

## **The effectiveness of Whole System Approaches to prevent obesity**

Guidance to tackle obesity at a local level using whole system approaches was initiated by NICE in 2009. The work was put on hold in November 2010 and reviewed as part of the Government's obesity strategy work programme. The revised scope has a stronger focus on local, community-wide best practice. It addresses both process and outcomes.

Before the development of this guidance was put on hold, the Programme Development Group (PDG) for this work met on four occasions and a series of evidence reviews was completed.

This is one of four evidence reviews that were considered by the PDG. The review has been edited to produce a shorter more accessible report for stakeholders.

The PDG is of the view that this review on the effectiveness of *whole system* approaches to prevent obesity will have resonance in considerations about *community-wide* approaches to prevent obesity. For example, this review considers issues around capacity building, sustainability, embeddedness and partnerships. However, we would also like to hear stakeholder's views on the work that the PDG has considered to date.

**We are particularly interested to hear stakeholder's views on:**

- 1. the implications of the review findings for current and emerging practice at the community-wide level.**
- 2. whether any evidence has been overlooked, particularly in light of revisions to the scope.**

Please also see the associated call for evidence.

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Please note that the original version of the review also included studies on smoking cessation that met the inclusion criteria. These have been taken out from this edited version of the review because 1) the two studies did not add much to the review as it stands and 2) the evidence on smoking was not relevant to the revised scope for this work. The original unedited version of the report is available on the NICE website.

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# **The effectiveness of Whole System Approaches to prevent obesity**

**Revised Final Report: 11<sup>th</sup> January 2011**

This is an edited version of a systematic review undertaken by the Peninsula Technology Assessment Group (PenTAG) for NICE (final version submitted January 2011). The original report authors were: Harriet Hunt, Associate Research Fellow; Rob Anderson, Senior Lecturer; Helen F Coelho, Research Fellow; Ruth Garside, Senior Research Fellow; Sue Bayliss & Anne Fry Smith, Information Scientists at WMHTAC, University of Birmingham

This review was edited by analysts at NICE in order to produce a shorter more accessible report for stakeholders. The original unedited version of the report is available on the NICE website.

## List of abbreviations

ANGELO	Analysis Grid for Elements Linked to Obesity
APPLE	A Pilot Programme for Lifestyle and Exercise
BAEW	'Be Active, Eat Well' programme (Australia)
BMI	Body Mass Index
BMI-z	Body Mass Index z-scores
CB	Capacity building
CDC	Centres for Disease Control and Prevention
CE	Community Engagement
Com	Communication
CPHE	Centre for Public Health Excellence (National Institute for Health and Clinical Excellence)
DEFRA	Department for Environment, Food and Rural Affairs (UK)
DoH	Department of Health
EAP	Embeddedness of action for obesity prevention
EEN	Epode European Network
EPAQ	Eating and Physical Activity Questionnaire
EPODE	'Ensemble, Prévenons L'Obésité Des Enfants' programme (France)
FL	Facilitative leadership
FLVS	Fleurbaix-Laventie Ville Santé
HLCK	'Healthy Living, Cambridge Kids' programme (USA)
KA&S	Key ages and stages
LC	Local creativity
MCH	Maternal and Child Health
NHS	National Health Service
NSW	New South Wales
OPIC	Obesity Prevention in Pacific Communities
PDG	Programme Development Group
PenTAG	Peninsula Technology Assessment Group
PH	Public Health
R&C	'Romp & Chomp' programme (Australia)
R&S	Robustness and sustainability

Rel	Relationships
SES	Socioeconomic status
SHYC	'Steps to a Healthier Yuma County' programme (USA)
SuS	'Shape Up, Somerville' programme (USA)
Sys	System
WHO	World Health Organisation
WSA	Whole System Approach

## Glossary of terms

Lay members	Members of the public who are not professional specialists in a subject area
Levels	Operating context, e.g. individual, neighbourhood, community, town, city, regional, or national.
Multi faceted	Having many aspects
Multi level	Operating on a number of levels
Organisation	An organised body of people with a particular purpose, e.g. a business
Settings	Patterns of behaviour restricted within time and space, either location-bound (e.g. schools) or activity-bound (e.g. sports activities)

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# 1. Summary

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## 1.1. Introduction

This systematic review builds on Review 1 considering a working definition of whole system approaches to tackling public health problems. Review 1 concluded that a whole system approach is characterised by ten core features

- Explicit recognition of the public health system
- capacity building
- encouragement of local creativity and/or innovation
- developing working relationships
- community engagement
- enhancing communication
- embeddedness of policy and action
- robustness and sustainability
- facilitative leadership
- monitoring and evaluation

## 1.2. Aim

This systematic review aimed to systematically identify, summarise, and synthesise relevant evaluation studies in order to answer the following:

How do the effectiveness, implementation and sustainability of whole system or whole community approaches to preventing obesity appear to vary in relation to:

- The specific combination of local actions and local strategies used to try and bring about change
- The characteristics of the population and/or places targeted (including level of social disadvantage)

- The local and national policy context
- Other factors which influence the effectiveness, implementation and sustainability of the relevant actions and strategies

### **1.3. Methods**

This systematic review was primarily based on bibliographic searches for comparative evaluations of obesity prevention programmes. These searches were supplemented by searches of the grey literature, internet searches and by contacting authors, contacts at the European EPODE Network and topic experts.

Study selection against predefined inclusion and exclusion criteria was conducted by two reviewers in three stages. (i) screening titles and abstracts; (ii) screening full-text papers and reports against all inclusion and exclusion criteria (iii) assessing and mapping the presence of WSA features in potentially includable studies of community-wide multi-level prevention programmes.

All obesity prevention programmes that met the inclusion criteria were included.

Each study was also quality-assessed using standard NICE methods and each study given an overall rating for internal validity and external validity.

### **1.4. Results**

The searches generated 2,429 unique references. After screening 8 community-wide obesity prevention programmes (covered in 28 texts) were included.

## **Evidence statements**

### **Evidence statement 1: paucity of evidence**

There is a paucity of evidence on the effectiveness of community wide programmes displaying features of a whole system approach to prevent obesity. Of the 8 community-wide obesity prevention programmes included in this review (two BA: [-] USA (Drummond et al. 2009), [+] USA (Chomitz et al. 2010); three nRCT: [+] USA (Economos et al. 2007), [+] Australia (Bell et al. 2008; Sanigorski et al. 2008), [+] New Zealand (4 sources<sup>\*1</sup>); one cBA [+] Australia (12 sources <sup>\*2</sup>); one longitudinal epidemiological study ([+] France (4 sources <sup>\*3</sup>); and one repeated cross-sectional survey ([+] France: 3 sources <sup>\*4</sup>), none were undertaken in the UK and all targeted children below 14 years of age (though they stated an aim to influence the wider community through the programme, including parents, child care centre workers, teachers and other members of the community). This evidence is judged to be partially applicable to communities of a similar size within the UK.

### **Evidence statement 2: Range of WSA features in obesity prevention programmes**

None of the 8 obesity prevention programmes included in the review demonstrated evidence of explicit recognition of the public health problem as a system. All 8 obesity prevention programmes demonstrated inconsistent evidence of local creativity. Seven programmes demonstrated more robust evidence of capacity building, robustness & sustainability and community engagement, but this was still inconsistent across the groups and all these features did not appear across the same 7 programmes. Five obesity prevention programmes demonstrated inconsistent evidence of a focus on the embeddedness of actions and policies, and of developing working relationships within and between partners. Four of the obesity prevention programmes demonstrated inconsistent evidence of a focus on enhancing communication between actors and organisations within the system, facilitative leadership and the use of well-articulated methods for monitoring and evaluation of activities.

### **Evidence statement 3: The effectiveness of obesity prevention programmes: anthropometric outcomes**

Overall, there is evidence from a range of community-wide obesity programmes that they can have a beneficial effect BMI scores, weight gain or the prevalence of overweight / obesity in children. However, these observed differences tended to be relatively small and were not always significant. There is no clear evidence of a relationship between features of system working and programme effectiveness. Studies reported **lower BMI scores** (one cBA [+] (12 sources \*<sup>2</sup>), one nRCT (Bell et al. 2008; Sanigorski et al. 2008) and one repeated cross-sectional survey [+] (3 sources \*<sup>4</sup>)); **lower BMI-z scores** (one cBA [+] (12 sources \*<sup>2</sup>), one nRCT (Bell et al. 2008; Sanigorski et al. 2008), one BA [+] (Chomitz et al. 2010) and one nRCT [+] (Economos et al. 2007); **weight gain** ( one nRCT [+] (Bell et al. 2008; Sanigorski et al. 2008) and one cross-sectional survey in France ([+]: 3 sources \*<sup>4</sup>)), increase in **waist circumference** (one nRCT [+] (Bell et al. 2008; Sanigorski et al. 2008)) or **the prevalence of overweight or obesity** (one cBA [+] (12 sources \*<sup>2</sup>); two nRCT (Bell et al. 2008; Sanigorski et al. 2008 and Economos et al. 2007), one BA [+] (Chomitz et al. 2010), one longitudinal study [+] (4 sources \*<sup>3</sup>) and one repeated cross-sectional survey [+] (3 sources \*<sup>4</sup>)). Only one BA study in New Zealand [+] (4 sources\*<sup>1</sup>) reported a statistically non-significant increase in the prevalence of overweight or obesity among the intervention group.

#### **Evidence statement 4: The effectiveness of obesity prevention programmes: diet and physical activity outcomes**

There is some evidence that community-wide obesity programmes can have a beneficial effect diet or physical activity outcomes in children. However, there is no clear evidence of a relationship between features of system working and programme effectiveness. Studies reported a significant decrease in the number of daily servings of “less healthy” foods and increased daily servings of vegetables and less TV viewing (one cBA ([+]: 12 sources \*<sup>2</sup>), a statistically significantly higher percentage of children passing a fitness test post intervention (one BA ([+] Chomitz et al. 2010) and a statistically significant increase in diet and activity “best practice” at childcare centres (one BA [-]: Drummond et al. 2009). One study also reported a decrease in the number of children unhappy with their body size post intervention (one nRCT Bell et al. 2008; Sanigorski et al. 2008).

#### **Evidence statement 5: Relationship between system working and effectiveness of obesity prevention programmes**

Due to the degree of variation across studies, the small number of the included studies, and the wide range of outcomes reported, the relationship between the presence of features of system working and the effectiveness of community based programmes to prevent obesity remains ambiguous. It is therefore not possible to suggest a clear relationship.

Two community programmes based in Australia demonstrated the **strongest evidence for system working**. One cBA study ([+] 12 sources \*<sup>2</sup>) explicitly describes nine out of the ten features of system working, and demonstrated statistically non-significant between group decreases in anthropometric outcomes. The programme also reported favourable outcomes relating to nutrition (which were statistically significant) and physical activity (which were statistically non-significant). The other study, an nRCT ([+]: Bell et al. 2008; Sanigorski et al. 2008), shows clear evidence of six out of ten WSA features, and makes implicit reference to an additional three features. This study reports statistically non-significant between-group decreases in BMI, weight gain and the prevalence of overweight / obesity.

Three community programmes in the US **showed 5 to 7 features of whole system working**. Economos et al 2007 ([+]) clearly demonstrates the presence of 4 WSA features and implies another three features. This study reported non significant decrease in BMI z score. Chomitz et al. 2010 ([+]) explicitly describes three WSA

features and makes implicit reference to another three features. It reported statistically significant change in the prevalence obesity and improvements in fitness among children post-intervention. Drummond et al. 2009 [-] explicitly describes only two WSA features and makes implicit reference to another three features. No anthropometric outcomes were reported, but the authors reported a statistically non-significant post-intervention increase in diet and activity “best practices” at childcare centres.

The remaining three community programmes clearly displayed evidence of **4 or less features of whole system working.**

One longitudinal epidemiological study based in France ([+]: 4 sources <sup>\*3</sup>) clearly demonstrated evidence of four features, and demonstrated unclear evidence of two additional features. Another, related, repeated cross-sectional survey in France ([+]: 3 sources <sup>\*4</sup>) demonstrated unclear evidence of four features. Both studies showed significant *pre-/post- reductions* in obesity prevalence. One nRCT (New Zealand [+]: 4 sources <sup>\*1</sup>) provides unclear evidence of two features and reported a between group statistically significant and favourable change in BMI-z scores.

#### Key

<sup>\*1</sup> **APPLE** sources: Taylor et al. 2006; Taylor et al.2007; Taylor et al.2008; McAuley et al 2009

<sup>\*2</sup> **Romp & Chomp** sources: Bell et al. 2008; de Groot et al. 2009; de Groot et al. 2010; de Silva-Sanigorski et al. 2009a; de Silva-Sanigorski et al. 2009c;de Silva-Sanigorski et al. 2009b; de Silva-Sanigorski et al. 2010b; de Silva-Sanigorski et al. 2010a; Nichols et al. 2009; Parker et al. 2009; Parker et al. 2009a; Parker et al. 2009b

<sup>\*3</sup> **EPODE** sources: EPODE abstract 2010; EPODE results 2010; EPODE Press Kit 2005; Thin Living 2007

<sup>\*4</sup> **FLVS** sources: Romon et al. 2008; Heude et al 2003; EPODE abstract 2010

Other obesity programmes:

**Be Active, Eat Well** - Bell et al. 2008; Sanigorski et al. 2008

**Shape Up, Somerville** – Economos et al. 2007

**Healthy Living, Cambridge Kids** - Chomitz et al. 2010

**Steps to a Healthier Yuma County** - Drummond et al. 2009

## 2. Background

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### 2.1.1. Definition of whole system approaches

The starting point for this systematic review is the working definition of whole system approaches to tackling public health problems, which was the product of Review 1 and discussions of the Programme Development Group (PDG). The features of 'whole system working' within community settings are shown in the table below

#### Box 1. Features of a whole system approach to tackling public health problems

1. **Identifying a system:** Explicit recognition of the public health system with the interacting, self-regulating and evolving elements of a complex adaptive system. Recognition given that a wide range of bodies with no overt interest or objectives referring to public health may have a role in the system and therefore that the boundaries of the system may be broad.
2. **Capacity building:** An explicit goal to support communities and organisations within the system. *For example, increasing understanding about obesity in the community and by potential partner organisations or training for those in posts directly or indirectly related to obesity.*
3. **Creativity and innovation:** Mechanisms to support and encourage local creativity and/or innovation to address obesity. *For example, mechanisms which allow the local community to design locally relevant activities and solutions.*
4. **Relationships:** Methods of working and specific activities to develop and maintain effective relationships within and between organisations. *For example, establishing and maintaining relationships with organisations without a health remit or an overt focus on obesity.*
5. **Engagement:** Clear methods to enhance the ability of people, organisations and sectors to engage community members in programme development and delivery. *For example, sufficient time in projects allocated to ensuring that the community can be involved in planning and assessing services.*
6. **Communication:** Mechanisms to support communication between actors and organisations within the system. *For example, ensuring sufficient face-to-face*

*meeting time for partners, having planned mechanisms for feeding back information about local successes or changes.*

7. **Embedded action and policies:** Practices explicitly set out for obesity prevention within organisations within the system. *For example, local strategic commitments to obesity, aligning with wider policies and drivers (such as planning or transport policy) and ensuring obesity is an explicit concern for organisations without a health remit.*
8. **Robust and sustainable:** Clear strategies to resource existing and new projects and staff. *For example, contingency planning to manage risks.*
9. **Facilitative leadership:** Strong strategic support and appropriate resourcing developed at all levels. *For example, specific methods to facilitate and encourage bottom up solutions and activities.*
10. **Monitoring and evaluation:** Well articulated methods to provide ongoing feedback into the system, to drive change to enhance effectiveness and acceptability. *For example, developing action-learning or continuous improvement model for service delivery.*

### **2.1.2. Some preliminary considerations for this systematic review**

Effectiveness reviews of broad public health approaches (such as community engagement) have been undertaken but these have struggled to separate the relative importance of the principles and processes of achieving community-wide changes, and the specific actions and policies implemented. For complex public health problems, such as obesity, which are influenced by social, environmental and behavioural factors, it may not just be *what you do* that can have desired impacts (i.e. not just the specific bundle of different activities and policy changes) but also *the way that you do it*, in terms of how organisations and communities at a range of levels aim to develop and implement policy changes. Therefore, effectiveness reviews have to consider both (1) specific prevention activities and policies that were delivered/introduced and (2) how the overall programme was conceived, developed and evolved (including the presence or absence of features of 'whole system working'). This may make it difficult to attribute effectiveness, i.e. whether effectiveness derives from the different components of prevention strategies, the different ways they were developed and delivered, or a combination of the two.



While taking a whole system approach may be the most appropriate strategy for tackling complex public health problems such as obesity, the Foresight report (2007) noted that the evidence base in relation to obesity was limited.

## **3. Aims**

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### **3.1. Review questions**

This review aimed to systematically identify, summarise, and synthesise relevant evaluation studies to answer the following:

How does the effectiveness, implementation and sustainability of whole system or whole community approaches to preventing obesity appear to vary in relation to:

- The specific combination of local actions and local strategies used to try and bring about change
- The characteristics of the population and/or places targeted (including level of social disadvantage)
- The local and national policy context
- Other factors which influence the effectiveness, implementation and sustainability of the relevant actions and strategies

## **4. Methods**

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### **4.1. Identification of evidence**

#### **4.1.1. Search strategy, process and methods**

The search for this review built on the search terms and programmes identified for review 1. Relevant texts were identified through bibliographic databases and selected websites. This was supplemented by citation searching and communication with experts or organisations involved in relevant research or policy areas.

A broad strategy was devised comprising a combination of textwords and index terms to express the intervention (whole system approach) and the populations (obesity prevention). Grey literature was mainly searched via internet searches, and through contact (mainly e-mail) with authors and other experts or contacts.

Two information specialists (SB & AF-S) conducted the searches alongside the two reviewers (RA & HH) undertaking the review.

Title and abstract screening was carried out between the two reviewers (HH and RA) with consistency checking carried out on 10% of the decisions made. Where the research methods used or the intervention being evaluated was not clear from the title or abstract, the full text paper was ordered. Papers that were excluded at title/abstract screening under the inclusion/exclusion criteria, but warranted further study (eg for references or to inform the review) were also marked for retrieval at full text.

Full text screening was carried out by the same two researchers (HH & RA); any adjudication in case of disagreement would have been carried out by a third reviewer (RG) but this was not required.

At the full text stage, where relevant programmes were identified but without comparative evaluation data, authors were contacted by email to ask whether evaluation of effectiveness was available. We also contacted authors of key editorials about whole systems thinking and public health (Dr Patti Mabry and Dr Stephen Marcus of the US National Institutes of Health) ; contacts at the European EPODE Network (EEN) and the leads for ongoing Healthy Town initiatives in England.

#### **4.1.2. Inclusion and exclusion criteria**

##### **4.1.2.1. Inclusion criteria**

Obesity prevention interventions demonstrating at least one core feature of whole system approaches (as listed in Box 1) *AND* were:

- Implemented in whole populations or communities (i.e. whether they are or obese, overweight or not); *AND* which;
- Report any of the outcome measures or other indicators of an intervention's success/failure listed above in Section 10, *AND* using;
- Comparative study designs: Evaluations (prospective or retrospective) using comparative designs (randomized controlled trials, non-randomized controlled trials, before and after studies, or natural experiments, time series).

##### **4.1.2.2. Exclusion criteria**

Studies were excluded if they were:

- Empirical studies which only document the design and implementation of interventions without reporting evidence of the outcomes listed or which do not show time trends or report other (e.g. historical) control data for the outcomes of interest.
- Empirical studies which only present the effectiveness or successful implementation of individual interventions which were part of a broader strategy.
- Studies of interventions where EITHER obesity prevention, encouraging physical activity, or encouraging a healthy diet are not a central or major aim of the intervention.

#### **4.2. Screening to identify relevant studies**

Screening of search hits from the bibliographic database searches took place in three stages:

**Stage 1:** Examining the titles and abstracts of hits and identifying papers which could not be reliably ruled out as potentially includable;

**Stage 2:** Obtaining those potentially includable papers or reports in full text, and assessing them against the exclusion and inclusion criteria specified in the protocol. At this stage this meant ruling out those that were:

- not aimed at obesity prevention
- not effectiveness evaluations

**Stage 3:** Only those full-text studies which were included at stage 2 as being *both* genuinely community-wide (i.e. targeting all people in a specific geographical area) and multi-level or multi-faceted (e.g. different activities delivered in a variety of settings, such as schools, workplaces and sports clubs) were assessed for evidence of the ten features of a ‘whole system approach’ (the ‘WSA features’) (see Box 1).

This process meant that some papers were excluded at the full text stage (stage 2 above) where the description of the programme looked like it should be an *included programme*, but where the paper itself was not an effectiveness evaluation. On ten of these occasions, we contacted the authors of the relevant paper or conference abstract to ask if, to their knowledge, there were any published or unpublished (i) effectiveness evaluations (ii) cost-effectiveness studies or cost studies, or (iii) qualitative research, relating to the given community-wide multi-level prevention programme which would render their research includable in our review.

When an initiative was identified as containing potentially includable effectiveness data, other sources were used – where possible – to assess suitability, rather than simply relying on the often sparse descriptions of interventions within evaluation papers.

#### **4.2.1. Process of assessing presence of WSA features**

For each potentially includable effectiveness evaluation which was deemed to be a community-wide multi-level programme, we assessed which - if any - of the WSA features were present. We considered a) whether a feature or key element was evident in a described programme, and b) how clear this evidence was. As this was

undertaken by two reviewers (HH and RA) we adopted the following strategies to ensure consistency:

1. Two out of six of the assessments of papers judged includable by one reviewer (HH or RA) were blind assessed by the other reviewer. Differences were discussed and decisions revised.
2. We performed unblinded checking of each other's remaining assessments
3. Alongside this process we created a fuller annotated description of WSA features, in order to clarify what should and what should not count as demonstration of each feature.

#### **4.2.2. Other judgements made during the iterative screening process**

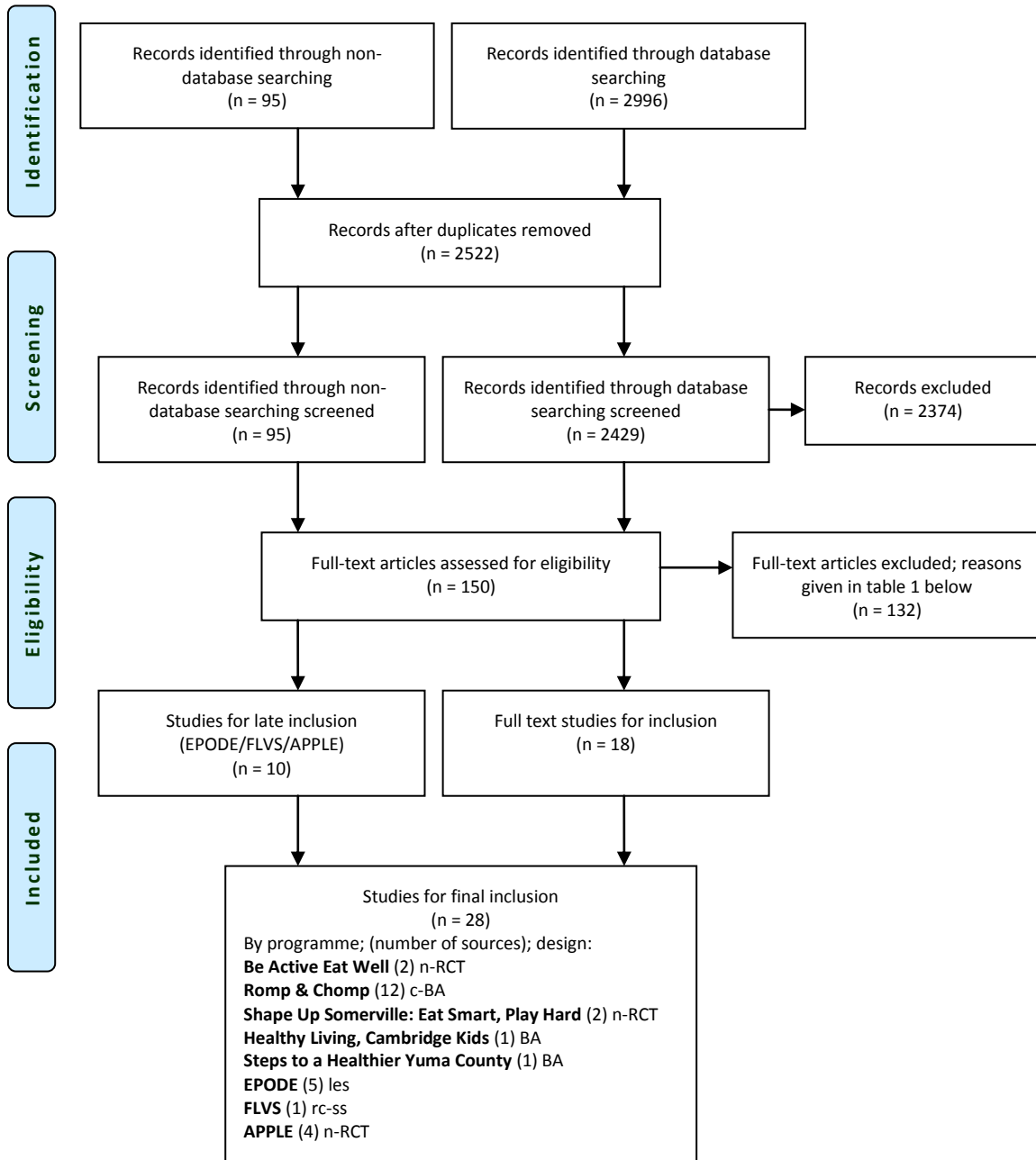
Population-based cardiovascular diseases (CVD) prevention programmes (e.g. North Karelia project, the Stanford Five Cities Programme) were not included in this review. From the abstracts of many of these CVD programmes, it was apparent that the reporting of these studies generally focused on hypertension or blood glucose outcomes rather than weight or BMI outcomes. Furthermore, the programmes were often not truly community wide as they typically involved screening for individuals at high risk of developing cardio-vascular disease, and then targeting health promotion activities and health monitoring activities at those individuals.

Due to the limited number of studies identified with our initial inclusion criteria, we re-screened 4 full-text and 57 title-and-abstract exclusions of papers which had initially been excluded because they focussed solely on either physical activity or diet. Ultimately, this re-screening did not lead to any new programmes being included in our review; one source was not an effectiveness/evaluation study; two sources did not use a comparative study design; and one source did not clearly address obesity prevention.

Three programmes (FLVS, EPODE and APPLE) were introduced at a late stage to the final list of included programmes. Evaluation data on FLVS and EPODE was received late in the reviewing process, and APPLE programme data was initially excluded on the basis of containing insufficient evidence of WSA features.

### 4.3. Summary of the searches

Figure 1: Review flowchart



Abbreviations: WSA = Whole System Approach; PA = Physical Activity; n-RCT = non-randomised controlled trial; BA = uncontrolled before & after study; cBA = controlled before & after study; BAEW = Be Active Eat Well, Victoria; R&C = Romp & Chomp, Victoria; KGFYL = Kids Go For Your Life!, Victoria; CPHE = Centre for Public Health Excellence (NICE); les = longitudinal epidemiological study; rc-ss = repeated cross-sectional survey

## 4.4. Methods of analysis/synthesis

### 4.4.1. Data extraction & quality assessment

A range of data was extracted from studies including (1) the programme focus (e.g. target population, policy context) (2) study details (e.g. aims, design, setting) and (3) features of a whole system approach.

Two researchers (HH and HC) quality assessed the included interventions using the revised GATE checklist to assess the quality of comparative quantitative studies (NICE, 2009). Consistency checks were carried out between the two researchers on a minimum 10% of extractions and appraisals, and all extractions and appraisals were checked for accuracy and relevance by one other reviewer (HC, RA or HH). On the basis of assessing studies against a number of questions each study is given an overall grading for its internal validity<sup>1</sup> and its external validity<sup>2</sup>. The grading is as follows:

- ++** All or most of the criteria have been fulfilled. Where they have not been fulfilled the study conclusions are thought **very unlikely** to alter.
- +** Some of the criteria have been fulfilled. Those criteria that have not been fulfilled or not adequately described are thought **unlikely** to alter the study conclusions.
- Few or no criteria have been fulfilled. The study conclusions are thought **likely or very likely** to alter.

### 4.4.2. Data synthesis

Synthesis was achieved primarily through narrative means, although tables and graphs were used for those outcomes which were more comparable or conversely, in some cases, to illustrate the wide variation in outcomes and results. Meta-analysis was not possible.

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<sup>1</sup> Internal validity is here defined as: the study has been carried out carefully, and that the outcomes are likely to be attributable to the intervention being assessed, rather than some other (often unidentified) factors.

<sup>2</sup> External validity is here defined as: the extent to which the results of a study are generalisable beyond the confines of the study to the study's source population.



## 5. Results

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### 5.1. Identified reports

#### 5.1.1. Included reports

The screening process resulted in the review focusing on 10 interventions (within 45sources). The included programmes were:

- ‘Be Active, Eat Well’ (2 sources: Bell et al. 2008; Sanigorski et al. 2008)
- ‘Romp & Chomp’ (12 sources: Bell et al. 2008; de Groot et al. 2009; de Groot et al. 2010; de Silva-Sanigorski et al. 2009a; de Silva-Sanigorski et al. 2009c; de Silva-Sanigorski et al. 2009b; de Silva-Sanigorski et al. 2010b; de Silva-Sanigorski et al. 2010a; Nichols et al. 2009; Parker et al. 2009; Parker et al. 2009a; Parker et al. 2009b)
- ‘Shape Up, Somerville: Eat Smart, Play Hard’ (1 source: Economos et al. 2007)
- ‘Healthy Living, Cambridge Kids’ (1 source: Chomitz et al. 2010)
- ‘Steps to a Healthier Yuma County’ (1 source: Drummond et al. 2009)
- EPODE (5 sources: EPODE abstract 2010; EPODE results 2010; European Public Health alliance 2010; EPODE Press Kit 2005; Thin Living 2007)
- FLVS (3 sources: Romon et al. 2008; Heude et al 2003; EPODE abstract 2010)
- APPLE (4 sources: Taylor et al. 2006; Taylor et al.2007; Taylor et al.2008; McAuley et al 2009)

**Table 1 Programme overview**

Programme name; country, programme dates, quality	Quality	Levels of action	Sectors involved	System recognition	Capacity building	Local creativity	Relationships	Community engagement	Communication	Embeddedness	Robust & sustainable	Facilitative leadership	Monitoring & Evaluation
<b>Romp &amp; Chomp;</b> Australia 2004-2008 (and onwards)	+	Individual Family School	Local and State authorities, primary and secondary schools, community agencies and families.		●	●	●	●	●	●	●	●	●
<b>Be Active, Eat Well;</b> Australia 2002-ongoing	+	Community PH policy			●	●	●	●	○	○	●	○	●
<b>Shape Up Somerville: Eat Smart, Play Hard;</b> USA 2002-2005 (1 <sup>st</sup> year planning only)	+	Individual Family School Community	Children, Parents, Teachers, School food service, City department, Policy makers, Healthcare providers, Before- and after-school programs, Restaurants, Media, the Mayor of Somerville, and President of Tufts University.		●	●		●	○	○	●	○	
<b>Healthy Living, Cambridge Kids;</b> USA 2005-2007	+	Individual Family School Community PH policy	Cambridge Public Schools and schools Committee, Institute for Community Health, School Health and Public Health Departments, Parents, Researchers. Later expanded to include gardening organisation, Department of Human Service Programs, Green Streets Initiative, Farmers' Markets		●	●	○	●		○	○		
<b>Steps to a Healthier Yuma County;</b> USA 2005-2008 (with 9 months planning)	-	Individual Family School Community PH policy	Public Health Services Community Nutrition Arizona Nutrition Network Women Infants and Children program, Health District		●	○	○	●			○		
<b>EPODE;</b> Europe 2004-ongoing	+	Individual Family School Community PH Policy	EPODE team (incl. National Coordinators and local programme managers, Local Authority Leaders), Schools, Health organisations / professionals; local associations, shops, local producers, media and other local stakeholders and decision makers.		●	●	○	○			●		●
<b>FLVS;</b> France 1992 - 2007	+	Individual Family School Community	Schools, local stakeholders		○	○					○		○
<b>The APPLE project;</b> NZ 2003-2005	+	Individual Family School Community	University of Otago; Schools serving the Otago area (n=4 intervention schools and n=3 control schools)			○		○					

**Key:**

- - means of attaining programme element explicitly described, or clearly stated as a goal
- - programme element mentioned, but means of attaining not described

- ++ All or most of the criteria have been fulfilled. Where they have not been fulfilled the study conclusions are thought **very unlikely** to alter.
- + Some of the criteria have been fulfilled. Those criteria that have not been fulfilled or not adequately described are thought **unlikely** to alter the study conclusions.
- Few or no criteria have been fulfilled. The study conclusions are thought **likely or very likely** to alter

## 5.2. Programme design

None of the community-wide obesity prevention interventions were based in the United Kingdom; they were instead based either in the USA and Canada (Shape Up Somerville, Healthy Living, Cambridge Kids; Steps to a Healthier Yuma County); France (FLVS; EPODE), New Zealand (APPLE) or Australia (Romp & Chomp, Be Active, Eat Well). All of the obesity prevention interventions targeted children below 14 years old. With the exception of FLVS, all obesity programmes began after 2000.

All interventions stated an aim to influence the wider community through the programme, including parents, child care centre workers, teachers and other members of the community. Correspondingly, the programme activities and strategies were predominantly school-focussed. However, to be included in this review the community-wide programmes had to exhibit some broader out of school actions and policy changes.

Interventions were delivered by a mix of teachers, care centre workers, community members and researchers, with a number of organisations involved ranging from local university departments, local and regional government education, health, child care, dental health and human services departments, kindergarten associations, leisure associations, private health care providers, local neighbourhood renewal agencies, schools, local gardening organisations, local 'Green Streets' initiatives and farmers' markets collectives.



**Table 2 Programme design and characteristics**

	<b>Study design</b>	<b>Programm characteristics</b>
Romp and Chomp Victoria, Australia	<p>A repeat cross-sectional quasi-experimental design, which ran for four years from 2004 to 2008, with measures taken from control and intervention groups at post-intervention. Anthropometric data was collected for both intervention and comparison groups at follow-up (2007) among children who attended standard health check appointments at ages 2 and 3.5 years old. Diet and physical activity outcomes were collected using validated parental-reported questionnaire (EPAQs) when children attended for their 2 year old or 3.5 year old health check, before (intervention sample only) and after (both intervention and comparison samples) the intervention. At baseline, 950 children completed EPAQs (intervention only), and at post-intervention 375 children in the intervention group and 786 children in the comparison group completed questionnaires. Process evaluation data was collected.</p>	<p>Part of a wider “Sentinal site” programme supported by Deakin University, incorporating ‘Be Active, Eat Well’ (see below) and a number of other interventions which did not meet the inclusion criteria. A ‘whole of community’ intervention promoting healthy weight and healthy eating among children under age 5 years and their families. Designed, planned and implemented in partnership by range of agencies, including State Departments, regional health providers, community based pre-schools, a sporting body, and the local dental service. Links were made at a later point in the programme with two ongoing interventions aimed at increasing physical activity and oral health. Community activities included promotional campaigns, integrating key messages into policies and practices, increasing access to drinking water, and distributing social marketing materials.</p> <p>The authors refer to a ‘whole of community’ approach which was “complex and ambitious, involving multiple strategies at multiple stages”. Aimed to build capacity, encourage local creativity, enhance partnerships, strategic alliances and community organisational networks, providing evidence for reinforcing relationships. Used ANGELO Framework to enable communities to specify targets, engaging the community and allowing for greater ownership. Focus on communication plan, change policy and ensure the sustainability of changes. Integration of the programme into local government and health-service strategy to ensure sustainability. Evidence of facilitative leadership, for example through community works and health professionals being trained to support kindergartens to undertake intervention activities.</p>

<p><b>Be Active, Eat Well (Australia)</b></p>	<p>A non-randomized controlled before and after quasi-experimental design was used, with measures taken pre- and post- intervention in both intervention and control. Data was collected in 2003/4 and 2006 with follow-up data taken immediately post-intervention from six primary schools and four preschools in the Colac area (Intervention N=997) and a stratified random sample of schools in the wider area (Control N=2687) using a controlled before and after study design in a school, home and community combined setting. Anthropometric data was collected among children who attended standard health check appointments at ages 2 and 3.5 years old. Diet and physical activity outcomes were collected by various existing questionnaires using Computer-Assisted Telephone Interviews (CATI) for parental reports of physical activity (baseline and in 2006) and collected using Direct Report of Physical Activity for children aged 10-12 years at baseline using a 16 item survey (baseline and in 2006). Satisfaction with body shape and size, also collected using Direct Report of Physical Activity for children aged 10-12 years. Process evaluation was planned using document analysis, interviews, participant feedback, focus groups, case studies and surveys (de Silva Sanigorski, 2010). However, comparative evaluation data was not reported.</p>	<p>'Be Active, Eat Well' was a Sentinel Site intervention (see above) based in Colac, Victoria, Australia. The aim of the programme was to promote healthy eating and physical activity in children aged 4 – 12 years old, run between 2002 and 2006, although with the stated aim to be sustainable with no end date for completion. Incorporated evidence of a number of WSA "key features". Relating to capacity building, the programme project staff provided leadership, funds, and knowledge to encouraged change (e.g. school canteen changes). The programme also sought to build on the skills of health professionals and other stakeholders. Demonstrating local creativity, the local community was supported to create its own solutions to promoting healthy eating and physical activity in the target population. As part of the capacity building process, the lead agency and funding agency aimed to provide support in building personal and organisational relationships. Engagement with the community involved provision of training (e.g. workshops) and setting up committees (e.g. a local implementation committee). Programme strategies were incorporated into local policies. Be Active, Eat Well explicitly aimed to develop sustainable health promotion strategies and build leadership through community ownership and operation of the programme.</p>
<p><b>Shape Up, Somerville: Eat Smart, Play Hard (USA)</b></p>	<p>A non-randomised controlled study design was used measuring between groups change pre- and post-intervention, with baseline measures collected September/October 2003 and post-intervention measures taken in May/June 2004. Anthropometric data was collected on height and weight, and BMI-z scores were calculated as recommended by the U.S. Centers for Disease Control and Prevention. Changes in prevalence of overweight/obesity: was categorised in accordance with the Centers for Disease Control guidelines (z score <math>\geq 5^{\text{th}}</math> and <math>&lt;85^{\text{th}}</math> percentile = desirable; <math>\geq 85^{\text{th}}</math> percentile and <math>&lt; 95^{\text{th}}</math> percentile = at risk for overweight; <math>\geq 95^{\text{th}}</math> percentile = overweight). Intermediate outcomes were based on behavioural data</p>	<p>The 'Shape Up Somerville' programme aimed to facilitate a collaborative partnership with Somerville's communities in order to bring about multiple environmental changes to prevent weight gain in young children, "using every aspect of the community that touches children and their families" (Economos et al. 2007 p.1334). The programme ran for three years, from September 2002 to August 2005 with a one year planning stage and 2 years of intervention and follow-up data taken immediately post-intervention. The study design was a non-randomised controlled trial and was based upon the principles of Community-Based Participatory Research. It mostly included new policies and activities related to before-, during- and after-school activities in the 10 elementary schools in Somerville (over 1,600 children). These included: a healthy breakfast programme; a Walk to School Campaign; professional development of</p>

	<p>relating to sports and physical activity and television viewing, assessed as part of a 68-item postal questionnaire for parents/caregivers written in the household language (English, Spanish, Portuguese, or Haitian Creole), but these data did not form part of the programme evaluation: only pre-intervention data were presented.</p> <p>Process evaluation outcome data were not comparative, but were reported in narrative form.</p>	<p>school staff (nutrition and physical activity); a school health office (for anthropometric data collection); an improved school food service; a related SUS classroom curriculum (including a 10 minute daily 'Cool Moves', and a weekly 30-minute nutrition and physical activity lesson); enhanced recess (i.e. equipment and resources for more active breaks between lessons); development of school 'wellness' policy; after-school SUS curriculum; and professional development for programme staff.</p> <p>In terms of community activities based outside schools there was: parent outreach and education including a newsletter and free/reduced price coupons; 'parent nutrition forums'; 'walking/pedestrian trainings'; a City Employee Wellness Campaign; a Farmers' Market initiative; local physician and staff training; a monthly SUS column in the city's newspaper; and the production and dissemination of a number of resource guides (e.g. physical activity, healthy meetings). Most of these initiatives and policies were developed through an extensive community engagement process and the involvement of community members "in all phases of the research: identifying the problem, designing, implementing and evaluating the intervention" (Economos et al. 2007 p.1326).</p> <p>In terms of our defined features of a Whole System Approach, the SUS initiative involved clear processes for community engagement, an evident commitment to embed actions and policies in the longer term (especially through the school wellness policy development), and further evidence of robustness and sustainability (for example in securing external funding to continue many of the SUS programme activities. However, at the same time, the approach of the SUS initiative had no stated theoretical basis and made no mention of using a whole system understanding of the causes of obesity to design their programme.</p>
<p><b>EPODE (France)</b></p>	<p>A recent abstract of findings from the EPODE European Network, reports before and after data on the prevalence of overweight and obesity in children for eight pilot towns in France. The data were collected as repeat cross-sectional survey data, with anthropometric measurements carried out in schools, in a total sample of 24,752 children in 2005 and 23,617 children in 2009. However, given the age-range of children (age 4 to 12 years) and involvement of virtually the same schools in data collection in 2005 and 2009, many of the same children will have been followed up over the</p>	<p>The EPODE programme is a long-term centrally directed and supported programme which began in 2005. The methodology is implemented in 226 towns in France. There are also affiliated programmes in Belgium, Spain and Greece. EPODE aims to be "a coordinated, capacity-building approach for communities to implement effective and sustainable strategies to prevent childhood obesity" (EPODE Abstract from Epode European Network). Local project managers are trained by a national coordination team in social marketing and "organisational techniques" so that they can mobilise stakeholders at a local level. The four pillars of the EPODE methodology are stated as: the involvement of political</p>

	<p>period. Sub-group analyses by area-based social deprivation were conducted. No intermediate or process evaluation outcomes were reported.</p>	<p>representatives; scientific evaluation and dissemination; methods and social marketing, and; public/private partnership. Details of the specific activities undertaken during 2005 to 2009 in the eight pilot towns were not provided but involved schools (catering and extra-curricular activities), local government, health organisations, health professionals, shop owners and local producers, and the local media.</p>
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<p><b>Healthy Living, Cambridge Kids (USA)</b></p>	<p>A longitudinal, single-group, before and after design was used, with measures of within groups change pre- and post-intervention taken at baseline (2003/4) and following the intervention (2006/7). Anthropometric data was collected which allowed BMI to be calculated from height and weight measurements, collected routinely by CPS teachers and school nurses. BMI scores were not reported in the final analysis. BMI-z scores were also calculated based on Centres for Disease Control and Prevention, CDC growth charts. BMI-z <math>\leq -4</math> and <math>\geq 5</math> were excluded from the analysis. The prevalence of overweight/obesity was also calculated using BMI percentiles based on age and gender (BMI <math>\geq 95</math>th percentile =obese; BMI <math>\geq 85</math>th and <math>&lt; 95</math>th percentile =overweight; BMI <math>\geq 5</math>th and <math>&lt; 85</math>th percentile =healthy weight; BMI <math>&lt; 5</math>th percentile = underweight. Intermediate outcomes were sourced from fitness data collected routinely during PE each spring by CPS, comprising five age and gender adjusted fitness tests (listed in the Results section). No process evaluation outcomes were reported.</p>	<p>This programme, which focussed on child weight and fitness, formed a three-year intervention in Massachusetts, USA running from 2005 to 2007 with follow-up data taken immediately post-intervention. It was aimed towards children aged between 5 (kindergarten) and 11 years old (5<sup>th</sup> grade) within the Cambridge Public Schools (CPS) system. The programme was based theoretically on the Social Ecological Model, and used a wide range of partners including Cambridge Public Schools (CPS), Cambridge Schools Committee, Cambridge City, Institute for Community Health, School Health, Cambridge Public Health Department, Parents of children attending schools, researchers, CitySprouts (gardening organisation), Cambridge Department of Human Service Programs, Cambridge Green Streets Initiative, and Federation of Massachusetts Farmers' Markets. A collaborative Task Force contained members of the community and was involved in policy and implementation. There were a number of WSA 'core features' (identified by PenTAG) which mapped onto the Healthy Living, Cambridge Kids intervention. Capacity building was evident in the staff assessment training, purchasing of school equipment and professional development for PE teachers and canteen staff. The Task Force, partly consisting of community members, created guidelines and were encouraged to seek future funding. Family feedback was incorporated into individualised fitness reports for children, and the programme used a community-based participatory research approach which aimed to foster collaboration. Implementation strategies aimed to embed the programme by providing policy support for healthy living choices. The study authors report community wide change provided momentum for the "post intervention sustainability of many policies" (p.S51, Chomitz et al, 2010).</p>
<p><b>Steps to a Healthier Yuma County (USA)</b></p>	<p>A before and after study design was used from 2005 to 2008, with data collection at baseline and follow up at an interval of approximately nine months. This was part of a broader state-wide initiative, titled "Steps to a Healthy Arizona", which began in 2003. The study was aimed at children, their parents and the staff attending 30 participating childcare centres in Yuma County, Arizona but only the results from 17 centres was included due to data collection issues (the data collection tool was changed in some centres part way through the intervention). No anthropometric data was</p>	<p>The 'Steps to a Healthier Yuma County' (SHYC) programme, which ran for approximately 9 months in each child care centre between 2005 to 2008 with follow-up data taken immediately post-intervention, aimed to implement a comprehensive health promotion programme which targeted kindergarten aged children, their parents and child care staff. It covered 30 child care centres in six rural communities in Arizona with a focus on obesity and diabetes prevention, and involved 337 staff and 1,876 children. SHYC was one of a number of pilot programmes under the Arizona Steps programme for focusing health promotion at the social, environmental, organisational and policy levels.</p>

	<p>collected. Intermediate outcomes were reported for within groups change, with data sourced from a self-assessment questionnaire addressing 56 best practices in nutrition and physical activity, designed through community workshops with no mention of piloting or standardisation. No process evaluation outcomes were reported.</p>	<p>The programme activities centred on a coordinator and a number of workshops for child care centres to raise awareness of the problems of childhood obesity. It also used a self-assessment questionnaire to identify where centres were not using best practice in nutrition and physical activity. On the basis of each centre's self-assessment, a programme coordinator helped centre staff to develop an action plan to address priority areas. These activities generally involved professional development for staff, education for parents, typically delivered through three workshops (on Healthy Eating for Pre-schoolers; Physical Activity for Pre-schoolers, and Taking Care of Yourself. After these, later workshops might include "values clarification" in order "to help staff and parents connect the information to their own lives". The programme was said to involve "many adaptations" – for example, collaboration with the agricultural sector promoted understanding of the term 'whole grain', together with demonstration kits and recipes. In terms of our defined features of a Whole System Approach, the SHYC initiative exhibited a number of activities which involved capacity building (extra training in child care centres, demonstration kits and healthy recipes) local creativity (emergence of school salad bar initiative), and relationship-building. There was no obvious element of community engagement in overall programme design and implementation of strategies for improving diet and increasing physical activity. In relation to the robustness and sustainability of the programme and its achievements, it was claimed that the programme "created a culture of health promotion within the child care setting" but the extent to which the programme aimed to make this goal a sustainable one is not clear. However, the SHYC appeared successful in securing longer term funding to provide direct services, which will be administered through some of the structures set up by the Yuma County programme.</p>
<p><b>Fleurbaix-Laventie Ville Santé [FLVS] (France)</b></p>	<p>The mainly school-based obesity prevention initiatives in Fleurbaix and Laventie were evaluated by both uncontrolled repeated measures (in 1992, 2000, 2003 and 2004) and a controlled comparison using 2004 data from the two comparison towns, Bois-Grenier and Violaines. In the published evaluation by Romon et al (2008), 633 school children were measured in 2004 in the intervention towns and 349 in the comparison towns. Data for over 500 children</p>	<p>Three phases of intervention were carried out in two towns in northern France between 1992 and 2007. The first phase ran from 1992 to 1997, and involved nutrition education in schools. The second phase ran from 1997 to 2002, and involved continuing the work of the first phase with the addition of community involvement in the programme (which began in 1999). In 2002, the third phase began which involved a continuation of the first two phases in addition to a physical activity and nutritional education activities within both schools and the community.</p>

	<p>each year was also collected in the intervention towns for 2002 and 2003. The paper reported both before versus after changes in overweight in the two intervention towns, and compared the prevalence of overweight in 2004 between the intervention and control community children (i.e. without baseline data for this measure in the control community). No intermediate or process evaluation outcomes were reported.</p>	<p>The initial school-based activities involved an education programme established by the school teachers, who had themselves received extra training in nutrition. The education programme was complemented by practical initiatives, such as changes to school cafeteria menus, cooking classes, visits to farms, and family breakfasts. The more community-based activities in the later years included dietitian-led interventions delivered to community associations and town meetings, new facilities to promote physical activity, walking to school days and other 'healthy lifestyle' family activities. In relation to features of systems working there was an explicit focus on robustness and sustainability, capacity building (especially dietitians and disseminating knowledge relating to improving nutrition), and improving communications.</p>
<p><b>APPLE (New Zealand)</b></p>	<p>A non-Randomised Controlled Trial design was used, with the intervention and control groups from different schools and geographical areas. Children aged between 5 and 12 years old (n=720) from four intervention and three control schools were measured for height, weight, BMI, waist circumference, blood pressure, diet, and physical activity levels at baseline and at follow up one and two years later.</p>	<p>The APPLE study (A Pilot Programme for Lifestyle and Exercise) was conducted in the Otago region of New Zealand with the aim of determining whether increasing levels of extra-curricular activity and promoting healthy eating could reduce weight gain in children aged between 5 and 12 years old within the local ("relatively rural") area. The non-randomised controlled trial design used intervention and control groups in separate schools and geographical areas and was both implemented and evaluated over two years from 2003 to 2005. The main initiative was the provision of community Activity Coordinators who were attached to each intervention school with the primary role to encourage increased activity amongst schoolchildren outside the normal school curriculum. It is unclear to what extent the community was also targeted as there was no explicit mention of how the community was engaged. Data was collected on differences in BMI, height and weight scores and prevalence of overweight pupils between intervention and control groups from baseline to 2-year follow-up. Regarding WSA features, there was evidence of local creativity being harnessed through a number of community members volunteering their time to teach the children new skills. There was weak evidence for community engagement by the Activity Coordinators in encouraging parents and others within the target community to get involved in the school's extracurricular activities.</p>

## 5.3. Study results

### 5.3.1. Anthropometric measures

#### *BMI scores*

The difference in BMI scores between intervention and control groups at post-intervention was measured in three of the eight studies (Romp and Chomp, Be Active Eat Well and FLVS); while the results of all favoured the intervention, only one demonstrated statistically significant between group differences at follow up (Romp and Chomp). In Romp and Chomp, data from the two year-old age group demonstrated a statistically significant decrease in BMI between the intervention and control groups. Regression analysis of BMI data from the 3.5 year-old age group (adjusting for age, sex and height) demonstrated a significant between-group difference at baseline (coefficient<sup>2</sup>=0.11, 95% CI=0.01 to 0.21; p<0.05) but not at post-intervention (coefficient<sup>2</sup>=-0.001, 95% CI=-0.09 to 0.01), demonstrating that the intervention children were no longer heavier than the comparison sample. The change between groups in BMI scores pre- and post-intervention was measured in Be Active, Eat Well and whilst the outcome favoured the intervention, this was not statistically significant (difference in BMI increase =-0.28 (95% CI=-0.7 to 0.15), robust standard error =0.21, p=0.20). . For the FLVS study, there was a statistically significant within groups change favouring the intervention from pre- to post-intervention.

#### *BMI-z scores*

The 5 studies which assessed BMI-z scores at follow up (Romp and Chomp, Be Active, Eat Well; Shape Up, Somerville; APPLE; Healthy Living, Cambridge Kids) showed consistent reductions in BMI-z scores within intervention groups, although this was only statistically significant for one programme (Healthy Living, Cambridge Kids, p<0.001).

It is worth noting that the assessment varied between the studies. The difference in BMI-z scores was measured between groups at post-intervention in one of the eight obesity prevention programmes (Romp & Chomp), changes between groups pre- to post-intervention was measured in three of the eight programmes (Be Active, Eat Well; Shape Up, Somerville; APPLE), and change within groups pre- to post-intervention was measured in another (Healthy Living, Cambridge Kids).

### *Weight gain*

Only two of the studies - Be Active, Eat Well and FLVS – reported findings for changes in weight. In Be Active Eat Well, children in the intervention group gained significantly less weight than controls at follow up (difference in weight gain = -0.92 (95% CI = -1.74 to -0.11), robust standard error = 0.41,  $p=0.03$ ). Be Active, Eat Well also reported that the increase in waist circumference was less in the children in the intervention group than controls (difference in waist circumference gain = -3.14 (95% CI = -5.07 to - 1.22), robust standard error = 0.96,  $p=0.01$ ). In FLVS, children's weight decreased pre/post intervention, but this was only statistically significant for females.

### *Prevalence of overweight and obesity*

The programmes used different methods for assessing overweight and obesity in children - IOTF cut offs (Romp & Chomp, Be Active, Eat Well; FLVS; EPODE), age-specific BMI cut-off points (Shape Up, Somerville; Healthy Living, Cambridge Kids; APPLE) making it difficult to directly compare the studies. However, the prevalence of overweight and obesity was lower in intervention groups at follow up in four out of the five the programmes that reported it (Romp and Chomp, Be Active, Eat Well, Epode, FLVS and Healthy Living, Cambridge kids). Only the APPLE study reported a statistically non-significant increase in the prevalence of intervention group children rated as overweight/obese from pre- to post-intervention (increase of 0.70 units 95% CI: 0.54 to 0.90).

In Romp and Chomp, the percentage of the intervention group that were overweight/obese post intervention fell by 3.4 percentage points to  $15.2\pm 1.1$  at post-intervention compared with a 0.7 percentage point fall in the control group to  $15.7\pm 0.3$ . Healthy Living, Cambridge Kids reported the prevalence of children rated as 'healthy weight' (<85<sup>th</sup> percentile) increased to a statistically significant level from pre- to post-intervention within the intervention group (baseline 61.0%, post-intervention 63.4%, change = 2.4 percentage points,  $p<0.05$ ). Epode reported post intervention population prevalence of obesity and overweight as 18.83% ( $n=23617$ ),  $p<0.0001$  compared to 20.57% at baseline (2005,  $n=24752$ ), although it is unclear from the analysis what statistical tests were used to generate this data. FLVS reported a decrease in the prevalence of overweight/obesity from 2000 to 2004 ( $n=86$ , 14.3% in 2000;  $n=68$ , 13.2% in 2002;  $n=62$ , 10.5% in 2003;  $n=56$ , 8.8% in 2004) but supporting statistical information from models was not provided by the authors.

**Table 3 Overview of WSA features exhibited by obesity prevention programme and study results**

Programme name country (study design)	System recognition	Capacity building	Local creativity	Relationships	Community engagement	Communication	Embeddedness	Robustness & sustainability	Facilitative leadership	Monitoring and Evaluation	Anthropometric outcomes				Intermediate outcomes			
											BMI	BMI-z	Prevalence of children rated as overweight/obese	Other	Nutrition	Physical activity	Other	
Romp & Chomp Australia (cBA)		●	●	●	●	●	●	●	●	●	2 yrs old	Between groups difference at post-intervention: ↑↑	Between groups difference at post-intervention: ↑	Between groups difference at post-intervention: ↑		Between groups difference at post-intervention: : N° servings of packaged snacks/ cordial/ fruit juice: ↑↑	Between groups difference at post-intervention: No. trips to playground/park/ pool: ↑	
											3.5 yrs old	Between groups difference at post-intervention: ↓	Between groups difference at post-intervention: ↑	Between groups difference at post-intervention: ↑		Between groups difference at post-intervention: No. servings of vegetables per day: ↑↑	Between groups difference at post-intervention: Time spent watching TV: ↑	
Be Active, Eat Well Australia (nRCT)		●	●	●	●	○	○	●	○	●	Between groups change pre/post: ↑	Between groups change pre/post: ↑	Between groups change pre/post: ↑	Between groups change pre/post: waist circ. ↑ Between groups: weight in kg ↑			Between groups change pre/post: child's unhappiness with body size: ↑ Between groups change pre/post: child not feeling good about themselves: ↑	
Shape up Somerville: Eat Smart, Play Hard USA (nRCT)		●	●		●	○	○	●	○			Between groups change pre/post: ↑						

Programme name country (study design)	System recognition	Capacity building	Local creativity	Relationships	Community engagement	Communication	Embeddedness	Robustness & sustainability	Facilitative leadership	Monitoring and Evaluation	Anthropometric outcomes				Intermediate outcomes		
											BMI	BMI-z	Prevalence of children rated as overweight/obese	Other	Nutrition	Physical activity	Other
<b>EPODE</b> (longitudinal epidemiological study)		●	●	○	○			●		●			Within groups change pre/post-intervention: ↑↑				
<b>Healthy Living, Cambridge Kids</b> USA (BA)		●	●	○	●		○	○				Within groups change pre/post: ↑↑	Within groups change pre/post: <sup>a</sup> ↑↑			Within groups change pre/post: No. of fitness tests passed: ↑↑	Pre/post change: % of children passing 5 fitness tests/endurance cardiovascular test: ↑↑
<b>Steps to a Healthier Yuma County</b> USA (BA)		●	○	○	●		○								Within groups change pre/post: Best practices by childcare centre: ↑↑	Within groups change pre/post: Best practices by childcare centre: ↑↑	
<b>FLVS France</b> (repeated cross-sectional survey)		○	○				○			○	Within groups change pre/post: ↑↑		Within groups change pre/post: Males: ↑ Females: ↑↑	Within groups change pre/post: weight in kg Males: ↑ Females: ↑↑			
<b>APPLE New Zealand</b> (nRCT)			○		○							Between groups change pre/post: ↑↑	Between groups change pre/post: ↓				

<sup>a</sup> results only for obese, not for overweight

**Key:** ↑ favoured the intervention – no significance (or no significance reported)      ↑↑ favoured the intervention – significant  
↓ did not favour the intervention – no significance (or not reported)  
Comm. - community      PH policy- local Public Health policy  
● - means of attaining programme element explicitly described, or clearly stated as a goal      ○ - programme element mentioned, but means of attaining not described  
BA - before and after study      nRCT - non Randomised Controlled Trial  
cBA - controlled Before & After study

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### 5.3.2. Diet and physical activity

No intermediate outcomes were reported by Shape Up, Somerville; Epode; FLVS; and APPLE.

Differences between groups at post-intervention only for nutritional and physical activity outcomes were measured in one of the eight obesity prevention studies (Romp & Chomp). At follow up, Romp & Chomp reported a statistically significant reduction in the number of daily servings of packaged snacks (coefficient<sup>2</sup> = -0.23, 95%CI = -0.44 to -0.03, p = 0.03), cordial (coefficient<sup>2</sup>=-0.43, 95% CI=-0.73 to -0.13, p=0.005) and fruit juice (coefficient<sup>2</sup>=-0.52 to 95% CI=-0.79 to -0.25, p<0.001), and increase in daily servings of vegetables (coefficient<sup>2</sup>=0.13, 95% CI=0.03 to 0.23, p=0.01) favouring the intervention. No significant between-group differences at post-intervention were reported for the number of times in the last week that the child was taken to playground, park, pool etc. (coefficient<sup>2</sup>=0.05, 95% CI=-0.02 to 0.12). However, the intervention group watched significantly less TV/DVD at follow up than the control (coefficient<sup>2</sup>=-0.03, 95% CI=-0.04 to -0.02 p<0.001).

Within-groups changes from pre-/post-intervention were reported for nutritional and physical activity outcomes in two of the eight obesity interventions (Healthy Living, Cambridge Kids; Steps to a Healthier Yuma County). Steps to a Healthier Yuma County reported a statistically non-significant increase in the number of nutritional and physical activity best practices adopted within child care centres. Within Healthy Living, Cambridge Kids, although *no p value was given* the authors also reported a statistically significant increase from pre- to post-intervention physical activity outcomes in the number of fitness tests passed by children, in addition to a statistically significant increase in both the percentage of children passing all five fitness tests (p<0.001), and in the percentage of children passing the endurance cardiovascular test (p<0.001).

Between groups differences in changes pre-/post-intervention in other outcomes were measured in one of the eight obesity interventions (Be Active, Eat Well). Childrens' reports of unhappiness with their body size and "not feeling good about themselves" were statistically non-significant and favoured the intervention.



### 5.3.3. Process measures

Only one out of the eight obesity prevention studies reported pre-/post-intervention process outcome data (Romp & Chomp).

Regression analysis of the post-intervention data highlighted the dichotomy between process evaluation of effects relating to policies and those relating to activities. For example, there was a significant post-intervention difference in the number of care providers who participated in training relating to physical activity (OR=2.61, 95% CI 1.60 to 4.25,  $p<0.001$ ) but very little difference in the number of services that had a minimum time set for organised active play (OR=0.45, 95% CI 0.29 to 0.69,  $p<0.01$ ). There was a significant increase in the number of guidelines provided on bringing in healthier foods (OR=3.06, 95% CI 1.95 to 4.81,  $p<0.001$ ) but no significant change in whether care providers sit with children while they eat “always” or “most of the time” (OR=0.901, 95% CI 0.50 to 1.64,  $p=0.73$ ).

The New South Wales (NSW) Healthy Capacity Building Framework was used to assess the actions contained in the Romp & Chomp Action Plan. Relating to ‘Partnerships’, Romp & Chomp scored 39.6% overall (21/53 Action Plan activities mapped onto the NSW Framework), with the subset of ‘Relationships’ scoring highly (15/21, 71.4%) but with ‘Planning’, ‘Evaluation’, ‘Implementation’ and ‘Sustained Outcomes’ all scoring 0%. Regarding ‘Leadership’ (which contained subsets including ‘Strategic visioning’ and ‘Systems thinking’) Romp & Chomp also failed to score against any of the Framework domains (0%, 0/53). ‘Resource allocation’ (featuring subsets including ‘Human resources’, ‘Financial resources’ and ‘Specialist advice’) scored 22.6% (12/53), ‘Workforce Development’ (incorporating ‘Workforce learning’ and ‘Professional development opportunities’) scored 7.5% (4/53) and ‘Organisational development’ (featuring ‘Strategic directions’, ‘Recognition and reward system’, ‘Quality improvement systems’ and ‘Informal culture’ at 0%, with ‘Organisational structures’ and ‘Management support’ at 31.2% and 37.5% respectively) scored 30.2%. However, without comparison data from other programmes, or detailed reporting of the items ‘failed’, it is difficult to interpret such results.

Parental awareness of the Romp & Chomp intervention had increased post-intervention, although only percentage increases were reported (23% in 2006 and 47% in 2008). Statistically significant increases from pre-to post-intervention were also observed for the number of nutrition related guidelines implemented by Family Day Care services.

One other intervention (Be Active, Eat Well) reportedly measured changes to environments, physical activity and eating behaviours, as well as changes in community capacity assessed using the capacity building index for key stakeholders. However, these outcome data were not reported. The six other interventions (Shape Up, Somerville; EPODE; Healthy Living Cambridge Kids; Steps to a Healthier Yuma County; FLVS; APPLE) did not report process outcome data.

Area boundaries were highlighted as both facilitators, enabling the easy partition of populations (Be Active, Eat Well; EPODE; FLVS; APPLE), and as barriers, forming population boundaries that were too wide (Romp & Chomp). Community engagement also presented advantages and disadvantages. On the one hand, some programmes found engagement with specific groups difficult, encountering problems such as lack of engagement in programme development, budgetary constraints and resistance to change (Romp & Chomp; Shape Up Somerville; Steps to a Healthier Yuma). However, in some situations community engagement became a facilitator in helping to develop collaboration and creativity between community agencies (Romp & Chomp; Shape Up Somerville).

On a greater scale, the issue of partnership and trial integrity was referred to by several programmes (Be Active, Eat Well; Romp & Chomp). This refers to the difficulty in balancing true community participation and ownership, against the need to assess an intervention with scientific integrity in order to guarantee there is an appropriate degree of uniformity and consistency between intervention communities, whilst not interfering too much with the purpose of the intervention. (p.193 of .

Funding was a recurring barrier reported for all programmes, with competing demands, under-resourcing and the desire for quick visible successes often creating tension within programme delivery mechanisms (Be Active, Eat Well; Romp & Chomp; Shape Up, Somerville; Healthy Living, Cambridge Kids; Steps to A Healthier Yuma).

#### **5.4. Evidence of WSA features in programmes**

None of the eight obesity prevention programmes included in the review demonstrated evidence of being designed and delivered with explicit recognition of the public health problem as a system. For the remaining nine features of systems working, six of the included programmes demonstrated clear evidence whilst one programme

demonstrated partial evidence of ‘capacity building’. Across seven programmes there was some, but less consistent, evidence of ‘local creativity’ and ‘robustness & sustainability’. Five obesity prevention programmes demonstrated some evidence of a focus on developing working relationships. Four of the obesity prevention programmes demonstrated some evidence of a focus on enhancing communication, embeddedness of actions and policies, facilitative leadership and well articulated methods for ongoing monitoring and evaluation of activities.

Two community programmes based in Australia demonstrated the **strongest evidence for system working**. One cBA study [+] (Bell et al. 2008; de Groot et al. 2009; de Groot et al. 2010; de Silva-Sanigorski et al. 2009a; de Silva-Sanigorski et al. 2009c; de Silva-Sanigorski et al. 2009b; de Silva-Sanigorski et al. 2010b; de Silva-Sanigorski et al. 2010a; Nichols et al. 2009; Parker et al. 2009; Parker et al. 2009a; Parker et al. 2009b) explicitly describes nine out of the ten features of system working, and demonstrated statistically non-significant between group decreases in anthropometric outcomes. The programme also reported favourable outcomes relating to nutrition (which were statistically significant) and physical activity (which were statistically non-significant). The other study, an nRCT ([+]: Bell et al. 2008; Sanigorski et al. 2008), shows clear evidence of six out of ten WSA features, and makes implicit reference to an additional three features. This study reports statistically non-significant between-group decreases in BMI, weight gain and the prevalence of overweight/ obesity.

Three community programmes in the US **showed 5 to 7 features of whole system working**. Economos et al 2007 [+] describes 4 WSA features and implies another three features. It reported non significant decrease in BMI z score and the prevalence of overweight or obesity. Chomitz et al. 2010 [+] explicitly describes three WSA features and makes implicit reference to another three features. It reported statistically significant change in the prevalence obesity and improvements in fitness among children post intervention. Drummond et al. 2009 [-] explicitly describes only two WSA features and makes implicit reference to another three features. No anthropometric outcomes were reported, but reported a statistically non-significant post-intervention increase in diet and activity “best practice” at childcare centres.

The remaining three community programmes displayed **4 or less features**.

One longitudinal epidemiological study based in France ([+]:EPODE abstract 2010; EPODE results 2010; European Public Health alliance 2010; EPODE Press Kit 2005; Thin Living 2007) clearly demonstrated evidence of four features, and demonstrated unclear evidence of two additional features. Another, related, repeated cross-sectional survey in France ([+]: Romon et al. 2008; Heude et al 2003; EPODE abstract 2010) demonstrated unclear evidence of four features. Both studies showed significant pre-/post- reductions in the prevalence of obesity prevalence, which were statistically significant for all children in one of the studies but only for girls in the other. One nRCT (New Zealand [+]: Taylor et al. 2006; Taylor et al.2007; Taylor et al.2008; McAuley et al 2009) provides unclear evidence of two features and reported a between group statistically significant and favourable change in BMI-z scores.

## 6. Discussion

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### 6.1. Summary of main findings

The obesity prevention programmes were all focussed on children under 15 years old with a wider element targeting community, adults and/or family. The duration of both the intervention and the evaluation varied widely across all programmes, as did study quality. None of the programmes were undertaken in the UK.

Of the eight community-wide multi-strategy obesity prevention programmes included in the review, seven programmes (Romp & Chomp, Be Active Eat Well, Shape Up Somerville, EPODE, Healthy Living Cambridge Kids, FLVS and APPLE) reported anthropometric outcomes such as changes or between-group differences in BMI, weight or waist circumference. While most of the reported anthropometric outcomes favoured the intervention, not all findings were significant, reported change tended to be relatively small and follow up tended to be unclear or short term (less than 3 years). Four of the 8 included obesity programmes reported intermediate outcomes. There was evidence of a positive impact of the included programmes upon nutrition, physical activity and other measures, with a range of statistically significant and non-significant results observed which favoured the intervention.

#### **Relationship between whole system features and effectiveness**

It is not possible to make clear statements about the effectiveness (or otherwise) of adopting a whole system approach for obesity prevention from this current evidence, due to the variability in outcomes reported, duration of evaluations and study quality across included programmes. The two programmes which demonstrated the strongest evidence for system working both took place in Australia (Romp and Chomp and Be Active, Eat Well) but shared few commonalities in terms of design, methods and outcomes measured, even though both programmes were part of the same Sentinel Site for Obesity Prevention, a demonstration site in Victoria, Australia.

Similarly, because the extent and range of truly community-based activities was generally only briefly described (the activities within most of the obesity programmes appeared to be dominantly school-based and child-focused), it was not possible to consider the impact of the 'reach' or 'intensity' of the included programmes. It is worth noting that the programmes included typically lasted two years or less.

## **6.2. Potential barriers and facilitators to implementation**

A number of potential barriers and facilitators to implementation were identified post-intervention by programme study authors, relating to: population, sampling, data collection, cut-off points, community engagement, resistance to change, tensions between, trial integrity and local ownership; funding; and the confounding effects of other initiatives.

Area boundaries were highlighted as both facilitators, enabling the easy partition of populations (Be Active, Eat Well) and barriers, forming population boundaries that were too wide (Romp & Chomp). Community engagement also presented advantages and disadvantages. Some programmes found engagement with specific groups difficult, encountering problems such as lack of engagement in programme development, budgetary constraints and resistance to change (Romp & Chomp; Shape Up Somerville; Steps to a Healthier Yuma). However, in some situations community engagement became a facilitator to develop collaboration and creativity between community agencies (Romp & Chomp; Shape Up Somerville).

The issue of partnership and trial integrity was referred to by several programmes (Be Active, Eat Well; Romp & Chomp). This refers to the difficulty in balancing true community participation and ownership, against the need to assess an intervention with scientific integrity in order to guarantee there is an appropriate degree of uniformity and consistency between intervention communities, whilst not interfering too much with the purpose of the intervention. (p.193 of .

Funding was a barrier reported for all programmes, with competing demands, under-resourcing and the desire for quick visible successes often creating tension within programme delivery mechanisms (Be Active, Eat Well; Romp & Chomp; Shape Up, Somerville; Healthy Living, Cambridge Kids; Steps to A Healthier Yuma).

## **6.3. Review limitations**

Systematic reviews of complex multi-component multi-level community-wide public health interventions have many potential causes of variations in effectiveness. Thus, even where a group of studies have measured outcomes using the same standard measure (e.g. BMI) it is extremely difficult to ascertain whether variations in effectiveness may have arisen due to differences in:

- The combination of actions and strategies
- The characteristics of the population
- The local and national policy context
- Other factors which may influence the effectiveness, implementation and sustainability

This reviewed aimed to consider whether programmes which exhibited more features of a whole system approach or which strongly demonstrated particular features of whole system approach (WSA) appeared more successful. Thus, we aimed to consider both the activities and strategies implemented in particular community-wide multi-level obesity prevention programmes and how these changes were designed, developed and implemented. The main limitation to us being able to do this is the paucity of evaluated programmes the characteristics of a WSA. Even among the 10 identified studies, there was variation in the range of features demonstrated. At one end, Romp & Chomp (Australia) was judged to exhibit all WSA features, except that it was not developed around explicit recognition of the systems nature of the causes of obesity. At the other end amongst the community-wide obesity prevention programmes, Steps to a Healthier Yuma County only clearly demonstrated capacity building and community engagement as key ways of working, with less evidenced commitments to local creativity, relationship-building and robustness and sustainability.

For anthropometric measures of effectiveness and intermediate outcomes, although most effectiveness results were in the intended directions few were of sufficient magnitude or statistical significance to attribute the findings to the number of or combinations of WSA features. This is mainly a consequence of the few studies found, and that beyond BMI and BMI-z score, the outcome measures used were variable. For example, the four studies that reported prevalence of obesity or overweight/obesity used a number of different thresholds. Process measures are even less likely to be comparable across studies. If, on top of these differences between study designs, we are to consider the different age groups of children included, the different length of time from baseline to with intervention data collection, and the robustness of the different study designs, it is almost impossible to make reliable inferences.

Lastly, designing searches to identify such a potentially diverse and differently named set of prevention programmes is difficult. Although we based our searches on a previous review and expert advice, there may be other search terms which would have yielded other potentially includable studies.

The qualitative nature of the WSA features coupled with the different language and amount of text that authors use to describe the conception, design and development of their programmes and constituent interventions mean that the attribution of the WSA core features to particular community-wide programmes may not be reliable. Certain features or programme aims (like community engagement and capacity building) tended to be more explicitly mentioned or described, and were therefore easier to attribute than more elusive features – like a focus on the “embeddedness of actions and policies” or “facilitative leadership” (at least by the descriptions that academic papers allow space for). Therefore, the resultant patterns of features attributed to each programme will be partly a reflection of these factors.

Some of our defined features of a whole system approach can also be viewed as important process outcomes. For example, improved communication between agencies and between agencies or the community is both a goal of the programme and potentially an outcome of interest to the review. However, this overlap between some programme features and outcomes of interest is legitimate because the programme features were primarily judged on the basis of how the programme was intended to be developed and implemented. In contrast process outcomes were reported, regardless of whether they related to an intended feature of the programme.

No obesity programmes were identified which focused on adults or all age groups. Although some of the programmes had some actions and policy changes that targeted adults or both adults and children, most strategies for change were school-based, and all of the evaluations only reported anthropometric outcomes for children. While the rationale for preventing obesity in childhood is strong, it is likely that a truly whole system approach would need to address the causes of obesity across those of all ages.

None of the evaluated obesity prevention programmes was in the UK. Although some aspects of policy, society and community organisation are similar between the UK and the USA, New Zealand and Australia, where most of the evaluated programmes took place, there are also many differences in social, behavioural and economic factors that can impact on weight.



The included programmes had diverse study designs, typically resulting in a high risk of bias in any effects measured. All of the included studies used non-randomised designs and there were substantial variations in both the types of outcome measured, and the specific definition of some outcomes (e.g. the definition of overweight or obesity by two different conventions). Another aspect of the variability of study designs is the often short follow-up times (relative to the expected timescale of likely changes) and mixed timing of baseline data collection.

Reporting of data was also an issue. The EPODE programme only reported effectiveness data on eight towns out of a possible 226 towns included in the programme. This is a missed opportunity in terms of the breadth of evaluation data potentially available, but also raises questions of generaliseability.

Taking together these various limitations, but especially the few studies that met our inclusion criteria, it is extremely difficult to draw any firm conclusions about the effectiveness (or otherwise) of adopting a whole system approach.

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