resulted in increased physical activity scores at 12 weeks but this was not maintained at 12 months. A personalised 10-week programme for sedentary 45–70-year-olds resulted in a significant (10.6%) reduction in the proportion of participants classed as sedentary in the intervention compared with the control group at 8 months' follow-up.[169] Taylor and coworkers[236] did not report physical activity outcomes.

The more recent RCT of oral and written advice from GPs or practice nurses plus motivational phone calls by an exercise specialist from New Zealand reported a significant difference between intervention and control including the proportion undertaking 2.5 hours/week exercise ($p = 0.003$) at 12 months.[240]

Sixteen studies offer evidence of UK corroboration. The success of programmes is influenced by the qualities of personnel in contact with participants, while the views of referring practice members or barriers such as lack of time could be significant.[267,269,273,277,284] Individual perceptions of self-efficacy ('I believe I can exercise regularly') are strongly related to exercise behaviour and clinicians can help facilitate these perceptions (Keller 1999).[285] Barriers to leisure centre attendance include social support, time, the gym environment and time spent with instructors.[267,279,281,282] Other barriers were illness and injury, work pressure, transport, programmes not appropriately tailored, lack of money. When 'not knowing where exercise facilities are' is cited as a barrier by participants at the start of the programme, the likelihood of those participants completing the programme is increased by 3.5 times. Guided walks (Health walks) were found to be a sustainable form of exercise,[280] but it was noted that planning and promotion activities should take into account the seasons and varying needs of walkers (grades of difficulty, evening walks for workers, etc.) as well as emphasising the social benefits.

Lack of time, confidential space, training and cost issues were barriers to the involvement of pharmacy contractors, advisors and pharmacists[270,271,274–276] and well as concerns about 'interference'.[270,271] In addition, consumers do not tend to regard the pharmacy as a source of health promotion advice.[270,286]

11.4.2.3 Incentives

Two physical activity interventions providing incentives demonstrated a positive short-term effect. A UK-based RCT offering vouchers entitling free access to leisure facilities reported increased physical activity scores at 12 weeks and increased vigorous activity in the intervention participants.[252] However this increase was not maintained at 12 months. Jeffery[231] reported that exercise decreased less in the education and education plus incentives groups. However, statistical significance of this was unclear.

11.5 Sub questions

Evidence on implementation identified potential barriers to behaviour change – such as time and social support – which if addressed, could increase participants receptiveness/ability to change.

11.5.1 Variation by gender, age, ethnicity, religious practices or social group

Studies were undertaken with a range of ages and with both men and women. The findings did not appear to vary by gender, although females may be more receptive to health professional advice than males.[262]

Participants in the majority of studies were predominantly white, of higher social status and reasonably motivated. However, there is some evidence that interventions can be effective among lower social groups (for example, Steptoe et al.[260]).

Cost and availability were identified as practical barriers to change for physical activity and diet (for example, Wrieden et al.,[246] Anderson et al.,[263] Lloyd et

al.[264]). Indeed one study found that a significantly higher proportion of those who cited 'lack of money' as a barrier dropped out of a physical activity programme than those who did not cite it as a barrier (55.3% vs 44.7%, p = 0.024).[281]

A range of studies suggest that tailoring advice is key to the effectiveness of interventions and that this will obviously impact on issues related to gender, age, ethnicity, religious practices or social group.

11.5.2 Previous weight loss

No evidence was identified.

11.5.3 Source and mode of delivery

11.5.3.1 Source of delivery

Evidence from three RCTs of primary care based interventions to increase physical activity showed a trend to a more positive outcome was achieved when interventions were delivered by facilitators from more than one discipline (GP/practice nurse and exercise specialist;[240] physiotherapist and local health walks coordinator;[244] and exercise specialist only[245]).

A weak UK-based study reported that trained community nutrition assistants providing healthy eating advice and support increased coverage by fourfold, and that the majority of respondents preferred advice from a local person rather than a health professional, perceiving them to be more approachable and easier to access.[287]

One cross-sectional UK-based survey of mainly white patients suggests that significantly more respondents would have liked to have received advice from health professionals than did (p < 0.001).[262] Hardcastle and Taylor[267] demonstrated the importance of encouragement from GPs in promoting physical activity in addition to participant commitment and confidence. However, a cross-sectional survey on the effectiveness of walking packs found that the major barrier was lack of time (60%) rather than motivation by a GP or health

professional (14%).[277] A small qualitative study found that couples and GPs viewed general practice as a place for treatment of illness and disease rather than provision of dietary advice.[268] The GP's advice was affected by personal preference (younger, females doctors being more enthusiastic). GPs were concerned that dietary advice could damage their relationship with patients. These findings were supported by a qualitative study of exercise promotion.[273] Data from a suspended RCT found that barriers to recruiting patients to a GP-led programme included time, overly complicated questionnaires and lack of financial incentive for the health professionals.[284]

The studies bear out the findings of Biddle and coworkers[269] on physical activity promotion schemes in primary care, which concluded that success depends on the qualities of key personnel in contact with participants and establishing a programme depends on the enterprise of an energetic innovator. Certainly the negative responses of those surveyed by Hopper and Barker[272] – where by the primary healthcare workers surveyed felt that their practice population was not sufficiently motivated to follow dietary advice – are unhelpful. With the negative views expressed by GPs, it is unsurprising that Hopper and Barker[272] reported that practice nurses gave dietary advice more frequently than GPs.

11.5.3.2 Mode of delivery

The identified evidence did not appear to suggest that the health professional who provides advice and support was important (for example, GP compared with practice nurse). The key issue is whether the health professional is motivational[269] and the support of the health professional (along with social support) is maintained, for example, through motivational phone calls, mailed information. The importance of health professionals reassuring participants on the consistency of advice was highlighted by Fuller and coworkers.[268]

No evidence identified on how best to encourage partnerships.

11.5.4 Potential negative impacts

No evidence was identified.

11.6 Limitations of the review

RCTs often lacked (or failed to report) a description of the randomisation process, concealment allocation and/or an ITT analysis.

According to the agreed parameters paper (Appendix 2), RCTs without ITT but 80% or more follow-up were downgraded in quality assessment but not to CCTs. The lack of description of randomisation and/or concealment allocation also led to a downgrading but not automatic rejection. Where an RCT did not meet one or more of the NICE criteria, reasons are listed in the comments column of the evidence tables (Appendix 9).

Relevant studies with evidence of efficacy of community-based interventions for children were not found, and so a number of studies containing corroborative evidence about children were not included in the evidence tables.

12 Prevention evidence summary: broader community interventions ('Community 2')

The following is based on an evidence review produced by Cardiff University.

Detailed evidence tables and supporting information are in Appendix 10.

12.1 Evidence statements (Table 12.1)

Table 12.1 Evidence statements and grading

No.	Statement	Grade	Evidence
Weight outcomes			
1	There is no evidence on the effectiveness of broader environmental interventions on the maintenance of a healthy weight and prevention of obesity	N/A	N/A
2	There is little evidence of benefit from locally implementable multi-component city- and state-wide interventions to prevent cardiovascular disease on weight outcomes	2+	Three CBAs (all 2+) generally do not support: Shelley et al. 1995[288] suggests trend; O'Loughlin et al. 1999,[106] Baxter et al. 1997[289] do not support
	Diet and activity outcomes		
3	No interventions were identified which addressed both diet and activity	N/A	N/A
4	There is little evidence of benefit from locally implementable city- and state-wide interventions to prevent cardiovascular disease in relation to diet and/or physical activity outcomes.	2+	Four CBAs (all 2+) generally do not support. Baxter et al.1997[289] supports diet change in one area No support for dietary change from Huot 2004,[290] O'Loughlin et al. 1999,[106] Osler and Jespersen 1993[109] No support for physical activity change from O'Loughlin et al 1999,[106] Baxter et al. 1997,[289] Osler and Jespersen 1993[109]
5	Point of purchase schemes in shops, supermarkets, restaurants	2++	Body of evidence variable but generally supportive from four

No.	Statement	Grade	Evidence
	and cafes can be effective in improving dietary intakes at least in the short term, particularly if accompanied by supporting education, information and promotion. There is some evidence that longer-term, multi-component interventions may show greater effects		systematic reviews of non-randomised studies and three RCTs Systematic reviews support: Roe et al. 1997[291] (1++), Seymour et al. 2004[206] (2++), Matson-Koffman et al. 2005[292] (2+), Holdsworth and Haslam 1998[293] (2+) One RCT suggests trend: Kristal 1997 [294] (1+) One RCT suggests low-fat alternative acceptable: Stubenitsky et al. 2000[295] (1+) One RCT does not support: Steenhuis et al. 2004[296] (1+)
6	There is a body of evidence that creation of, or enhanced access to space for physical activity (such as walking or cycling routes), combined with supportive information/promotion, is effective in increasing physical activity levels	2++	Body of evidence generally supports. One systematic review and three additional studies (all 2++/2+) One systematic review (Kahn et al. 2002[297] [2++]) and one BA (Merom et al. 2003[105] [2+]) support One CBA (Brownson 2004[298] [2+]) shows trend. One BA (Evenson et al. 2005[299] [2+]) does not support
7	The general promotion of active travel (for example, publicity campaigns) does not appear to be effective in increasing physical activity levels	1++	Body of evidence from one systematic review supports: Ogilvie et al. 2004[300] (1++)
8	Targeted behavioural change programmes with tailored advice appear to change travel behaviour of motivated groups. Associated actions such as subsidies for commuters may also be effective	1++	Body of evidence from one systematic review supports: Ogilvie et al. 2004[300] (1++)
9	Point of decision prompts or educational materials such as posters and banners have a weak	2+	Body of evidence from two systematic reviews and two BA studies generally suggest weak

No.	Statement	Grade	Evidence
	positive effect on stair walking		positive and/or short-term effect Systematic reviews (Foster and Hillsdon 2004[301] [2+], Kahn et al. 2002[297] [2++]) and two BA studies (Marshall et al. 2002[302]) support One BA study (Adams and White 2002[303] [2+]) does not support
Generalisability			
10	Barriers may vary by age, gender and social status	3	Body of evidence from 10 observational studies supportive (all 3) *Age:* Whelan et al. 2002[304] (qualitative), Holdsworth et al. 1997[305] (cross-sectional), Watt and Sheiham 1996[306] (cross-sectional), Watt and Sheiham 1997[307] (qualitative), Mulvihill et al. 2000[308] (qualitative), Davis et al. 1996[309] (qualitative) *Gender:* Foster et al. 2004[310] (cross-sectional), Coakley et al. 1998[81] (qualitative), Mulvihill et al. 2000[308] (qualitative) *Social status:* Coakley et al. 1998[81] (qualitative), Watt and Sheiham 1996[306] (cross-sectional), Furey et al. 2001[311] (qualitative /quantitative), Caraher et al. 1998[312] (cross-sectional), Whelan et al. 2002[304] (qualitative)
Implementation			
11	Auditing the needs of all local users can help engage all potential local partners and establish local ownership	3	Three sets of case studies support (all grade 3): Sustrans 2004,[313] Department for Transport 2003,[314] Derek Halden Consultancy 1999[315]
12	Interventions may be ineffective unless fundamental issues are addressed, such as individual confidence to change behaviour,	3	Body of evidence from 14 corroborative studies support (majority 3) *Dietary change*: Wrigley et al.

No.	Statement	Grade	Evidence
	cost and availability; pre-existing concerns such as poorer taste of healthier foods and confusion over mixed messages; the perceived 'irrelevance' of healthier eating to young people; and the potential risks (including perception of risk) associated with walking and cycling		2003[316] (BA; 2+), Whelan et al. 2002[304] (qualitative), White et al. 2004[317] (cross-sectional), Knox et al. 2001[318] (qualitative), Dibsdall et al. 2002[319] (qualitative) *Physical activity:* Cole-Hamilton et al. 2002[320] (systematic review), Derek Halden Consultancy 1999,[315] Dixey 1999[321] and 1998[322] (survey/interviews), DiGuiseppi 1998[175] (cross-sectional), Coakley et al. 1998[81] (qualitative), Jones 2001[323] (BA/survey; 2+), Hillman 1993[324] (cross-sectional)
13	Addressing safety concerns in relation to walking and cycling may be particularly important for females and children and young people and their parents	3	Four corroborative studies support: Foster et al. 2004[310] (cross-sectional), Coakley et al. 1998[81] (qualitative), Mulvihill et al. 2002[308] (qualitative), Davis and Jones1996[309] (qualitative).
14	Interventions which incorporate novel educational and promotional methods, such as videos and computer programmes, may improve dietary intake	1++	Three RCTs support: Winett et al. 1988, Winett et al. 1991 (both cited in Roe et al. 1997[291] [1++]), Anderson et al. 2001[325] (1+)
15	Changes to city-wide transport, which make it easier and safer to walk, cycle and use public transport – such as the congestion charging scheme in the City of London and Safer Route to School schemes, have the potential to make active transport more appealing to local users	3	Four corroborative studies support: Transport for London 2005[326] (case study/audit 3); DETR 2000[327] (case studies 3), Parker and Seddon 2003[328] (BAs; 2+), Jones 2001[323] (BA/survey; 2+)

BA, before-and-after study; CBA, controlled before-and-after study; DETR, Department for Transport, Environment and the Regions; N/A, not applicable; RCT, randomised controlled trial.

See Appendix 10 for associated evidence tables.

12.2 Methodology for review

Database searches were carried out in April 2005 for papers published from 1990 onwards (1995 onwards for systematic review level evidence). A final update search was completed on 1 December 2005 on a reduced number of databases. From an initial 4320 hits, 524 papers were assessed in detail of which 61 papers (including 10 systematic reviews) met the critical appraisal criteria for inclusion in evidence tables.

The inclusion and exclusion criteria for the review adhered to the standard public health review parameters. However, specific criteria were also developed to make this topic manageable in the time available. The following were included:

- City-, county- and state-wide interventions with potential for local implementation. Although interventions without a control or comparison group are usually excluded within rapid reviews, for two topics in this review, stair climbing and multi-use trails, the only evidence available was from uncontrolled before-and-after studies and therefore these were included.
- Mass media interventions that include an intervention and are not just about raising awareness. A note was made in the evidence tables if individual studies were assessed by McDermott et al.[329] as meeting the Andreasen[330] benchmarks for a social marketing programme.
- Papers on perception of causation (environmental reasons people give for not exercising, etc.) and all other corroborative evidence relating to the topics of interest.

The Guidance Development Group (GDG) also considered a non-evidence-based, expert review paper prepared by one of the GDG members on the potential impact of the built environment on weight and obesity.

12.3 Weight outcomes

Three multi-component before-and-after studies aimed at reducing cardiovascular risk factors in adults included weight outcomes.[106,289,288] The studies employed a range of educational and behavioural strategies such as workshops, point of choice, educational and multimedia components. O'Loughlin and coworkers[106] and Baxter and coworkers[289] looked at lower-income populations. None of the studies noted a significant reduction in weight or body mass index (BMI) in the intervention compared to the control communities although Shelley and coworkers[288] recorded a trend towards weight reduction in the intervention group.

No studies in other settings were identified that reported weight outcomes.

12.4 Diet and activity outcomes

Seven systematic reviews, five randomised controlled trials (RCTs) and four before-and-after studies were identified which provided evidence of efficacy. UK studies were identified in the majority of areas and an additional 20 UK-based studies provided evidence for implementation.

Interventions to improve diet focused on supermarkets, restaurants/cafes and churches. Environmental action to improve physical activity levels focused on the promotion of active travel, point of decision prompts to stimulate stair climbing, and the creation of space and safer routes.

Long-term follow-up of interventions was rare. Although interventions did not appear to be skewed towards higher income, white populations, dietary studies focused more on women rather than men. The majority of studies were delivered by researchers, and, where appropriate, setting-based workers (for example, supermarket or community centre staff).

12.4.1 Diet

The results suggest that point of purchase schemes can be effective in improving dietary intakes, at least in the short term, particularly if accompanied by supporting information and local promotion. Incorporating novel methods, such as video and computer programmes, may be particularly effective. Promotions in restaurants and cafes may have a greater impact than those in supermarkets. Interventions based in religious or other community settings may also have a positive impact on dietary intake.

There was little evidence of effectiveness from the five city/state-wide multi-component interventions in terms of dietary outcomes.

12.4.1.1 Supermarkets

Two good quality systematic reviews with limited overlap[206,291] and three RCTs[296,325,294] considered supermarket based interventions. These primarily focused on point of purchase schemes. The majority of studies were US based. Both systematic reviews concluded that point of purchase strategies in supermarkets can increase the purchase of targeted 'healthier foods' (particularly if supported by informational brochures and local promotion[291]). The magnitude of the effect was around 1–2% of total market share of healthier food items.[291]

The conclusions of the two reviews were not entirely supported by two additional supermarket-based RCTs. A Dutch RCT[296] assessing education with or without shelf labelling found no decrease in total fat intake 6 months post intervention, and a US-based RCT[294] found no increase in fruit and vegetable consumption at 4 months after the intervention. Kristal did note an 8.4% increase in intervention shoppers in the action or maintenance stage of dietary change but this was not significant ($p < 0.07$). These findings may reflect the length of the interventions; Seymour and coworkers[206] noted that the longer, multi-component studies appeared to be more effective (although no data were provided).

The two RCTs of educational videos included in the systematic review by Roe et al.[291] (Winett et al. 1988 and 1991) showed a 4–5% decrease in the percentage of energy from fat of purchases during the intervention. Longer-term follow-up data were not available. An RCT to assess the impact of a self-administered, computer-based intervention on supermarket shoppers found that the treatment group was more likely than the control to attain 'goals' for fat at the end of the 16-week intervention ($p < 0.001$) and 6-month follow-up ($p < 0.05$).[325] There was also a non-significant trend ($p < 0.1$) towards goal attainment for fibre and fruit and vegetables after the intervention. However, some caution is needed on these findings as the initial low response rate and compliance may suggest that the participants were a motivated group.

12.4.1.2 Restaurants and cafes

Four systematic reviews with limited overlap and including 28 studies in total were identified. Two were good quality (Roe et al.[291] and Seymour et al.[206]) and two were much lower quality (Matson-Koffman et al.[292] and Holdsworth and Haslam[293]). All four reviews focused on 'point of purchase' interventions in restaurants and cafes.

All four reviews concluded that point of purchase strategies increased the consumption of targeted items. Roe et al.[291] concluded that point of choice promotions led to an increase in sales of promoted items of 2–12% total market share but the effect generally only lasted as long as the intervention was in place. Seymour stated that most of the restaurant studies reported some significant increased sales of targeted menu items (but no data were provided).[196] The two lower-quality reviews (Matson-Koffman et al.[292] and Holdsworth and Haslam[293]) concluded that point of purchase or choice strategies increased the consumption of 'healthier foods'. Some caution is required when considering these findings as 'unpicking' of the reviews revealed that none of the included studies met the rapid review inclusion criteria.

An additional small UK-based RCT found that the provision of menu information about a lower-fat option had no effect on total energy and fat intake and did not influence the subjects' choice. However, information was only provided on one menu item.[295]

12.4.1.3 Multi-component state- and city-wide interventions

Four multi-component controlled before-and-after studies (CBAs) aimed at reducing cardiovascular risk factors measured dietary outcomes.[106,109,289,290] Of these, three reported no difference in dietary outcomes between the intervention and control areas.[106,109,290] One UK-based study[289] observed that 8.7% more people in the intervention population drank lowfat milk compared with the control group ($p < 0.001$), which the authors attributed to the mailing of a leaflet promoting semi-skimmed milk to 11,000 households over a 2-year period.

12.4.2 Physical activity

The results suggest that although the general promotion of active travel does not appear to be effective, targeted behavioural change programmes appear to improve travel behaviour of motivated subgroups. Associated action, such as subsidies for commuters, may also be effective. Promotions which aim to motivate stair use, such as posters and banners, appear to have a weak, positive effect. The only RCT considering safer routes to schools, which looked at the effect of a school travel coordinator, was unable to assuage parental fears and alter children's travel patterns.[331]

No studies were identified which considered interventions linked to supermarkets and shops, restaurant and cafes, or religious organisations. There was little evidence of effectiveness from the five city/state-wide multi-component interventions in terms of physical activity outcomes. Identified interventions included a mixture of UK, US and Australian-based studies. The length of follow-up varied considerably.

12.4.2.1 Active travel versus car travel

One good quality systematic review (including nine UK studies) concluded that targeted behavioural change programmes with tailored advice can improve the travel behaviour of motivated subgroups (the largest study showing a 5% shift to active travel).[300] The authors also concluded that identified single studies of commuter subsidies and a new railway station also showed positive effects, but this was not the case for publicity campaigns, engineering measures and other interventions promoting active travel.

12.4.2.2 Point of decision prompts to stimulate stair climbing

Two systematic reviews, one good-quality[297] (including two UK studies) and one lower-quality[301] (including eight UK studies) review concluded that educational materials such as posters and stair riser banners have a weak positive effect on stimulating stair climbing. Kahn et al.[297] reported a range of effect sizes from a 5.5% to 128.6% net increase and noted that the effectiveness of interventions may be increased by customising signs to appeal to specific population groups. Foster[301] found that most studies saw a short-term effect for up to 3 months although one study observed a 29% increase at 6 months. Three additional short-term before-and-after studies were identified, two supporting the conclusions of the systematic reviews (references [302] and [332], a very weak study) and the third not.[303] Finally, a Swedish-based observational study found that over a 1-hour period 35% of commuters walked up the stairs when one escalator was in operation compared with only 18% when two were in operation.[333]

12.4.2.3 Creation of space for physical activity

One good-quality systematic review (all US-based studies of varying designs) found strong evidence that the creation of space or enhanced access to places for physical activity combined with informational outreach activities is effective in increasing physical activity levels.[297] Interventions increased frequency of activity between 21% and 84%. Interventions included access to fitness equipment, access to community centres and creation of walking trails.

An additional CBA of walking trails in the USA found no significant difference between intervention and control communities overall, although two intervention subgroups (lower education/income) showed positive trends in total walking rates.[298] Two additional, non-UK-based before-and-after studies considered the use of multipurpose trails. Evenson and coworkers[299] found that 2 months following the building of a multi-use trail, there was no increase in physical activity among adults living within 3.2 km (2 miles) of the trail. However, this intervention did not include an associated campaign/promotion. Conversely, Merom and coworkers[105] found that a promotional campaign for a local cycle trail increased the number of bikes in the area ($p < 0.001$) and influenced cyclists living within 1.5 km of the trail (increasing cycling time).

12.4.2.4 Safer routes to school

One UK-(inner city)-based RCT found that assistance from a school travel coordinator did not change primary school children's travel patterns, nor did it substantially affect parental fears about the safety of the journey to school.[331]

12.4.2.5 Multi-component city/state-wide interventions

Three multi-component CBAs aimed at reducing cardiovascular risk factors measured physical activity outcomes.[106,109,289] None of the studies detected a difference between control and intervention groups although two noted an increase in physical activity in both intervention and control populations.[106,109]

12.5 Sub questions

Corroborative evidence highlighted the importance of interventions addressing fundamental issues such as cost and availability and pre-existing concerns such as the poorer taste of healthier foods and the potential risks of walking and cycling.

12.5.1 Variation by gender, age, ethnicity, religious practices or social group

12.5.1.1 Age

UK-based studies of 'food deserts' suggest that younger women, especially those with low incomes, may be more concerned about the cost rather than the quality of the food whereas this situation may be reversed in older women who may be more enthusiastic about buying 'healthier' foods.[304] This reflects the findings of the Heartbeat Award that the availability of healthier food choices was more important to those aged 45 or over.[305]

In London, 14-year-olds considered 'healthy foods' to be largely irrelevant, unappealing, expensive and not readily available outside their own homes.[306,307] Fast foods were consumed largely for the opposite reasons, and were considered part of their independent lives. Parental disapproval of fast foods was also part of their appeal. The participants considered addressing these factors, along with will power, support from family and advice from doctors, as helpful in promoting future changes in eating habits.

A cross-sectional and focus group study of 9–11 and 13–14-year-olds found that children were aware of the health promotion messages about being active but felt considerable environmental constraints.[309] Many were not allowed to play outdoors, use local parks or cycle to school – nor they did not feel comfortable doing so. Girls especially were restricted in how late they were allowed out. In the children's views, traffic danger, 'stranger danger' and social and cultural factors interact to create barriers to keeping healthy and active. A qualitative study of 5–11-year-olds also found that the main barriers were lack of time, cost, lack of transport in rural areas and parental concerns about lack of safety and the poor condition of local parks.[308] Children stressed the importance of the social aspects of physical activity.

12.5.1.2 Gender

A cross-sectional survey found that the perceived safety of walking during the day and lack of shops within walking distance were significant barriers to walking for women but not men.[310] Conversely, environmental perceptions were not related to the number of women walking for more than 150 minutes a week whereas having a park within walking distance was significantly associated with this measure in men.

A qualitative study of young people in London reported that young women mentioned parental constraints and the influence of boyfriends as affecting their leisure choices whereas young men tended to 'do what they wanted'.[81] Young women's decisions about sport participation reflected past experiences and were often associated with feelings of discomfort and embarrassment. Mulvihill and coworkers[308] also found that barriers for young women being active included feeling intimidated by young men, lack of time and lack of self-confidence.

12.5.1.3 Ethnicity

No specific issues were identified.

12.5.1.4 Social status

Financial constraints may have a significant impact on sport participation for young people of both sexes.[81] However, Watt and Sheiham[306] reported that young people from non-manual households were more likely to consider friends' support, information and the availability of healthy foods as being important in making healthier choices than their peers from manual households.

Cost rather than quality is the major issue for those in lower-income brackets when deciding where to shop,[304,311] and lack of transport may be a limiting factor for those on a low income.[311,312] A qualitative study of women on low incomes found that although they reported good food availability and control of budgets, buying 'more' foods such as more fruits and vegetables was beyond their budgetary control.[319]

Six studies addressed the specific issue of 'food deserts': a before-and-after study[316] and associated qualitative study[304] considered the effect of the opening of a supermarket in a deprived, poor-retail-access community in Leeds; and a cross-sectional study assessed relations between dietary intake and retail access in Newcastle upon Tyne.[317] The studies did not provide evidence of a 'food desert' effect on dietary intake although in the Leeds study, participants who switched to the new store increased their consumption by 0.23 portions of fruit and vegetables per day.[316] The findings suggest that fundamental issues around cost, availability and taste are key considerations for future interventions. In the Leeds study, 28% of those who did not switch to the new store were concerned about the expense. This was backed-up by qualitative work which found that although the stores improved physical access, this did not fundamentally alter economic access. In the Newcastle study knowledge (itself related to social status) and relative affluence were the key indicators of 'healthy eating' rather than retail availability.[317]

Other corroborative evidence suggests that supermarket-based interventions to improve dietary intake may also be hindered by a range of factors including confusion about product labelling (particularly among lower social groups), conflicting or confusing information, and concerns about taste.[318,319]

12.5.2 Influence of previous weight loss

No evidence was identified.

12.5.3 Source and mode of delivery

12.5.3.1 Source

The majority of studies were delivered by researchers, and, where relevant, appropriate setting-based workers (for example, supermarket or community centre staff).

Case studies suggest that involving the local community from the outset, establishing effective partnerships and including an evaluation of pedestrian

needs may improve the effectiveness of interventions promoting active travel.[313–315] The need for project sustainability, publicity and clear roles for project champions have also been highlighted.[315]

Parents are likely to have an important role in the success of interventions aimed at children and young people. A systematic review of 93 consultation studies in England found that barriers to play for school-age children are: fears for their own safety, in particular bullies; dirty unkempt play areas and parks; the lack of things to do; traffic; and lack of facilities for disabled children.[320] A weak report of cross-sectional surveys of English 7–11-year-olds between 1971 and 1990 (Hillman 1993)[285] noted large decreases in the number of children, particularly girls, allowed to cycle, cross roads or use the bus on their own. The primary concerns of parents were danger from traffic, and children's reliability and fear of molestation.

Cross-sectional and focus group surveys provide powerful evidence that children would like to walk, cycle or take the bus to school but perceived and actual dangers have led to increase vigilance by parents and reduced activity in children.[175,315,321–323] A safer route to school scheme that incorporated the views of children in its development found a considerable increase in walking and cycling to school 3 years after the intervention.[323] Encouragement from parents may be particularly important for children and young people but advocates and role models may be more important for those over 16.[81] Children using staffed provision like staff who listen; staff who are funny, friendly and fair; having a say in what they do; and staff who can deal with conflicts between children.

12.5.3.2 Source

A systematic review (including two UK studies) suggests that tailoring prompts to stimulate stair climbing, either by specifying the benefits of stair use or by customising the sign to appeal to specific population groups, may increase intervention effectiveness.[297]

Data from two sets of case studies[313,314] suggest a range of practical issues that may improve the effectiveness of interventions promoting active travel including (i) improving the walking and cycling environment (for example, traffic calming, crossings, signs and lighting); (ii) improving facilities (for example, cycle stores, traffic-free routes); and (iii) influencing behaviour (for example, guides, maps, walking schemes). Experience from Scotland suggests that a promotional campaign and helpline may encourage motivated individuals (callers to the helpline) to walk more but this study found no effect on the population as a whole.[100]

The findings of the Department for Transport case studies[314] – that addressing practical issues may impact on behaviour – are reflected in the findings of the impact of the City of London's congestion charging scheme.[326] Two years after implementation of the scheme it was estimated that 10–20% car journeys had transferred to cycling, walking, motorcycle, taxi or car share. Before and after street surveys found that comfort and quality of walking and public transport, and safety of cycling, was perceived to have improved.

There is good corroborative evidence from the UK that 'Safer routes to school' schemes can be effective (that is, at odds with one identified RCT).[331] A series of before and after studies found that, when both school travel plan and safer routes to school programmes were in place, there was a 3% increase in walking, a 4% reduction in single-occupancy car use and a 1.5% increase in car sharing. Bus and cycle use remained largely static.[328] Conversely, a selected series of case studies found an overall increase in cycle use and decrease in car travel whereas the effects on walking and bus travel were variable.[327] Another scheme also found a considerable increase in walking and cycling to and from school 3 years after the intervention.[323] The effectiveness of such interventions among younger children remains unclear; the 'Early bird' longitudinal study found that being driven to school did not affect the overall physical activity of 5-year-olds.[174]

Support and advice for food providers, for example, through an award scheme may aid, the implementation and sustainability of point of purchase and other schemes promoting 'healthy eating'. Premises participating in the Heartbeat Award Scheme self-reported greater provision and uptake of 'healthier' food choices.[334] Provision of a range of affordable healthier choices may be viewed favourably by customers, particularly women and be one of a number of factors influencing their choice of eating place.[305] Qualitative work of community cafes suggests that a strong lead, active involvement of trained and supported staff, competitive pricing and active promotion of healthier options may be important for effectiveness of such schemes.[335] A weak cross-sectional study reported that 42% of respondents were eating more fruit and vegetables after the implementation of the scheme with 45% of respondents listed convenience/ease of access as a benefit.[336]

No evidence was identified on how best to encourage partnerships.

12.5.4 Potential negative impact

The majority of studies considering this issue did not report such findings. One UK study found evidence that prompts to stimulate stair climbing could be guilt inducing[303] (see also workplace review).

12.6 Limitations of the review

In general there was little evidence from RCTs for relevant interventions and this consisted of uncontrolled studies only for some topics (stair climbing and multi-use trails). By contrast there were a number of good UK-based corroborative studies although these did not always tie in directly to the intervention evidence.

RCTs often lacked (or failed to report) a description of the randomisation process, concealment allocation and/or an intention to treat (ITT) analysis.

According to the agreed review parameters, RCTs without ITT but 80% or more follow-up were downgraded in quality assessment but not to non-randomised clinical controlled trials (CCTs). Studies with no ITT and less than 80% follow-up

were treated as CCTs. The lack of description of randomisation and/or concealment allocation also led to a downgrading but not automatic rejection. Where an RCT did not meet one or more of the NICE criteria, reasons are listed in the comments column of the evidence tables.

13 Prevention evidence summary: interventions aimed at black, minority ethnic groups, vulnerable groups and vulnerable life stages ('BMEGs')

The following is based on an evidence review produced by the University of Teesside. Detailed evidence tables and supporting information are in Appendix 11.

13.1 Evidence statements (Table 13.1)

Table 13.1 Evidence statements and grading

No.	Statement	Grade	Evidence
Weight outcomes			
BMEGs			
1	There is a dearth of evidence on the effectiveness of interventions among BMEGs in the UK. All identified RCTs were undertaken in the USA, the majority among African/black Americans	N/A	N/A
2	There is some evidence that interventions among African/black American women, which promote a low-fat diet and moderate activity, can result in modest decreases in BMI and waist circumference in the short to medium term	1+	Two RCTs: Yanek et al. 2001[337] (1+) and Hall et al. 2003[338] (1++)
3	The effectiveness of interventions among African/black American children remains unclear. The majority of identified studies were not adequately powered to identify differences in BMI	N/A	Five of eight RCTs lacked power to detect changes in BMI (Baranowski 2003[339] [1+] , Beech et al. 2003[340] [1+], Robinson 2003[341] [1+], Story et al. 2003[137] [1+], Wilson 2002[342] [1+]); another two probably lacked power (Stolley 1997[343] [1+],

No.	Statement	Grade	Evidence
			Baranowski et al.1990[344] [1–])
			Only Hip-Hop (Fitzgibbon et al. 2005[110–111] [1+]) was adequately powered and showed positive improvements in BMI in children
4	There is evidence that school-based intervention are effective in preventing excess weight gain among black American children	1+	Three RCTs showed positive results: Flores 1995[138] (1+) (girls only at 12 weeks Stephens and Wentz 1998[140] (1+); Hip-Hop (Fitzgibbon et al. 2005[110–111] [1+])
			One RCT (Healthy Start[115–116] [2++]) showed intervention more effective in white pre-school children compared with African American children
5	There is some evidence that ethnicity may be a risk factor for greater weight gain during childhood, pregnancy and smoking cessation	3	Three (body of evidence from cohort studies – see energy balance review)
			Ethnicity in childhood: Ambrosius et al. 2001[88]
			Ethnicity and pregnancy: Rosenberg et al. 2003,[23] CARDIA[20,53–54]
Vulnerable groups			
6	The effectiveness of interventions among lower-income and other vulnerable groups remains unclear	N/A	Only one study among Mexican American children identified: Trevino 2005[154] (1+); no difference between intervention and control following intervention
7	There is a dearth of evidence on the effectiveness of interventions among individuals with a disability.	N/A	Rimmer 2004[345] (1+); two additional studies were not adequately powered: Chapman et al. 2005[346] (2–) and Van den berg-Emons et

No.	Statement	Grade	Evidence
	There is limited short-term evidence to suggest that intervention may prevent excessive weight gain in overweight adults with Down's syndrome		al. 1998[347] (1+)
8	There is some evidence that interventions to prevent excess pregnancy weight gain may be effective among lower-income groups but the impact of baseline weight remains unclear	1+	One RCT: Polley et al. 2002[348] (1+); one CBA Olson et al. 2004[349] (2++)
Vulnerable life stages			
9	On balance, smoking cessation interventions incorporating weight management may increase continuous abstinence rates but the long-term impact on weight, and the impact on diet and physical activity levels, remains unclear	1+	Four support: Marcus 1999[173] (1+), Danielsson et al. 1999[350] (1++), Perkins et al. 2001[351] (1+), Hall et al. 1992[352] (1+) Three did not: Pirie et al. 1992[353] (1++), Spring et al. 2004[354] (1+), Jonsdottir and Jonsdottir 2001[355] (2++)
10	There is a body of evidence that exercise (walking, other aerobic training, resistance training, strength training with weights machines or combinations) can improve body composition and result in a small loss of body weight and fat in postmenopausal women. This effect seemed to be optimal when combined with a weight-reducing diet	1++	Systematic review (1++): Asikainen et al. 2004[226]
11	There is limited evidence that a weight management programme addressing diet and activity during the menopause can prevent excess weight gain in	1++	One RCT (1++): Simkin-Silverman et al. 2003[227]

No.	Statement	Grade	Evidence
	women during the menopause		
12	There is limited evidence to suggest that continuing a regular exercise regimen and following an appropriate, healthy diet throughout pregnancy can result in significantly less total weight gain and significantly less increases in the sum of skinfolds	2+	Clapp 1995[356]) (2–); Olson et al. 2004[349] (2+); Polley et al. 2002[348] (1+); Kramer and Kakuma 2003[357] (1+)
Diet and activity outcomes			
BMEGs			
13	There is a dearth of evidence on the effectiveness of interventions among BMEGs in the UK. All identified RCTs were undertaken in the US, the majority among African/black Americans	N/A	N/A
14	There is a body of evidence that culturally specific interventions among black American adults can significantly improve fruit and vegetable intake, reduce percentage energy from total and saturated fat and reduce energy intake up to 2 years	1+	Body of evidence (seven RCTs) (1+/1++) *Fruit and vegetables:* Resnicow 2001[358] (1++), Resnicow et al. 2004[359] (1++), Resnicow et al. 2005[360] (1+), Campbell et al. 1999[361] (1++) *Energy and fat intake*: Hall et al. 2003[338] (1++), Yanek et al. 2001[337] (1+), Stolley 1997[343] (1+)
15	The effectiveness of tailored physical activity interventions targeted at BMEGs, compared with a non-targeted intervention programme, remains unclear	N/A	Three RCTs (all 1+) providing inconsistent findings Supportive: Chen et al. 1998[362] (1+) No difference: Newton and

No.	Statement	Grade	Evidence
			Perri 2004[363] (1+) Supportive for diet but not activity: Reniscow et al. 2005[360] (1+)
16	The effectiveness of interventions among children remains unclear	N/A	Eight studies but five lacked power (Baranowski 2003[339] [1+], Beech et al. 2003[340] [1+], Robinson 2003[341] [1+], Story et al. 2003[137] [1+], Wilson 2002[342] [1+]); another two probably lacked power (Stolley 1997[343] [1+], Baranowski et al.1990[344] [1–]) Only Hip-Hop (Fitzgibbon et al. 2005[110–111] [1+]) was adequately powered
Vulnerable groups			
17	There is a paucity of evidence on the effectiveness of interventions to manage weight, improve dietary intake and or improve activity levels among vulnerable groups	N/A	N/A
18	The impact of interventions during pregnancy to lower income groups in relation to long-term diet and activity levels remains unclear	N/A	No evidence
Generalisability			
BMEGs			
19	The generalisability of specific interventions among black American populations to all UK BMEGs may be limited but general learning can be applied to the UK	4	Expert opinion of GDG
Implementation			

No.	Statement	Grade	Evidence
20	Community settings, such as churches, have been shown to be an effective setting for engaging black/African Americans	1++	Five RCTs in churches for BMEGs: Yanek et al. 2001[337] (1+), Resnicow 2001[358] (1++), Resnicow et al. 2004[359] (1++), Resnicow et al. 2005[360] (1+), Campbell et al. 1999[361] (1++).
21	Additional barriers for BMEGs and vulnerable groups include cost, child care, cultural codes of conduct, language, racism and religious discrimination	3+	3+ body of evidence from case studies and surveys. Bush 1998,[364] Carroll et al. 2002,[365] Health Education Authority 1999,[366] Rai and Finch 1997,[367] Asian Arts 1996,[368] Verma 1994,[369] Dibsdall 2003,[370] Kennedy 2001[371]

BMEGs, black and minority ethnic groups; BMI, body mass index; CARDIA, Coronary Artery Development in Young Adults Study; CBA, controlled before-and-after study; GDG, Guidance Development Group; N/A, not applicable; RCT, randomised controlled trial.

See Appendix 11 for associated evidence tables.

13.2 Methodology

All studies previously identified for other review areas were considered for inclusion if they provided salient information on black and minority ethnic group (BMEGs), vulnerable groups or vulnerable life stages. Additional database searches were carried out in June 2005 for papers published from 1990 onwards (1995 onwards for systematic review level evidence). A final update search was completed on 1 December 2005 on a reduced number of databases. After de-duplication, 120 papers from previous reviews and additional database searches were assessed in detail of which 35 papers (including two systematic reviews) met the critical appraisal criteria for inclusion in evidence tables.

The inclusion and exclusion criteria for the review adhered to the standard public health review parameters (see Appendix 2). However, specific criteria were also

developed to make this topic manageable in the time available. The following were included:

- BMEGs – minority population groups to consider based on UK census data[372] and the prevalence data of obesity among BMEGs.[373] However, studies that met the inclusion parameters for effectiveness were conducted solely in black American or African American populations. Mean body mass index (BMI) in these populations is higher than in Caucasian populations. Therefore, at odds with the standard review parameters, studies among these population groups were not excluded if the mean baseline BMI was above 30 kg/m^2 but the study was not specifically aimed at weight loss.

- Vulnerable groups – included standard terms used for all previous Health Development Agency work regarding inequality (for example income, socioeconomic status, education) along with children in care; children in special schools; people in institutions. Additional terms were included to identify studies on individuals with learning difficulties, special needs and developmental disorders.

- Vulnerable life stages – based on the findings of the 'Energy balance' review which identified that smoking cessation, pregnancy and menopause were life stages associated with weight gain. Search terms were not included for other life stages where the energy balance review had identified more limited evidence (such as marriage, divorce and shift working).

13.3 Weight outcomes

13.3.1 BMEGs

Two large US-based studies in postmenopausal women reported weight outcomes, one in which 28% of the population were black, 16% Hispanic and 56% white[338] and the other in which all the middle-aged women were of African American descent.[337] The BMI of women in both studies ranged from approximately 28 kg/m^2 to 33 kg/m^2.

Eight randomised controlled trials (RCTs) were identified which reported weight outcomes in children of which four were conducted as pilots for one trial (GEMS [Girls health Enrichment Multi-site Studies]) in African American/black American children. Two additional family-based studies[111;337;337;344] were also identified. The RCTs focusing on children all had a 12–14-week follow-up (with the exception of one 2-year study) whereas seven of the nine studies including adults had follow-up between 5 and 30 months duration. All RCTs involved the staff at the location where the intervention was provided, including school staff, summer camp staff and community centre staff.

None of the RCTs were conducted among BMEGs in the UK. The majority of studies were conducted in African American females and five studies were conducted in church settings. This limits generalisability of the study outcomes to UK population groups.

13.3.1.1 Adults

Two good-quality, large RCTs reported weight outcomes in middle-aged African American/black American adults.[337;337;338] Both studies showed modest but statistically significant decreases in BMI (–0.6 kg/m^2 to –1.1 kg/m^2) and waist circumference (–1.7 cm to –1.9 cm). The study by Hall and coworkers[338] – incorporating weekly and monthly sessions with a research nutritionist encouraging a reduction in total and saturated fat, and an increase in fruit, vegetables and whole grain foods – showed modest but statistically significant decreases in weight, BMI, and waist and hip circumference in black American women at 6 months. Yanek and coworkers[337] reported the findings of a church-based intervention including nutrition education classes for 20 weeks and promoting moderate activity and a low-fat diet rich in fruit and vegetables. The intervention resulted in a significant reduction in BMI and waist circumference at 1 year in African American females but not weight or per cent body fat.

13.3.1.2 Children

Only one study was adequately powered to detect changes in weight.[374] Therefore the results of the four GEMS pilot studies – that there was no change in BMI at 12 weeks – must be treated with caution.[137;339-341] The four pilot studies addressed dietary intake (promoting reduced consumption of high-fat foods, increased water consumption/reduced sweetened beverages, increased fruit and vegetable intake) and physical activity (increased moderate to vigorous activity including dance and decreased sedentary behaviours including television viewing). Mothers were actively involved in one of the GEMS pilot studies.[340]

The two RCTs including parents and children did not report weight outcome data at 12 weeks for the children but one of these studies reported 'no weight change' between intervention and control group mothers[343] and the other study reported 'no significant differences' between groups (that is, parents and children) for anthropometric measures.[344] The two studies were assessed as unlikely to have been adequately powered and so the results should be treated with caution.

The one study that definitely was adequately powered appeared to be effective. US-based ethnic minority children who received a 14-week diet and physical activity intervention (Hip-Hop to Health Jr.) had significantly smaller increases in BMI compared with control children at 1-year ($p = 0.01$) and 2-year ($p = 0.02$) follow-up with adjustment for baseline age and BMI. This study was adequately powered.

13.3.1.3 Relevant studies from interventions identified in previous reviews

There is a notable dearth of information from the workplace and community reviews. In the workplace review, none of the included workplace studies focused exclusively on BMEGs. The studies which included African/black Americans did not analyse results by ethnicity. In the two reviews of community interventions none of the studies identified, which included black, ethnic minority populations, reported subgroup analysis by race. There is some evidence from the schools review that interventions are effective in preventing excess weight gain among

black American Children. Among pre-school children, one study suggested that the intervention reduced weight gain among white participants but not African American or Hispanic participants.[115]

13.3.2 Vulnerable groups

Few RCTs on vulnerable groups reported weight outcomes. Six of the RCTs of black, minority ethnic populations were among low-income groups.[137;340;343;344;361;374] Two of the pregnancy studies were in low-income women.[349,348] None of the seven smoking studies or the study during menopause was in low-income populations. Three further studies were identified focusing on low income/literacy groups, two among adults[231;375;375] and one among children.[153;154] Three further studies were identified focusing on children with spastic cerebral palsy,[347] adults with learning difficulties[346] and adults with Down's syndrome.[345]

13.3.2.1 Adults

The low-intensity diet and exercise 'pound of prevention' intervention showed no significant difference in weight outcomes between treatment and control groups (education, education plus lottery incentive and control).[376] The authors suggest intervention may be having a greater impact on high- than low-income women. There was a non-significant trend for less weight gain among intervention participants versus control in men and high-income women, but more weight gain among low-income women in the intervention versus control groups.[376] A culturally specific low-fat diet intervention among low literacy/income Mexican American women included weight outcomes but it was unclear whether the study was adequately powered to detect changes in weight.[375] It is therefore difficult to draw conclusions on the finding that the study failed to increase the effect of a standard nutritional education course without maintenance period, and there was no weight change in either group at 18 weeks. A study among low-income pregnant women suggests that such interventions may be more effective in preventing excess pregnancy weight gain in normal-weight low-income women than overweight women.[348] Conversely, Olson and coworkers[349] reported that

low-income women, particularly those who were overweight, who received the intervention to prevent excessive weight gain during pregnancy had a significantly reduced risk of excessive gestational weight gain.

A 12-month intervention led by health practitioners to reduce obesity among adults with learning difficulties in Manchester showed that in the control group obesity levels deteriorated in 10.2%, remained the same in 81.6% and improved in 8.2%.[346] In the intervention group 10.5% deteriorated, 63.2% remained the same and 26.3% improved. Mean BMI did not appear to significantly differ from baseline or between the groups at 1 year. A 12-week cardiovascular and strength exercise programme in adults with Down's syndrome showed a significant difference between groups ($p < 0.01$) with a slight reduction in weight at 12 weeks whereas control group weight increased. BMI was not significantly different between the groups at 12 weeks.[345] It is important to note that in both these studies the majority of participants were obese (in line with population estimates that approximately 69% of all adults with Down's syndrome are obese).

13.3.2.2 Children

Mexican American children from economically disadvantaged households who received a diet and exercise intervention to prevent diabetes did not improve per cent body fat compared with controls at 1 year.[153;154]

A nine-month German-based aerobic exercise programme (45 minutes, four times per week) in 20 9-year-old children with spastic cerebral palsy reported 'no changes' in fat mass compared with an average 1.1 kg increase in the control group (small sample, not powered to detect significant changes).[347]

13.3.2.3 Findings from interventions identified in previous reviews

There is a dearth of evidence relating to vulnerable in all the reviews, although particularly in the schools and workplace reviews. Where lower income groups were included subgroup analysis was seldom presented. The community 1 review noted that studies tended to be among higher socioeconomic status populations.

13.3.3 Vulnerable life stages

In relation to the menopause, one systematic review) of 18 good-quality RCTs of at least 8 weeks' duration assessed the effect of exercise in healthy postmenopausal women (aged 50–65 years) was identified.[226] An additional US-based RCT followed predominantly white women of higher social status from premenopause for 54 months when 35% of the women had become postmenopausal.[227]

In relation to pregnancy, a systematic review of diet during pregnancy was identified[357] and included three trials (two UK based) involving 384 women. An additional three US-based studies (one RCT[348] and two controlled before-and-after studies [CBAs][349,356]) were also identified which aimed to prevent excessive weight gain during pregnancy.

In relation to smoking, seven studies (six RCTs and one CBA) were identified that aimed to prevent excessive weight gain during smoking cessation.[173,350–355] The majority of the studies were small, US based and included predominantly women in their late thirties to forties who smoked 19–32 cigarettes a day. Although three of these RCTs included dietary and physical activity interventions[173,352,353,355] none reported dietary or physical activity outcomes. Most of the interventions were provided by research plus hospital staff, counsellors/therapists and/or an exercise specialist.

13.3.3.1 Menopause

One high-quality systematic review found that body composition was improved in 9 of the 18 included RCTs and the majority of RCTs showed a small loss of body weight and fat.[226] The effect was optimal when exercise (walking, other aerobic training, resistance training and/or strength training) was combined with a weight-reducing diet, particularly for overweight participants. The mean weight loss ranged from 2 kg to 10 kg in 12 weeks to 1 year.

Evidence from one high-quality RCT suggests that a tailored programme with a behavioural element addressing both dietary intake (calories, fat, and fruit and vegetable intake) and physical activity (for example, through lifestyle activities) can prevent excess weight gain and attenuate increase in waist circumference and per cent body fat in women during the menopause.[227] There was a significant reduction in waist circumference and BMI ($p < 0.001$) and per cent body fat ($p < 0.01$) in intervention women compared with controls at 54 months. At 54 months' follow-up 55% of the intervention women were at or below their baseline weight compared with 26% of controls.

13.3.3.2 Pregnancy

A Cochrane systematic review of diet in pregnancy reports that the limited evidence available suggests that protein/energy restriction of pregnant women who are overweight or exhibit high weight gain is unlikely to be beneficial and may be harmful to the developing fetus.[357] Only three studies were included, two in Scotland (published prior to1990), of which one was in obese women and the other in women with high gestational weight gain between weeks 20 and 30. Both trials reported that energy/protein restriction was associated with a significant reduction in weekly maternal weight gain, although the magnitude of the reduction was much larger in the 1975 trial.

Conversely, evidence from one RCT and one CBA suggests that interventions can minimise retention of excess weight after pregnancy among low-income women,[348;349] but it remains unclear whether the effectiveness varies depending on whether the woman is overweight or not. The CBA[349] demonstrated that the diet and exercise intervention reduced the risk of excessive gestational weight gain in the low-income subgroup only. Low-income women who received the intervention had a significantly reduced risk of excessive gestational weight gain at 1 year postpartum.

The RCT of diet and exercise, using a stepped-care approach that increased the intervention in women who had excessive weight gain, reported that the

intervention was effective in reducing the frequency of excessive weight gain in normal-weight women, with the intervention having no significant effect among overweight women.[348]

One controlled clinical trial (CCT) demonstrates that continuing a regular exercise regimen throughout pregnancy can result in significantly less total weight gain and significantly less increases in the sum of skinfolds at 37 weeks compared with women who voluntarily stop their regular exercise regimen because of concern that it would have negative effects on pregnancy ($p < 0.001$).[356] The intervention did not influence the rate of early pregnancy weight gain or subcutaneous fat deposition but both decreased in late pregnancy. Overall pregnancy weight gain remained within the normal range.

13.3.3.3 Smoking

Six of the seven identified studies suggested that additional interventions to prevent weight gain did not undermine smoking cessation.[173;350;351;353-355] Indeed three of the seven RCTs significantly increased continuous abstinence rates compared with controls.[173;350;351;353-355]

One study reported lower abstinence at 12 months in the intervention group compared with control (continuous abstinence 21–22% compared with 35% in control),[352] in other words including a specific and non-specific diet and exercise programme significantly increased the risk of smoking (13–14%) compared with control. Although the authors reported no significant difference in weight gain between treatment groups, the control group was 2.75 kg heavier than the diet and exercise group. Another study reported no significant difference in abstinence rates between the groups.[355]

One study demonstrated that cognitive behaviour therapy for weight concerns (to promote acceptance of and reduce concerns about modest weight gain when stopping smoking) significantly attenuated weight gain (2.5 kg vs 7.7 kg) compared with standard smoking cessation counselling in weight concerned women.[351] The third arm of the intervention included a 500 kcal/day deficit but

there was no significant difference in weight change between this weight control arm and the standard intervention arm (5.4 kg vs 7.7 kg).

Four other studies targeting exercise,[355] diet[350;354] or diet and exercise[350;352] reported no significant differences between groups in relation to weight change. Observed weight gain was consistently higher in the control compared with the intervention groups, though caution is required in interpreting non-significant trends. Furthermore, two of the studies[350;354;355] were not adequately powered to detect differences in weight.

Two of the seven studies found greater (non-significant) increases in weight in the intervention group compared with control. Marcus and coworkers[173;350] reported that the intervention group gained 8.92 kg compared with 5.76 kg in the control group. Pirie and coworkers[350;353] reported that weight gain ranged from approximately 4.5 kg (10 lb) in control or nicotine only to 4.4 kg (9.8 lb) in weight control or 6.4 kg (14 lb) in nicotine plus weight control.

13.4 Diet and activity outcomes

13.4.1 BMEGs

The evidence identified on diet and activity was limited. This was particularly the case in children where studies were generally relatively small pilots including girls only. Of the 16 US-based RCTs reporting intermediate outcomes in black/African American populations, four interventions addressed diet alone (three studies specifically focusing on increasing fruit and vegetables and one study of a low-fat diet).[338;350;358;359;361] Two RCTs addressed physical activity alone.[362;363] Ten other interventions addressed diet and physical activity.[137;339-342;360;374,343] The length of intervention ranged from 8 weeks[362] to 18 months.[338] Five of the identified dietary studies in adults were based in religious organisations.[337;358-361] In addition to research staff interventions, the interventions aimed at adults were provided by a range of individuals including a research nutritionist,[338] pastors and lay leaders,,[337] trained counsellors or lay members.[358;361-363] All eight RCTs that included children involved the staff at the location where the intervention was

provided, including school, fitness centre, summer camp and community centre staff.

The results suggest that dietary interventions aimed at BMEGs can be effective in children and adults (particularly in relation to intake of fat and fruit and vegetables). Physical activity programmes aimed at adults may also be effective but the evidence is equivocal on the benefits of tailoring the intervention to be culturally specific. The benefit of physical activity programmes in children remains uncertain due to the limited evidence base.

13.4.1.1 Diet

Adults

All seven adult RCTs addressing dietary intake reported significant improvements in intake in the intervention group. All four studies focusing on fruit and vegetable intake among African American churchgoers[358;358;359;359;360;360;361] reported that intakes were significantly increased in the intervention church populations up to 2 years, and one study reported significant difference in per cent energy from fat.[359] A culturally tailored diet and physical activity intervention significantly increased fruit and vegetable intake at 1 year compared with controls who received education materials only, with motivational telephone counselling having an additive effect.[360] A low-fat dietary intervention produced significant (11%) decreases in per cent energy intake from fat and total energy intake at 6 months in postmenopausal black American women.[338] A diet and moderate aerobic activity intervention produced significant decreases in total energy intake and total fat intake but not per cent energy from fat) at 1 year.[337] Saturated fat intake and per cent energy from fat was significantly reduced (by 8%) at 12 weeks in African American mothers following a diet and physical activity intervention.[343] A cross-sectional survey conducted at baseline and 3 years later, of women who were participating in the pound of prevention study showed that frequency of fast food restaurant use was higher among women of non-white ethnicity.[377] Intake of

several other foods, including fruits and vegetables, did not differ by frequency of fast food restaurant use.

Children

The evidence among children is more limited but also suggests that dietary interventions may have positive effects. The four GEMS pilots failed to show significant difference between study groups with regard to dietary intake (promoting reduced consumption of high-fat foods, increased water consumption/reduced sweetened beverages, increased fruit and vegetable intake) at 12 weeks, and also none were powered to detect statistically significant effects for weight/diet or exercise outcomes. The Memphis pilot[340] found that parent and child intervention groups combined significantly reduced intake of sweetened drinks compared with non-active controls and the Minnesota pilot[137] and the study by Stolley[343] both showed significant reduction in per cent energy from fat in the intervention girls. Among African American adolescents, social cognitive theory and social cognitive theory plus motivational interviewing to increase fruit and vegetable intake, were equally effective compared with control at 12 weeks.[342] The Hip-Hop to Health Jr. study (which was adequately powered) demonstrated only one significant difference between intervention and control pre-school children regarding diet outcomes and this was a difference in per cent of calories from saturated fat at 1-year follow-up ($p = 0.002$).

13.4.1.2 Physical activity

Adults

There is evidence from two RCTS that interventions promoting walking and home-based physical activity can increase the activity levels of sedentary ethnic minority populations.[362;363] Brief education was just as effective as adding mail and telephone counselling[362] and a culturally tailored programme was no more effective than a standard programme.[363] It is unclear whether the study by Chen and coworkers[362] was adequately powered to detect significant differences in treatment effects and the study by Newton and Perri[363] was not powered to detect significant differences in walking outcomes between the treatment groups.

The results for programmes specifically tailored to black American families reported mixed results. A culturally tailored diet and physical activity intervention significantly increased physical activity at 1 year compared with controls who received education materials only, however motivational telephone counselling did not increase effectiveness of the culturally tailored diet and physical activity intervention (both active interventions increased physical activity compared with controls).[360]

Both a culturally specific low-fat diet and an aerobic exercise intervention in black American families significantly increased energy expenditure from baseline but did not produce significantly increased metabolic equivalents (METs) or kilocalorie expenditure at 14 weeks compared with control.[344] Newton and coworkers[363] reported that a culturally tailored programme was no more effective than the standard programme and an RCT addressing diet and moderate aerobic activity failed to show a significant difference in energy expenditure between intervention and control at 1 year.[337]

Children

All three of the four GEMS pilots failed to show significant difference between study groups with regard to physical activity (increased moderate to vigorous activity including dance and decreased sedentary behaviours including television viewing) at 12 weeks, and none were powered to detect statistically significant effects for weight/diet or exercise outcomes. There was one exception: the Stanford GEMS pilot showed significant reduction in television viewing in the intervention group.[341] The children of a family diet and exercise intervention actually decreased their activity (METs) compared with the control children who increased their activity (METs) and kilocalorie expenditure.[344] The Hip-Hop to Health Jr. study, which was adequately powered, did not demonstrate any significant difference between intervention and control in relation to physical activity outcomes.

Relevant evidence from previous reviews

At least four of the 10 identified studies in the review of interventions aimed at 2–5-year-olds and families included a significant proportion of black and minority ethnic children. In the majority of identified studies self-reported diet and physical activity outcomes improved in the intervention groups compared with controls. The church-based interventions in African American adults in this review demonstrated significant effect in increasing fruit and vegetable intake. This finding is in agreement with an RCT identified in the Community 2 review which did not focus on a particular ethnic minority group.

13.4.1.3 Corroborative evidence

Six population surveys, two reviews and two intervention studies of diet and physical activity in BMEG populations in Britain were identified for corroborative evidence. The majority focused on South Asian women and one focused on white Irish adults. Another two non-UK surveys including African Americans were also identified.

A review of health education promotion in ethnic minorities[378] confirms a dearth of relevant research on nutritional health promotion among minority ethnic groups in UK with few studies that can be directly applicable to UK. Most were experimental or demonstration studies, and many community-based projects to promote healthy eating in ethnic minorities in UK were identified in 'grey' literature, lacked formal evaluation and any sound evidence of effectiveness. British examples of case studies of dietary and physical activity programmes contain little formal evaluation of these programmes.[364;379]

13.4.2 Vulnerable groups

Four studies were identified which included dietary and/or physical activity outcomes, one which separately recruited low-income women and analysed results by income for the women only,[376] one in Mexican Americans, mainly women with low income and low literacy,[375] one study in Mexican American low-

income school children[153;154] and a study in children with spastic cerebral palsy.[347]

13.4.2.1 Adults

Two of the studies that included the BMEGs were in low income populations;[361;362] one in a church setting that significantly increased fruit and vegetable consumption[361] and one partially home-based study that showed brief education was just as effective as adding counselling to increase amount of walking.[362] An additional study among a low-literacy/income population also found that both interventions resulted in significantly reduced percentage of energy from fat.[362;375] These findings do not appear to be replicated in the 'the pound of prevention study' which reported that a low-intensity diet and exercise intervention showed no significant difference by treatment group (education, education plus lottery incentive and control) at 1-year regarding dietary intake or physical activity. The RCT to prevent excessive weight gain during pregnancy in low-income women[348;362] reported a lack of significant effect of the intervention on changes in intake of high-fat foods and changes in exercise level from recruitment (prior to 20 weeks' gestation) to 8 weeks' post pregnancy.

13.4.2.2 Children

The GEMS pilots included low-income groups and suggest that intervention may have positive effects. The parent and child intervention groups combined significantly reduced intake of sweetened drinks compared with non-active control in the Memphis GEMS study (Beech 2003, Chen 1998.[340;362] The GEMS Minnesota pilot[137;362] and the study by Stolley[343] both showed significant reduction in per cent energy from fat in the intervention girls. However, in a relatively old study, the children of a family diet and exercise intervention[339;362] actually decreased physical activity levels compared with the control children.

Among Mexican American children from economically disadvantaged households who received a diet and exercise intervention to prevent diabetes, dietary fat intake did not differ between groups ($p = 0.52$) but physical fitness score was

significantly improved in intervention compared with control children after adjusting for age and pre-intervention BMI ($p < 0.003$).[153;154;362]

In the study of children with cerebral palsy, the physical activity ratio did not differ between the intervention group and control group but in both groups it significantly increased from baseline.

13.4.2.3 Findings from previous reviews

The findings of the community 1 review suggest that interventions to increase fruit and vegetables in the UK can be effective among lower-income groups. Five of the 10 included studies in the review of 2–5-year-olds and families included children from lower-income households. The majority of these studies were found to be effective, although subgroup analysis was rarely presented.

13.4.2.4 Corroborative evidence

Evidence of corroboration was limited. The health practitioner intervention to reduce obesity in adults with learning difficulties was conducted in Manchester, UK, and so is directly relevant to this population in the UK (Chapman 2005)[285]. An additional two questionnaires[362;370;380] and two reviews[95;371] were identified of healthy eating in low-income populations in the UK and a further two surveys from the USA. The findings are presented in section 13.5.3. No corroborative evidence was identified regarding physical activity and low-income populations.

13.4.3 Vulnerable life stages

13.4.3.1 Menopause

The systematic review found significant improvements in calorie and fat intake and moderate physical activity level;[226] postmenopausal women in the intervention group were consistently more physically active and reported eating fewer calories and less fat than controls.

In the RCT, calorie intake was significantly reduced in the intervention group compared with the control group at 54 months ($p < 0.01$). The intervention group

reported eating significantly less dietary fat and cholesterol than the controls. There was a significant increase in the amount of energy expended through physical exercise (walking) in the intervention group compared with the control at 54 months ($p < 0.001$) but not sport or recreational activity (kilocalories).

13.4.3.2 Pregnancy

Polley and coworkers[348] reported a lack of significant effect of the intervention on changes in intake of high-fat foods, and changes in exercise level from recruitment (prior to 20 weeks' gestation) to 8 week' post pregnancy were not related to treatment condition or BMI. One UK-based CCT[381] identified for corroborative evidence, found that women who received information packs from hospital staff on nutrition at time of booking and at 26 weeks' gestation had significantly higher knowledge about nutrition although no significant differences were noted on attitude variables or nutrient intake (fat, energy).

13.4.3.3 Smoking

None of the studies identified reported diet or physical activity outcomes.

13.4.3.4 Previous reviews

No relevant data were identified from the workplace, 2–5 year olds and families or schools' review. Limited data on middle-aged/menopausal women were identified in the community 1 review. Pereira and coworkers[242] reported no weight differences at 10-year follow-up of US postmenopausal women encouraged to walk as part of the original trial but the women did continue to walk significantly more than the control group. The findings of the review were supported by two more recent RCTs among middle-aged women.[233;255]

13.5 Sub questions

13.5.1 Variation by gender, age, ethnicity, religious practices or social group

No evidence was identified for vulnerable life stages. For BMEGs, one study carried out in African American churches reported that the largest increases in

fruit and vegetable intake were observed among older adults, those with education beyond high school, and those who were widowed or divorced and/or attended church frequently. The least improvement occurred among younger adults and/or those who were single.[361] The community 2 review found that cost and availability are fundamental considerations for future interventions. Younger people in particular may be concerned about the cost of food and view cost as a barrier to healthier eating.

13.5.2 Influence of previous weight loss

It was not possible to answer this question from the evidence identified.

13.5.3 Source and mode of delivery

The community 1 and community 2 reviews highlighted that tailoring advice is key to the effectiveness of interventions and that this will obviously impact on issues related to gender, age, ethnicity, religious practices or social group. Corroborative evidence identified for the broader community review highlighted the importance of interventions addressing fundamental issues such as cost and availability and pre-existing concerns such as the perceived poorer taste of healthier foods and the potential risks of walking and cycling. These factors may be barriers to change.

In addition to the data identified in the community reviews, a survey among inner city GP practices found that food insecurity was negatively associated with household income[380]. Subjects who were food insecure were less likely to report eating fruit, vegetables or salad daily. Experiences of food insecurity may be common in households with incomes at or below the minimum wage in the UK. A survey of adults with low incomes living in housing association homes in the UK also found that access and affordability were only a small part of the 'problem' surrounding low fruit and vegetable consumption.[370]

A review of food and low-income initiatives in UK (Hastings 2003) found a 'great deal of existing work to tackle food poverty by local sector health workers running

statutory initiatives focusing on individual behaviour change'.[95] However, only low numbers of projects are reporting actual changes in behaviour or attitudes. Structural factors are not being addressed. Consultation with the community is not being done. Other agencies as well as health sector need to get involved.

A review of healthy eating and low income in the UK, based on the work of the SUPER (European Food and Shopping Research Project) health promotion programme in Liverpool, found that local food initiatives such as 'cook and taste' are labour intensive and are unable to reach a sufficiently large proportion of those in need to be cost effective.[371] Research consistently demonstrates that low-income households find it difficult to adopt healthy eating guidance because of economic and circumstantial barriers, such as lack of income, access to shops, or inadequate storage and cooking facilities, and not because of lack of nutrition knowledge. A major strength, and possibly the most important outcome, of the project in Liverpool was the process of reorientation experienced by participating health professionals and organisations. Experience demonstrated, however, that community involvement or community participation was much more difficult to achieve in practice. Local people were involved in the data collection process but because they were excluded from planning what questions to ask, were provided with no real sense of ownership. It is essential that communities share responsibility for the rapid appraisal of and help to identify local needs in order to develop a sustainable programme of activities.

Interventions may need to address specific issues around adherence among BMEGs. One survey conducted at baseline and year 5 among women who were participating in the Women's Health Initiative showed that one of the factors associated with poorer adherence was being African American (compared with white).[382]

Similar to rest of UK, South Asians have reported low motivation and priority to being physically active and reported barriers are also similar to the general population – with lack of time, burden of domestic duties and family

responsibilities cited as main barriers to participation.[367] Barriers also reported in general population surveys included issues around consciousness about body size or shape, high costs, personal safety, transport, opening hours, childcare facilities. However, other barriers appear to be more culturally specific to this group. Those questioned by Rai and Finch[367] viewed activity as part of normal everyday life and the concept of paying for it as strange. Participants were also concerned about lack of privacy, dress codes, separate sex provision, actual or potential experiences of racism, all of which acted as barriers to exercise, including 'not fitting in'.[367] These concerns are reflected in views of South Asian women interviewed by Verma.[369] Although all South Asian who wanted to exercise reported barriers, it appeared that Pakistani and Bangladeshi women in particular experienced additional barriers to exercise related to culture and custom (expected approval of other members of community, including religious teachers, parents, siblings and friends). Religion powerfully reinforced the authority and behaviour patterns which appeared to reduce participation; racism acted as constraint.[369]

A 14-week diet and exercise intervention in Asian women in Manchester[383] showed that formal methods of recruiting had little impact; verbal recommendation of the group by link worker and participants was more effective; the intervention fulfilled social and weight loss functions and both functions were interrelated and affected weight; difficulty getting to venue and needs of family coming first were cited as reasons for none attendance; and women who said they would definitely re-attend were generally those with a higher BMI. Carroll and coworkers[365] found that South Asian Muslim women were very positive about exercise on prescription schemes (indeed demand for the service was greater than could be met) and women were willing to pay if they had to, but only if classes remained local. Many significant barriers were reported including access, cost, childcare, cultural codes of conduct, language, racism and religious discrimination.

In relation to vulnerable life stages, although weight concern is a serious obstacle to quitting smoking, particularly for women, it is not clear how best to address these concerns in the context of smoking cessation. Perkins and coworkers[384]) have proposed that a logical approach may be to assist weight concerned smoker in attitudes to weight in relation to health risks of continuing smoking. The author of this review is the author of the only RCT identified demonstrating that cognitive behaviour therapy for weight concerns significantly attenuated weight gain during smoking cessation. Adding brief exercise counselling to a UK-based smoking cessation programme did not increase smoking abstinence or reduce gains in weight or body fat significantly, although exercise levels were raised and there were some beneficial effects on psychological symptoms.[385]

13.5.4 Potential negative impact

No evidence was identified for BMEG or vulnerable groups. For vulnerable life stages, one smoking cessation study[350] reported significantly more headaches among participants in the diet group compared with the control group. One of the seven smoking cessation studies reported that the weight intervention group had increased risk of smoking compared with standard smoking cessation treatment.[352]

13.6 Limitations of the review

There were extremely limited UK-based data on evidence of effectiveness for all the groups considered in this review, although particularly for children in all groups, people with disabilities, and children and adults from BMEGs. For the latter, the evidence identified (predominantly on black/African Americans) may not be directly applicable to the target groups in the UK. This is compounded by the limited UK-based corroborative data.

In the included BMEG studies, average baseline BMI was higher compared with average BMI in Caucasian populations. For all groups considered, the studies commonly included predominantly women and the studies in children were of short duration.

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