

Whole systems approach to childhood obesity: A review of the evidence.



Whole systems approach to childhood obesity: A review of the evidence

Publication date: November 2021

Foreword

Obesity is a major public health issue in both Northern Ireland and Ireland. Obesity levels remain high among adults and children and there is a strong social gradient whereby the incidence of obesity tends to fall as socioeconomic status increases. The rates of obesity have stabilised among children at a population level but are still rising among the socially disadvantaged. Those involved in the implementation of obesity policy in both jurisdictions are reviewing the current approaches to tackling the issue and are considering different approaches. A whole systems approach is one promising approach and **safefood** commissioned a review of the literature on whole systems approaches to childhood obesity internationally to support decision making and inform future whole system approach interventions on the island. The review is one of the elements of a project entitled “Public Acceptability of obesity interventions on the island of Ireland”.

The commissioning of this review by **safefood** was supported by the Departments of Health in both Ireland and Northern Ireland. The review builds on the ongoing work in relation to the development of whole systems approaches for example the reference to the requirement for whole systems approaches to end childhood obesity in the [healthy weight for children framework](#) and the Sláintecare [Healthy Communities](#) Programme to provide increased health and wellbeing services in 19 community areas across Ireland. In addition, Sport Ireland have commenced an [Active Cities Initiative](#) which takes a systems approach to improving physical activity, based on the principles of the Global Action Plan for Physical Activity, developed by the World Health Organisation. Also available to support the development of whole systems approaches is [a guide and set of resources that can be used to support the implementation of a whole systems approach to obesity](#) that has been published by Public Health England.

The focus of the review is on interventions that take a whole systems approach with a primary aim of addressing childhood obesity. The report identifies the learnings, the facilitators and the barriers. The report also considers the obesity policy context in Ireland and Northern Ireland as a basis for the further development of whole systems approaches. It is intended to support policy makers and local decision makers to progress whole systems approaches to childhood obesity in both jurisdictions.

Acknowledgements

safefood acknowledges the authors of this report: Dr Cale Lawlor and Dr Mirjam Heinen, School of Public Health, Physiotherapy and Sports Science, University College Dublin; and Dr Roisin O'Neill and Dr Laura McGowan, Centre for Public Health, Queen's University Belfast.

Table of contents

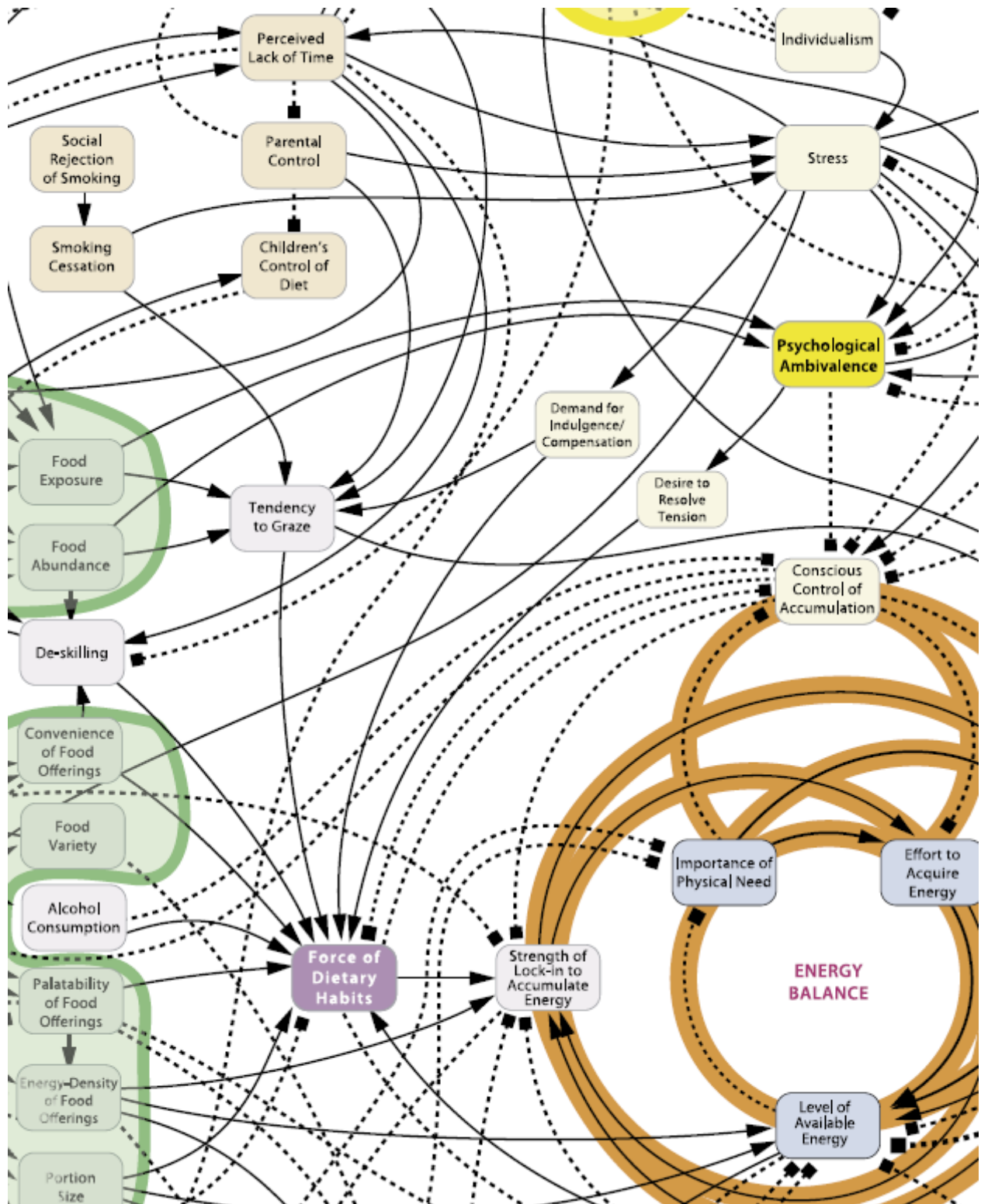
Introduction	2
1 Aims and objectives.....	7
2 Methods.....	8
Literature review	8
Consideration of whole systems approaches in Northern Ireland and Ireland.....	10
3 Results	11
Studies identified from review of literature	11
Features of whole systems approaches in studies reviewed.....	24
Potential effect modifiers in whole systems approaches.....	24
Practical examples of component success in whole systems approaches.....	26
Recommendations for whole systems approaches from systematic review and review of interventions.....	27
Development of whole systems approaches on the island of Ireland.....	29
4 Conclusion.....	39
Appendix 1 Results of database searches and inclusion steps.....	40
Appendix 2 References for organisational structure maps for Ireland and Northern Ireland	41
References.....	42

Introduction

Whole systems approach to complex problems are a relatively recent development in the public health world and show potential at managing complex public health challenges (1). Recognising the complexities, interactions, and multiple layers that contribute to individual health in a wider family, social, environmental, and cultural environment has led to ‘systems thinking’, whereby many, interacting, dynamic factors are realised to impact the individual health experience. Although there is no single definition, whole systems approaches “involve identifying the various components of a system and assessing the nature of the links and relationships between each of them” (2). The growth of this field of thinking has led to attempts to implement whole systems approaches to public health problems which have proved difficult to manage with more traditional, individualised approaches (3). The failures of individual approaches replicated many times across a society has led to innovative, whole systems approaches, where blanket interventions are applied across an entire population, often with smaller sub-interventions targeted at vulnerable groups (1). Obesity is one such complex and difficult to manage public health challenge that has been the subject of whole systems approaches and interventions internationally in recent years.

Systems thinking aims to make an assessment of and map the wider systems that impact individual health outcomes, not just to inform of the complexity of the health environment, but also to identify potential targets for interventions perhaps previously considered outside of the realm of public health (1, 4). One such map for obesity is the Foresight map (Figure 1) (5). In the middle sits individual energy balance, the ratio of energy consumed to energy expended. Immediately outside of this are factors that affect individual energy balance, physical activity, appetite control, habits and psychology. This has been the realm of traditional weight interventions. ‘Systems mapping’ realises the large factors that orbit outside of these and influence at a wider level, the highly inter-connected, social, environmental and political factors; food production and supply, early life experiences, media, education, transport, infrastructure and the built environment, healthcare, technology and macro-economic drivers (5), all of which impact individual energy balance. These factors are relevant inside the field of public health and obesity prevention and management, and their importance is starting to be recognised in whole systems approaches.

Figure 1: A small portion of the 'Foresight obesity systems map', the area of green shading representing 'macro-economic drivers. (1



While a traditional health approach may focus on the input and output of individual energy balance, a whole systems approach aims to encompass the influence of factors such as access to green space, early

childhood breastfeeding, social media, educational access and quality, and participation in the economy (5).

Whole systems approaches have been increasing in frequency on the back of the development of Systems Thinking, and the failure of traditional, narrow interventions to create long-lasting changes in individual health (3). To date, the published data, on whole systems approaches, shows promise that they could be an effective intervention to improve population overweight and obesity rates. It has been thought that they are likely cost-effective (1, 4). From the trialled whole systems approaches to date, positive and negative traits can be established. Though they show promise in positively affecting public health, whole systems approach has both positive and negative traits.

Pros

- Results show promise of success in reducing rates of population obesity when traditional interventions tend to not show long-lasting results.
- Consider the wider, very influential environment in which a person lives.
- With most public health programmes, there is a likelihood that they are cost-effective.
- Potential that all of society sees a positive effect from intervention, with vulnerable groups seeing greater effects still.
- Reflective, with the ability to reorient to meet needs.
- Spill-over effect onto other realms of health outside of obesity, such as those affected by the Social Determinants of Health.
- Ability to increase social capital through increased sense of community and safety.

Cons

- Resource-intensive and complicated.
- Need to run over a long period of time (years) and need to be analysed after long periods of time (up to 12 year follow up cited).
- Potential that although peoples' lives subjectively improve, quantitative changes may be difficult to prove.
- Quality and access to data very important, which may encounter difficulties with need for personal consent and current privacy legislation (which was identified as a possible reason for lack of effect in one study).
- Robust monitoring needed, with the potential that Programmes may need to be rethought if results not as positive as expected.

Though there are several operational elements that are resource-intensive, complicated and expensive in running a Whole systems approach, the general belief is that, like other public health interventions, they will be cost-effective (1, 4). This cost-efficacy, coupled with the potential ability to positively affect population health and obesity prevalence make whole systems approaches worthy of further trial, investigation, and implementation. In addition to the previously mentioned factors for success, there

remain more specific, operational elements as to what has worked well, and what has aided success, of other interventions globally.

The trial, implementation, and review of whole systems approaches is becoming more frequent. The field is still in its infancy (1), but some interventions have been promising, enough to consider whether interventions could be adapted to the island of Ireland context. A 2019 systematic review of whole systems approaches to complex public health challenges including obesity, by Bagnall et al found that, of the 65 studies reporting on health outcomes in whole systems approaches (with 33 including obesity interventions), the majority reported positive outcomes (1). The Bagnall et al review sets out features (Table 1) that should be present for an intervention to be labelled a whole systems approach. Thirteen of the included studies met all ten of the systems criteria. Studies of interventions which met a large number (8–10) of the whole systems approaches features frequently reported positive health effects, although the association between these systems features and health effects did not reach statistical significance. The studies that met all ten systems criteria were all associated with positive health outcomes (1).

Table 1: The ten features of a systems approach to tackle public health problems as cited in (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.
Capacity building	An explicit goal to support communities and organisations within the system.
Creativity and innovation	Mechanisms to support and encourage local creativity and/ or innovation to address public health and social problems.
Relationships	Methods of working and specific activities to develop and maintain effective relationships within and between organisations.
Engagement	Clear methods to enhance the ability of people, organisations and sectors to engage community members in Programme development and delivery.
Communication	Mechanisms to support communication between actors and organisations within the system.
Embedded action and policies	Practices explicitly set out for public health and social improvement within organisations within the system.
Robust and sustainable	Clear strategies to resource existing and new projects and staff.
Facilitative leadership	Strong strategic support and appropriate resourcing developed at all levels.
Monitoring and evaluation	Well-articulated methods to provide ongoing feedback into the system, to drive change to enhance effectiveness and acceptability.

The review (1) also identified facilitators and barriers to implementing whole systems approaches to complex public health challenges as:

Whole systems approach to childhood obesity: A review of the evidence

1. Strong leadership and full engagement of all partners is key for success
2. Engaging the local community is an important component of a successful approach
3. Creating successful outcomes requires time to build relationships, trust and community capacity
4. Good governance and shared values (results in more participation and intersectoral action)
5. Appropriate partnerships are important to create sustainable multilevel environmental change
6. Consistency in language across organisations (can overcome differences in organisational beliefs and structures)
7. Embedding initiatives within a broader policy context (helps to integrate and align initiatives)
8. Local evaluations (are important and inform effectiveness of local-level interventions)
9. Sufficient financial support and resources (were identified as essential and lack of resources identified as a barrier to successful implementation).

The island of Ireland, like much of the world's population, is seeing significant rates of overweight and obesity. The latest official figures from Northern Ireland and Ireland put the proportion of the adult population with excess weight at 62% and 60% respectively (6, 7), with obesity rates of 25% and 23%, respectively. These rates have changed little in recent years, despite evidence-based policy change (6, 7). Childhood obesity rates are also concerning, with 8% of children in Northern Ireland, and 5% and 9% of girls and boys, respectively in Ireland living with obesity (7, 8). The lifetime risk of chronic disease from these rates is significant, as greater time spent living with obesity can infer a greater health risk. The economic costs of these rates are also significant, running into billions of euros a year at current levels, and the predicted lifetime costs for childhood obesity at these rates is higher still (9, 10).

As also demonstrated in other environments, the island of Ireland context shows a health equity gradient; the most deprived suffer at rates much greater, and much more dangerous, than the least deprived. In Ireland, this difference can be as great as 10%, with the most deprived having a 10% higher proportion of obesity than the least deprived, and with it, significantly higher risk of morbidity and mortality due to excess weight (6). Not only do population proportions differ between the least and most deprived, but so do health-related behaviours, with the most deprived having been shown to engage in less weight loss behaviour (6). The weight difference is displayed in children also; data from Ireland showed that in disadvantaged schools, the prevalence of overweight and obesity in children was 32.8%, compared to 17.7% in non-disadvantaged schools (11). Similar childhood obesity trends have been shown across the United Kingdom (12). However, it is not just a lack of personal resources and capital that create this disparity, it is the wider social environment that produces a social gradient of health; and it is within the context of individual risk and wider social environment that whole systems approaches can intervene.

Around the world, whole systems approaches have been trialled to try and reduce rates of obesity or improve the health predictors that contribute to obesity. The aim of this report is to present a review of the literature on whole systems approaches to childhood obesity internationally to support decision making and inform future whole system approaches on the island of Ireland.

1 Aims and objectives

The aim of this report is to:

1. Carry out a literature review of the efficacy of whole systems approaches to childhood obesity and:
 - a. Describe the features of the whole systems approaches
 - b. Provide practical examples of successful whole systems approaches
 - c. Provide recommendations for Whole Systems Approaches from systematic reviews and reviews of interventions
2. Consider how whole systems approaches to childhood obesity can be developed on the island of Ireland
 - a. Review national obesity policies against the 10 pillars of the Amsterdam Healthy Weight Programme as per the approach used by Hawkes et al., 2017 (13).
 - b. Identify factors that need to be taken into consideration when developing whole systems approaches in Northern Ireland and Ireland

2 Methods

Literature review

A rapid review of the published literature relating to whole systems approaches to childhood obesity was undertaken. Searches were conducted on PubMed, Google Scholar and “One Search” at University College Dublin¹ and through Google searches between June 2 and June 8, 2020. From this, relevant studies were searched for references to additional useful papers for review.

Search terms were: “public health”, obesity, overweight, “health promotion”, “whole system”, “rainbow model”, “Dahlgren-Whitehead”, “social model of health”, programme, intervention. Three searches were conducted:

Search 1: (((“public health”[Title/Abstract] OR “rainbow model”[Title/Abstract] OR “whole system” [Title/Abstract] OR “social model of health” [Title/Abstract] OR Dahlgren[Title/Abstract] OR Whitehead[Title/Abstract] OR “social ecological model”[Title/Abstract]))) AND ((obesity[Title/Abstract] OR overweight[Title/Abstract] OR “Obesity”[Mesh])) AND ((programme[Title/Abstract] OR “health promotion” [Title/Abstract] OR intervention[Title/Abstract]))

Search 2: (((“public health”[Title/Abstract] OR “health promotion” [Title/Abstract] OR “rainbow model”[Title/Abstract] OR “whole system” [Title/Abstract] AND ((obesity[Title/Abstract] OR overweight[Title/Abstract]))) AND ((intervention[Title/Abstract]))

Search 3 (PubMed and Google Scholar): “public health obesity whole system intervention”

Inclusion criteria were:

- English language studies, those that reviewed an intervention; studies that addressed a whole systems approach; studies that related to obesity

Exclusion criteria were:

- Studies not in the English language,
- Studies where the full text paper was not accessible

Further exclusion of retrievable studies followed and excluded:

- Studies not related to the whole systems approach (21),
- Studies not relating to obesity (11)
- Studies better analysed by another article (2),
- Studies with results not yet available (1),

¹ This is a single point of discovery for the UCD library collections [Online Tools | UCD Library](#)

Whole systems approach to childhood obesity: A review of the evidence

- Studies that did not report quantitative findings (2)

A total of 14 studies detailing whole systems approaches were identified for appraisal by 2 researchers. The results of database searches and inclusion steps search strategy is detailed in Appendix 1. These studies were read entirely, and their relevant points summarised. After extraction of these factors, each study was rated against a scoring system for assessing non-randomised studies, called the 'Methodological Index for Non-Randomised Studies (MINORS) framework'(14). The system looks at a number of factors that lend strength to studies, and each item can be scored out of a possible 2 points; 0 for "not reported", 1 for "reported but inadequate" and 2 for "adequate". The factors considered for non-comparative studies include:

- a clearly stated aim
- inclusion of consecutive participants
- prospective collection of data
- appropriate endpoints for aims
- unbiased assessment of study points
- appropriate follow up period
- rate of loss to follow up and
- prospective power calculations.

For comparative studies, factors include:

- an adequate control group
- contemporary groups
- baseline equivalence of groups and
- adequate statistical analysis.

Possible scores were out of 16 for non-comparative studies and 24 for comparative studies. Each study was assessed and given a score out of either 16 or 24, and this was converted to a percentage or proportion out of 10 for comparison between studies based on strength. The studies were categorised as:

- 'strong' (>8.0) – 2 studies
- 'moderate' (6.5 - 8.0) – 8 studies
- 'low' (5.0 - 6.4) – 2 studies
- 'weak' (<5.0) – 1 study
- 1 study unpublished

Following assessment of each of the studies, a summary of the factors that strengthened and weakened the intervention and an assessment of the whole systems approach described was prepared for internal review and was used as the basis to writing this report.

Consideration of whole systems approaches in Northern Ireland and Ireland

The national obesity policies in both jurisdictions were reviewed against the ten pillars of the Amsterdam Programme as per the approach used by Hawkes et al., 2017 (13). Consideration of the wider policy framework was beyond the scope of the project. Examples of local government organisational structures for Northern Ireland and Ireland were identified from government websites (See Appendix 2).

3 Results

Studies identified from review of literature

The literature review identified 14 whole systems approaches to improving population health and obesity rates from around the globe. Most involve a town or city-level community intervention, over multiple levels and sectors, with varying lengths. Table 2 summarises the findings of all reviewed studies, with simplified outcomes and scoring of the strength of study based on the MINORS framework (14). The studies reviewed vary in quality (see Table 2 - column entitled Strength of study), but some studies which are of high-quality show promising results for whole systems approaches on population health. The methodologically strongest studies and/or studies showing positive results are described in more detail. The Amsterdam Healthy Weight programme is also described in more detail given that the national obesity policies in both Ireland and Northern Ireland are reviewed against the ten pillars of the programme.

Whole systems approach to childhood obesity: A review of the evidence

Table 2: Overview of reviewed papers on whole systems approaches

Nature of findings	Location	Intervention	Targets and results	Outcomes^	Reference	Strength of study*
Positive findings	Cambridge, USA	Multi-level, community-based Programme to improve childhood health	BMI z-scores BMI: -2.2% (p<0.05) z-score: -0.04 (p<0.001)	Decrease	Chomitz et al., 2010 (3)	8.1
			Physical Fitness +14.6% (p<0.001)	Increase		
	Geelong, Australia	'Romp & Chomp' intervention in day-care and schools to improve childhood health	Diet (multiple) Vegetable servings/day: 0.13 [0.03 - 0.23] (p - 0.01)	Increase	de Silva-Sanigorski et al., 2010 (15)	7.5
			Activity Sedentary time: -0.03 [-0.04 - -0.02] (p<0.001)	Increase		
			BMI 2 year olds: -0.02 [-0.06 - 0.01] (not sig.) 3.5 year olds: -0.06 [-0.10 - -0.01] (p<0.01)	Decrease		
	Somerville, USA	'Shape Up Somerville' multi-level community intervention to improve childhood weight	BMI z-scores: -0.1005 [-0.1151 - -0.0859] (p - 0.001)	Decrease	Economos et al., 2007 (16)	7.9
Mixed findings						
	Jaguariuma, Brazil	Seven-month multi-level, city-wide intervention to improve overall health	Physical activity (multiple) Leisure time physical activity: 37% [19% - 58%] (p < 0.001)	Increase	Atalla et al., 2019 (17)	6.3
			Diet (multiple) Recommended fruit and vegetable intake: 18% [2% - 36%] (p - 0.031)	Increase		
			BMI: -0.16 [-0.47 - 0.16] (p - 0.297)	Decrease among those with overweight or obesity		

Whole systems approach to childhood obesity: A review of the evidence

South Australia, Australia	'OPAL' locally-adapted community development through community projects, upgrades and social marketing to improve childhood health	Anthropometric measurements (multiple) BMI z-score: - 0.08 [-0.24 - 0.08] (p - 0.31)	Did not change significantly over time	Bell et al., 2019 (18)	7.5
		Healthy behaviours (multiple) Recommended fruit and vegetable intake: OR = 1.4 [1.0-1.9] (p - 0.04) - non-significant after adjustment	Did not change significantly over time		
		Health-related quality of life (multiple) Quality gain: 0.034 [0.006 - 0.062] (p - 0.02) - non-significant after adjustment	Did not change significantly over time		
Sheffield, UK	'Healthy Towns' multi-faceted, multi-level community intervention to improve childhood health	Diet: figures not reported well	Not well reported	Copeland et al., 2011 (19)	6.3
		Physical activity: figures not reported well	Increased		
		Attitudes toward healthy behaviour: figures not reported well, but multiple statistically significant results mentioned, without reporting actual results	Increased		
Golborne, UK	Community-wide intervention through social marketing, community events and upgrades to decrease childhood obesity	BMI: not reported, though reported not statistically significant	Not well reported	Gadsby et al., 2020 (20)	3.8
		Diet: not reported well	Increase		
		Sedentary behaviour: not reported well	Increase		
Nunavut and Northwest Territories, Canada	'Healthy Food North' locally adapted and owned community intervention to improve food environment, physical activity and knowledge	Health knowledge and behaviour (multiple) Healthy intentions: 2.14 (p <0.0001)	Increase	Mead et al., 2012 (21)	7.5
		Diet (multiple) Unhealthy food: -5.28 (p - 0.0019)	Decrease		
		BMI: -0.37 (p - 0.28)	Data not shown		
Bonnyville, Canada	Locally led, multi-level community intervention based on 'ANGELO' framework	Chronic disease risk, many measures BMI: -0.7% (p = 0.038) Blood pressure: -3.39 mm/Hg (p = 0.000)	No significant change	Raine et al., 2013 (22)	7.9

Whole systems approach to childhood obesity: A review of the evidence

	Mouscron and Marche-en-Famenne, Belgium	Multi-level, multi-faceted, social, environmental and community intervention to reduce childhood weight	BMI: -2.2 [-4.6 - 0.3]% (p=0.058) (results weren't compared against control)	No significant change	Vinck et al., 2015 (23)	7.9
Negative findings						
	Eight European Union countries	'IDEFICS' multi-level, multi-faceted, module-based, culturally-appropriate community interventions	BMI z-scores Boys: -0.134 (p<0.001) Girls: -0.147 (p<0.001)	Increase	de Henauw et al., 2015 (24)	7.9
			Anthropometric measures of "fatness" (multiple) Body fat mass - Boys: -1.988 (p<0.001) Girls: -1.931 (p<0.001) Waist/hip ratio - Boys: 0.012 (p<0.001) Girls: 0.015 (p<0.001)	Increase		
	Colac, Australia	'Be Active Eat Well' multi-level community intervention to decrease childhood obesity and build local capacity	BMI z-scores -0.11 [-0.21 - 0.01] (p - 0.04)	Increase	Sanigorski et al., 2008 (25)	7.9
	Eight European Union countries	'IDEFICS' multi-level, multi-faceted, module-based, culturally-appropriate community interventions	Physical activity (multiple, incl. cpm/day ¹) Boys: -18.47 (p - 0.062) Girls: -8.37 (p - 0.339)	Decrease	Verbestel et al., 2015 (26)	8.3
			Sedentary time Boys: 0.70 (p - 0.175) Girls: 0.86 (0 - 0.096)	Increase		
In progress						
	Amsterdam	The Amsterdam Healthy Weight Programme	Childhood health ¹ Obesity rates: -12%	Increase	European Commission, 2018, (4) Hawkes et al., 2017 (13)	Unpublished
			Breastfeeding At 3 months: +4% At 6 months: +5%	Increase		

Whole systems approach to childhood obesity: A review of the evidence

			Sugar sweetened drink consumption Two sugary drinks: 11%	Decrease		
			Physical activity At least 1 hour activity/day: +12%	Decrease		

^Statistically significant outcomes ($p < 0.05$)

*using MINORS framework (Slim et al., 2003 (14)): as a proportion of 10; split into 'strong' (> 8.0), 'moderate' (6.5 - 8.0), 'low' (5.0 - 6.5) and 'weak' (< 5.0)

^more results, including of sub-groups, were reported, these are summary figures

Alberta, Canada - Healthy Alberta Communities Intervention

- Score: 7.9 out of 10, results: mixed (22)
- Intervention Length: 3 years
- Measurements: Pre - and 1-year post-intervention

Based on the ANGELO (Analysis Grid for Environments Linked to Obesity) framework, and linked with other intervention communities, 4 intervention communities developed their own intervention consisting of multi-level projects in physical, economic, social and political realms, with the aim of reducing risk factors for chronic disease in the population. The ANGELO framework is another socioecological model for obesity, considering micro- and macro-environmental influences across physical, economic and sociocultural environments (27). The intervention provided a framework and network within which communities could develop a specialised, local approach to health intervention, with some example interventions being an increase in fresh fruit availability, utilisation of green space for recreation and expanding community drug and alcohol programmes. Funding was provided by the central government for running the intervention and hiring local implementers. The population sampled for analysis was just under 15,000 in total between intervention and control, with controls drawn from the Alberta population excluding the intervention communities. The analysis relied heavily on self-reported figures. The results were mixed, finding:

- Decrease in physical activity against control group.
- Decrease in waist/hip ration in intervention group.
- Decrease in average BMI in intervention group, but no statistically significant difference between intervention and control.
- Decrease in fasting glucose, total cholesterol and low-density lipoprotein in the intervention group.
- Increase in sense of community belonging against control group.
- Increase in waist circumference in the intervention group.
- No statistically significant change in perceived health, household food security and fruit and vegetable consumption compared to control group.

Cambridge, USA - Healthy Living Cambridge Kids (HLCK) Intervention

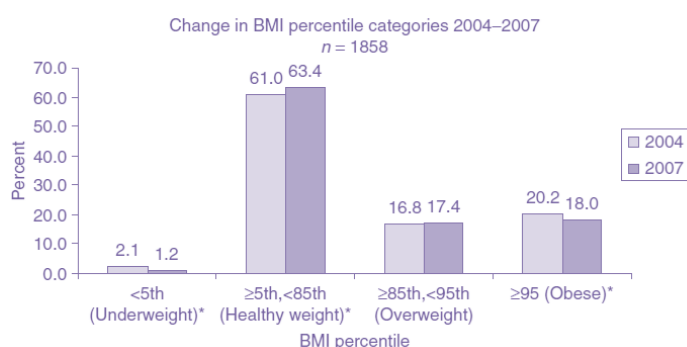
- Score: 8.1, results: positive (3)
- Intervention Length: 3 years
- Measurements: Pre- and end of intervention

The HLCK intervention took place in multiple communities in Massachusetts simultaneously, targeted at childhood health, primarily weight and physical fitness. Funding was through local government bodies. Some of the intervention actions included changing local food policy, raising awareness of community resources for physical activity, training of stakeholders to implement school-based health Programmes and individualised health reports provided to families, particularly targeting vulnerable children, such as

children already living with obesity. Review of the intervention included 1,800 children. General findings included:

- Decrease in BMI obesity prevalence by 2.2% (see Figure 4).
- Decrease in the prevalence of underweight, especially in some vulnerable subgroups.
- Increase in the prevalence of normal weight.
- Increase in all fitness scores.
- Increase in the prevalence of overweight (some of which was children moving from obesity into overweight).

Figure 1 Changes observed in weight class prevalence in HLCK intervention.(3)



Colac, Australia - Be Active Eat Well Intervention

- Score: 7.9, results: negative (25)
- Intervention Length: 3 years
- Measurements: Pre- and end of intervention

The Be Active Eat Well intervention targeted children in a single town in Victoria, comparing the outcomes with a stratified sample from the rest of the state, excluding the 30km around Colac. The intervention centred around 10 objectives for childhood health with a specific goal of building local capacity and community-developed actions to meet the objectives in the town. Actions struck across multiple realms and levels, such as advocating for school policy change to improve nutrition, promoting walking to school for physical activity, a TV power down week to reduce sedentary time, and sponsorship of multiple festivals. Funding was provided by the state government. The intervention was hindered by budgetary restrictions, such as only being able to hire part-time staff, and not being able to prolong outcome measurements, which the researchers would have liked to have done. The outcomes were mostly negative, but included some (first two points) positive findings, and included:

- Decrease in weight gain.
- Decrease in waist circumference and waist/hip ratio.
- Increase in BMI and weight, with a no statistically significant differences in prevalence of overweight and obesity between intervention and control group.
- No statistically significant difference in health beliefs, body satisfaction and stigma measures.

Eight European Union countries - IDEFICS Intervention

- Score 7.9 (26) and 8.3 (26) and 8.3 (24) , results: negative
- Intervention Length: 2 years
- Measurements: Pre- and end of intervention

The IDEFICS (Identification and prevention of dietary- and lifestyle-induced health effects in children and Infants) primary prevention Programme was a large-scale intervention across eight European Union countries (Belgium, Cyprus, Estonia, Germany, Hungary, Italy, Spain, and Sweden) to improve childhood health in multiple realms. The intervention was primarily school based, with complementary community actions, and relied on a central framework to be locally adapted and implemented in target communities, such as environmental changes to encourage active play, encouraging water, fruit and vegetable consumption at schools and setting up long-term media campaigns. Funding was from the European Commission. The intervention was quite ambitious and large, and covered many areas of childhood health in various analyses. Analysis for these two studies looked at the results of more than 16,000 children in these countries, comparing between local intervention and control communities. The results were disappointing, including:

- Increase in BMI in the pooled sample in both intervention and control with no statistically significant differences between groups.
- Statistically significant increase in measures of “body fatness” in boys.
- Decrease in physical activity.
- Increase in sedentary time.
- No overall positive effects, and seemingly better improvements in the control groups.

Geelong, Australia - Romp & Chomp Intervention

- Score: 7.5, results: positive (15)
- Intervention Length: 4 years
- Measurements: Pre-, during and 1-year post-intervention

The ‘Romp & Chomp’ community-wide intervention focussed on the health of young children carried out through day care and kindergartens and other child services to improve diet, decrease sugar intake, increase physical activity and structured play, and achieve integrated monitoring through a series of sequential campaigns in concert with local capacity-building and policy change. Funding was from multiple government agencies. The final analysis was undertaken with the Geelong sample and a matched control sample, amounting to around 40,000 children in multiple groups pre- and post-intervention. The results were mainly positive, including:

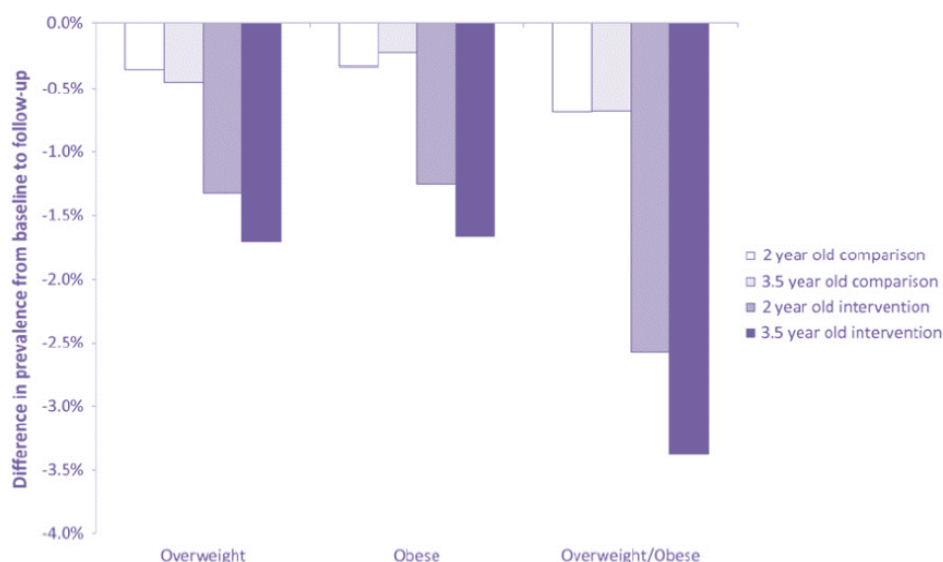
- Decrease in consumption of packaged snacks, fruit juice and cordial in the intervention group compared to control.
- Increase in servings of vegetables per day, fruit, water and milk consumption between intervention and comparison group.

Whole systems approach to childhood obesity: A review of the evidence

- Decrease in weight, BMI and BMI z-scores, which was statistically significant in the intervention group (see Figure 5).
- Decrease in screen time between intervention and control group.

However, it was also reported that weight, BMI, and zBMI increased in the 3 and half year-old intervention group, and this result was statistically significant (Figure 5).

Figure 2 Changes in overweight and obesity prevalence over two surveyed age groups in 'Romp & Chomp' Intervention.(15)



Mouscron and Marche-en-Famenne, Belgium - VIASANO Intervention

- Score: 7.9, results: mixed (23)
- Intervention Length: 3 years
- Measurements: Pre- and end of intervention

The VIASANO intervention was implemented in two towns in Belgium by targeting the population through social marketing and targeting the environmental and community by engaging local actors in a 3-year multi-level campaign. The intervention used a series of health-related campaigns, as well as distribution of healthy food and drink at events, community education and advocacy through the media, and community-based workshops. The analysis focussed on children in the community (around 1,300), and compared these with a large, equivalent sample (just under 77,000) of the French-speaking area of Belgium. Funding was provided within an ethical framework partly from the food industry. The overall results were mixed, mainly showing no effect:

- Decreased prevalence of obesity in intervention towns (which had lower prevalence at baseline), with a greater statistically significant difference after intervention in the intervention town compared to control.
- Non-statistically significant decreases in prevalence of overweight in intervention towns.
- No statistically significant results.

Somerville, USA - Shape Up Somerville Intervention

- Score: 7.9, results: positive (16)
- Intervention Length: 3 years
- Measurements: Pre- and one year prior to end of intervention

The ‘Shape Up Somerville’ community intervention was a three-year intervention to address childhood obesity. The intervention struck at multiple types of child environments, such as the family unit, school, and community, realising the limitation of exposure that a purely school-based intervention would have. Changes included school curriculum updates, farmers market initiatives, food environment improvements (some of which engaged local restaurants and private stakeholders), parental outreach, and awareness campaigns. Funding was provided by the Centre for Disease Control and Prevention, along with other local organisations. The analysis focussed on children, sampling just over 1000 children, split between the intervention community, and two equivalent control communities. Findings were generally positive, including:

- Decrease in BMI z-scores in the intervention community compared to control communities, which remained after controlling for multiple demographic factors.

Amsterdam Healthy Weight Programme

The details of the programme are presented in a European Commission report from 2018 (4) and the Obesity Policy Research Unit review of the Amsterdam Programme to highlight what can be learned from the Amsterdam Healthy Weight Programme to inform the policy response to obesity in England (13).

The Amsterdam Healthy Weight Programme started in 2013, with the goal of achieving a healthy weight for all children at a municipal level by 2033, through intervention on health inequalities, nutrition, physical activity and sleep (4). The program is universal, aiming to change the environmental drivers of obesity, but also targets vulnerable groups; children already living with excess weight or obesity, lower income or education families, and those of non-Dutch background (4). Deprived groups in Amsterdam were found to have higher Body Mass Index (BMI) scores than their least deprived counterparts (4). The overarching aim of the Amsterdam Programme is to make “the healthy choice... the normal choice”, and realising that obesity is not just an individual or parental responsibility, it is also a community responsibility (4).

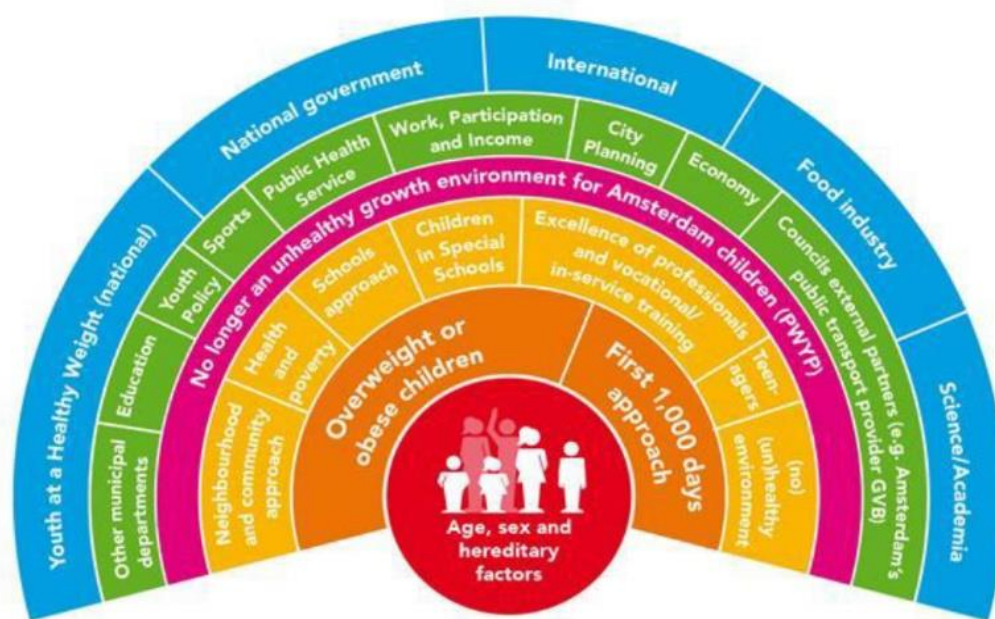
The Amsterdam Programme, like other whole systems approaches, looks to widen the intervention avenues outside of the more traditional, individualised and medically centred approaches. The formulation, and ongoing consultations, for the Programme has sought anthropological, political, education and industry advice, working to an adapted, specifically developed Rainbow Model of obesity (Figure 2). The modified Dalghren and Whitehead model was designed to identify where the intervention avenues can have an influence and where health policy can be effective, including:

- individual lifestyle factors,
- influencing social, physical and food environments, and

- influencing living and working conditions.

In this model, the individual sits in a space in the centre under the rainbow. The layers of the rainbow extending outwards speak to the multiple layers of influence that an individual is subject to, individual factors, social and community networks, and general socio-economic, cultural, and environmental conditions. While less extensive than the Foresight map, this model still illustrates the core theme; the individual sits in the middle of a wider, layered environment of influence, which are inter-linked, complex and dynamic.

Figure 3 The Rainbow Model adapted for the Amsterdam Healthy Weight Programme (4)



The interventions within the Programme worked on all different levels of the model, focussed around 10 pillars of action (13):

Preventative

1. A 'first 1000 days' approach (from the start of pregnancy until age two)
2. Schools approach (including pre-schools and primary schools)
3. Neighbourhood and community approach
4. Healthy environment approach (healthy urban design, healthy food environment)
5. Focus on teens
6. Focus on children with special needs

Curative

7. Helping children who are overweight or obese to regain a healthier weight

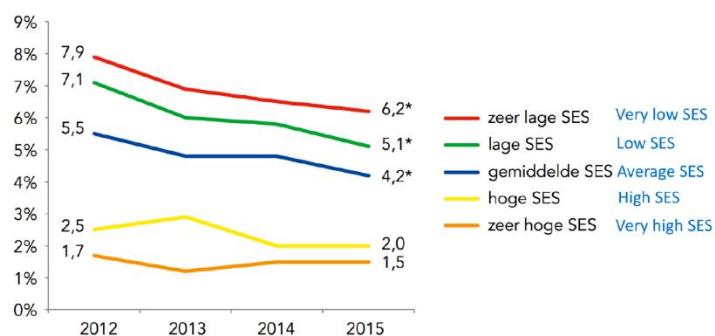
Facilitative

8. Learning and research approach
9. Use of digital facilities

10. Use of communications and methodologies for behavioural insight.

Changes were seen on the whole-city, municipal level in a concerted effort also. Municipal-level buying, licensing and sponsorship practises were reoriented with health in mind, billboard and sports advertising of unhealthy food was banned, healthier foods were introduced at sporting events with a greater than 25% expected attendance of children, industry was consulted to simplify labelling and infrastructure was upgraded, such as cycleways, pathways, and sport and play areas (4). The results of the full implementation programme are unpublished as peer-reviewed studies as of yet. The results have not undergone thorough statistical analysis neither have confidence intervals been given, therefore the causality of the changes in BMI seen so far should be treated with caution. Between 2012 and 2015 there has been a 12% drop in the prevalence of obesity from 21% to 18.5% in children as measured through public health surveillance systems (4). Low socioeconomic groups were seen to decrease their rates of obesity not only objectively, but also at a greater rate than higher socioeconomic groups with lower rates of obesity at the outset (see Figure 3) (4). Though these findings are encouraging, other unexplained negative changes were also seen, such as increased weights in some sub-groups, vulnerable ethnic groups and neighbourhoods (4). Unexpected findings such as this should spur change and adaption in Programme activities during the lifecycle of the intervention, as one of the key pillars of action in the Programme is that the intervention can reorient based on unexpected findings (4).

Figure 4 Prevalence of obesity by socioeconomic status in Amsterdam over time (15) (4)



Research has been undertaken by the London-based Obesity Policy Research Unit to assess what can be learned from the Amsterdam Healthy Weight Programme to inform the policy response to obesity in England. The components that make the Amsterdam Programme effective include:

- Strong vertical leadership
- Collaborative, cross-departmental approach
- Strategic use of power and influence
- Clear parameters and expectations
- An academically rigorous basis for action
- A culture of reviewing, monitoring and reflective action
- A creative approach to addressing barriers

Demographics

- City size - Amsterdam is large enough to influence industry and politics, but also contained enough to maintain a concerted effort.
- Prevalence of childhood obesity - Amsterdam had a higher prevalence of obesity than the rest of The Netherlands.
- Deprivation - the Programme was universally applied with a focus on deprived populations and communities, with some Programmes targeting geographically defined deprived districts.

The report makes special mention of the effect of having a charismatic and committed political leader, who was able to rally support across government sectors, with a focus on collaboration, while initially, not providing extra funding. It also mentions Amsterdam's culture of activism and community action. It indicates that it is possible that the results seen in Amsterdam so far, and even the ability to implement a plan such as the Amsterdam Programme, may be potentially location-specific, and that without strong, unifying leadership, and widespread support for social Programmes, implementation may not see the same successes in other locations as in Amsterdam. The report, however, concludes that the Programme's results warrant further investigation and piloting in other locations (13).

Features of whole systems approaches in studies reviewed

Threads of the principles of the 10 features listed by Bagnall et al. (1) can be seen through the reviewed literature. Not all studies commented on the leadership involved, but of those that did, all spoke to the importance of strong leadership to act across levels and sectors, communicate vision coherently among stakeholders and improve long-term stability and sustainability (3, 15, 18, 19). Engagement of the local community, with time to build relationships and community capacity was seen in a large number of the reviewed studies, and where seen, all studies emphasised the importance of local engagement in the success of whole system approaches (3, 15, 18, 19, 21, 22, 25). Multiple studies stated they had a formative-type phase where local relationships were built so that intervention could be more effective when implemented later (3, 21, 22). Embedded initiatives nestled within larger interventions were mentioned in near all of the analysed studies. Three studies identified the need for specific programs to target vulnerable populations (3, 17, 21). Financial support and funding were mentioned in few studies, and when it was, inadequate funding was identified as a barrier, possibly explaining the lack of expected positive results from the analysed intervention (18, 19, 25, 28). All studies used local evaluations, but none mentioned consistency of language across sectors.

Potential effect modifiers in whole systems approaches

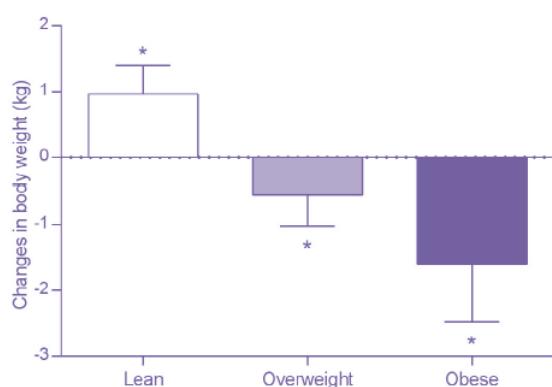
Other important points from reviewed literature that complement or expand on the factors already described include potential effect modifiers in whole systems approaches:

- Interventions may be more successful in smaller, rural communities, because of local amplification from awareness and word of mouth (18).
- Involvement of private stakeholder was cited as an important intervention, such as creating healthier food environments in Arctic Canada by involving grocery stores (21). This speaks to the larger concept of creating an environment where individuals can interact with interventions without limitation, such as fruit and vegetable availability (21, 22).
- Industry lobbying and targeting of vulnerable populations was seen as a barrier to implementation (18).
- Difficulties were found expressing vision of interventions across multiple sectors, encouraging a “vision soundbite”; a reliable, succinct idea of the overall strategy and its goals for use when communicating to potential stakeholders and sectors (19). The authors identified expressing the intervention goals succinctly was a challenge (19).
- Whole systems approaches may self-reinforce, with healthcare providers becoming more sensitised to detecting overweight and obese patients (16). Ability to recognise an overweight or obese patient has been found to be as low as 20% in healthcare providers (29).

Differences in effect on subgroups

- Less effect was sometimes seen in people of a healthy weight (Figure 6) (17, 21). This is possibly due to a degree of dismissal of interventions for weight by people of healthy weight (21). This has implications for the way programmes are framed and phrased.
- More effect may be seen in childhood interventions in children of affluent parents due to available resources (16). Less effect was seen in people of lower socioeconomic status and financial resources (21). Lack of financial resources was identified as a barrier to engaging with intervention components, including purchasing healthier foods (20). The effect of deprivation has implications for future whole systems approaches in dealing with the Social Determinants of Health that contribute to inequality, and how they affect individual ability to engage with programme interventions (25). Whole systems approaches should work across a whole system, working to deal with inequalities that were demonstrated to limit interaction with programme interventions, such as people not being able to take advantage of intervention initiatives due to personal financial issues.
- Interventions for overweight and obesity may also reduce rates of underweight (3).

Figure 5: Differences seen across different weight classes in Jaguariuna. (17)



Analysis points

- Long-term follow ups of intervention were recommended, sometimes up to 12 years (18). The follow up time between intervention and analysis was postulated to result in a lack of proof of effect in some settings (23, 26). The follow up times for the reviewed literature was usually within a year of the close of the intervention.
- From an analysis point of view, it was noted that proving quantitative changes may be extremely difficult, falsely indicating intervention failure if positive changes are not supported by data, going on to recommend that measures such as happiness and self-confidence may be better measures (22).

- Data access is essential and was associated with a possible type 1 error² in one study, where authors were unable to access detailed anthropometric data about the comparison population, only summary data, due to “administrative restrictions” (23).

Practical examples of component success in whole systems approaches

The reviewed literature adds further to the results of 2019 systematic review (1) as to how interventions can be robust in their application in practical scenarios. Highlights of the reviewing interventions are listed below. This list is non-exhaustive, but merely illustrates how the strengths identified by Systematic Review can be implemented.

Engagement of the local community

The Healthy Alberta Communities intervention in Canada was particularly strong in engaging the local community in the goals of a whole systems approach. In the formative stages of the interventions, local implementers were hired and quickly identified local resources on which to build a local framework. These implementers were able to draw in local stakeholders, and through community collaboration, were able to develop a local plan for a whole systems approach which was adapted to their local community, identifying the facilitators and barriers locally which affected individual health (22). Communities in which the intervention was implemented were also linked so they were able to share operational advice and build stronger interventions based on successes in the other communities. Local engagement in these environments is particularly important, as the involved communities had up to 10% Indigenous Canadian populations (22). Culturally-adapted programs which are locally guided have been shown to be effective in other areas of health with Indigenous populations, such as the successes of locally-developed community mental health intervention in Indigenous communities of the Alaskan Arctic (30).

Time to build relationships, trust and community capacity

The Be Active Eat Well intervention in Colac, Australia used a special focus on building community capacity to affect long-term change. The program used a framework, which was to be adapted at a local level to local needs, to advocate for strong governance, partnership, coordination, and importantly, local training. The training aimed to improve the skills of local health professionals and stakeholders so that local policy could be sustainable, scalable, progressive and flexible into the future, allowing for local reorientation in response to needs. By focussing on capacity building, the intervention was able to demonstrate a lessening of the social gradient in regard to obesity, and it was postulated that this capacity building has potential to influence to Social Determinants of Health that create disparities within communities.(25)

Appropriate partnerships for sustainable multilevel environmental change

² A type 1 error is the mistaken rejection of an actually true null hypothesis, also known as a "false positive" finding.

The Health Living Cambridge Kids intervention in Cambridge, USA was able to act on multiple levels of environmental influence to improve childhood health, partly through strong collaboration and partnerships. The intervention had multiple stages, including a 3-year formative phase and a 3-year pilot testing phase. The intervention was focussed on the health of school children, and acknowledged the layers of influence of childhood health, including the home, school and community environments. During these set-up phases, an evidence base was developed, systems put in place to survey population data, and a collaborative network built. When the intervention was fully implemented, the collaborative ties which had been built in the years leading up to implementation were able to be expanded further into the fields of welfare, infrastructure, physical activity and food environments, areas which would be outside of the realms of traditional weight interventions. This meant that during the implementation phase, multilevel change was able to be seen towards the unified goals of childhood health. By building an evidence base across multiple levels, and building collaboration, when the intervention was fully implemented, it was much more encompassing than would have otherwise been without the groundwork on which to collaborate. This multilevel environmental change was postulated to bring about more long-lasting, sustainable change, with much great post-intervention stability (3).

Embedding initiatives in broader policy context

Most of the assessed literature involved smaller initiatives within a broader policy framework. For example, the VIASANO intervention in Mouscron and Marche-en-Famenne, Belgium was a 3-year intervention which aimed to improve community and childhood health. The intervention was a series of campaigns over the implementation period, each of which focussing on a different area of childhood health. Overlaying this, there were also social marketing campaigns employed through awareness, workshops and local events to promote healthy lifestyles, and further, there were local environmental and infrastructure upgrades which looked to make environments safer for children, more attractive for physical activity and health, change social norms, and refocus social environments on health goals. The multiple implementation points, acting on multiple levels, through multiple channels all contributed towards the goal of the overarching intervention (23).

Recommendations for whole systems approaches from systematic review and review of interventions

Based on the evidence available in the reviewed literature, several recommendations are proposed to improve whole systems approaches to obesity, based on how previous interventions have been implemented. The recommendations for improvements are based on the findings of the systematic review, the reviewed interventions, and evidence to date from the Amsterdam Programme and the assessment of suitability of the Amsterdam Programme to England. While many of the reviewed interventions cover many of the following actions areas, some do not. Therefore, it is recommended that a robust intervention ideally would encompass all of the following traits.

- **Strong, ongoing, committed political leadership, which can unify goals across multiple sectors and levels:** much of the success to date of the Amsterdam Programme has been attributed to the Amsterdam Alderman's strong and charismatic leadership

- **Secure funding for the life of the Programme:** multiple Programmes identified funding restrictions or changes as inhibiting the action of the intervention
- **Long-term intervention with a focus on sustainability, building local collaboration and capacity, and relationships:** short term interventions are logically more likely to produce short term results. Time needs to be taken to build familiarity with interventions, and for stakeholder relationships to be formed
- **Acknowledgement of the wider influences on individuals across multiple levels:** individuals are subject to layers of influence in day-to-day life. Acknowledging that there is a complex system that influences individual health should be a starting point for building an intervention, with special attention to the Social Determinants of Health, and the conditions which are outside of individual control but have a strong influence on individual health and engagement with health interventions
- **Collaboration between sectors:** an intersectoral commitment, language consistency, and a unified understanding of the intervention goals, with a realisation that all sectors have a role to play in achieving intervention goals. Health should be a priority in all policy
- **Heavy community involvement:** interventions are more applicable when locally developed and guided, responding to the needs of the intervention communities and able to enact supported, locally relevant changes for the benefit of the local community. Community involvement should also focus on community capacity building, further adding to Programme sustainability by building local experience and expertise
- **Program flexibility:** the intervention should be subject to ongoing assessment with a flexibility to be able to reorient based on findings. The Amsterdam Programme has regimented flexibility, and ability to reorient in response to unexpected or underwhelming changes
- **Multi-stakeholder involvement:** not only should local communities be involved in charting their own interventions, but private actors and private enterprise should be involved, as an important factor in the environment of influence on individuals, and a significant barrier if not in mutual understanding with the intervention
- **A mix of universal and targeted interventions:** the evidence from the available literature attests that different subgroups will be affected at different levels by interventions. Therefore, interventions should mix universally applied campaigns alongside targeted actions towards vulnerable groups, with the ability to review and reorient based on observed changes
- **Programme framing and focus:** putting more emphasis on Programmes being a health intervention for all people, over, for example, an obesity intervention, may lead to less dismissal from people who see their own weight as healthy
- **Assurance of access to detailed data, and consideration of how to analyse effects:** access to data was identified as a barrier in some interventions (where detailed data could not be obtained for comparison populations), and the use of anthropometric data (such as BMI) to prove positive change was questioned, with suggestion that other psychological measures may be a better way

to measure health rather than measures such as just BMI. It should also be mentioned that multiple types of measurement should be taken, including demographic, anthropometric and behavioural, instead of relying on one main outcome

In conclusion, results to date have been mixed, but some whole systems approach interventions have shown promise in stalling and reversing rates of overweight and obesity and increasing other related measures, such as physical activity (3), sedentary behaviour (15), healthy behaviours and attitudes (18, 21), and diet and nutrition (15, 17, 18). Some trials have been on a village or community level, such as in Australia (25), Belgium(23) and Arctic Canada(21). Some are on larger town levels, such as in Latin America (17), United Kingdom (19) and the United States (16). Some are on a city level, such as Amsterdam (4). There are examples in the UK where local councils have built ‘systems thinking’ into local or state health policy (19).

Though the individual approaches in whole systems approaches differ, there are key themes that are present in all these interventions; an awareness of the wider environment, identification of new leverage points for intervention and community-wide implementation (4). Some interventions include sub-interventions targeted at specific vulnerable groups, and some are locally adapted and owned (1). As stated, results are mixed, with interventions showing positive, nil and negative results. However, despite the ambiguity of outcomes, the successes of some of these interventions is a strong basis on which to consider the adaption of whole systems approaches in Northern Ireland and Ireland.

Development of whole systems approaches on the island of Ireland

Review of national obesity policies against the 10 pillars of the Amsterdam Healthy Weight Programme

As has already been detailed, obesity has a significant effect on the health of the population on the island of Ireland. There exists a large economic and social effect also. Obesity is treated as a health priority by both the government of Northern Ireland (and the United Kingdom) and the government of Ireland.

The Northern Ireland framework for addressing overweight and obesity, ‘A Fitter Future For All’, makes note of the contribution of the obesogenic environment and the wider social contributors of excess weight, as mentioned in the Foresight report (31). Great focus is placed on the need for cross-sectoral action (31). The latest update of this framework for the 2019-2022 period goes on to recommend further policy actions outside of traditional interventions, such as tackling food poverty, improving cycling infrastructure and encouraging breastfeeding (32). A second framework, ‘Making Life Better’, also supports the actions of ‘A Fitter Future For All’, and is the “whole system strategic framework for public health” (33).

The key obesity prevention strategy in Ireland, ‘A Healthy Weight for Ireland’ (34), draws upon the Foresight Map and the Dahlgren and Whitehead Rainbow Model in its planning (34). It is a sub-framework to the overarching ‘Healthy Ireland’ framework. Again, the importance of cross-sectoral action is emphasised, as is the need for addressing the greater inequalities that determine individual

health (34). Actions points for this policy include attention to healthy urban planning, industry engagement around food labelling and nutrition and targeting of vulnerable groups, both through aiming to rectify socioeconomic imbalance, and specific initiatives (34).

Many of the pillars that the Amsterdam Programme aims to act upon are covered within the obesity policies on the island of Ireland, though neither is one unified whole systems approach, and not with the same intensity as the Amsterdam Programme. It is important to note however that the Amsterdam Programme operates against a backdrop of national obesity prevention policies and JOGG (35), a national childhood obesity prevention programme in the Netherlands. It has also built on existing initiatives e.g. Jump-in schools programme originated in 2002.

Table 3 shows a basic overview of the obesity policies in both Northern Ireland and Ireland against the 10 pillars of the Amsterdam Programme. A similar exercise has already been performed to assess policy in England (13). It is important to note that the Amsterdam programme worked on addressing policies that were within the remit or control of the municipality. Consideration therefore needs to be given to the differences in levels of devolved responsibility and accountability, including accountability for income raising and expenditure, at local authority or municipality level in Netherlands compared with Ireland and Northern Ireland.

The obesity policies on the island of Ireland were not developed to be whole systems approaches but do provide the platform and structures for implementing local whole systems approach interventions. Other strategies in both jurisdictions also work in concert with ‘A Fitter Future for All’ and ‘A Healthy Weight for Ireland’, but without these coming under one unified policy in one discrete geographical area, they cannot be considered a whole systems approach to obesity.

Table 3: Obesity Policy in Northern Ireland and Ireland compared to the 10 pillars of The Amsterdam Healthy Weight Programme (as done previously by Hawkes et al., 2017), with basic assessment of policy applicability (based on the text of the policy)

Pillar	Northern Ireland*	Ireland
Preventative		
First ‘1000 Days’ Approach	‘A Fitter Future for All’: dedicated block of policies focussed on peri-natal and early years health, split amongst 14 action points in groups of integrated prevention, food and nutrition and promoting physical activity. Actions focus on both maternal and children health, and the environments with influence on the early years of life. Multiple policy actions are assessed by single measures, such as the outcomes of four policy action to improve maternal health are measured by changes in the BMI of expectant mothers	‘A Healthy Weight for Ireland’: There does not seem to be a specific block of policies related to the first 1000 days of life. However, development of Programmes for healthy eating for expectant mothers and infants is a policy action point, as is supporting the breastfeeding action plan
School approach	‘A Fitter Future for All’: the majority of action points in the “Children and Young People” policy block specifically relate to the school environment, with 10 out of 23 making mention to school-based	‘A Healthy Weight for Ireland’: embedded multi-sectoral action is one of the key pillars of the policy, and within this a “whole-of-school” approach is taken to the development of healthy lifestyle

Whole systems approach to childhood obesity: A review of the evidence

	changes, in addition to others references environments where young people spend time and choices related to school, such as extra-curricular physical activity	Programmes within the life of the policy. Stated focus areas include school curricula, physical activity and nutrition. Implementation points also include anti-stigma training for teachers and provision of clean water for school children
Neighbourhood and community approach	'A Fitter Future for All' : though there are few references to the effect of neighbourhoods and communities and their effect on health independent of the physical and built environment, policy intervention action points aim to intervene at a local community level to reduce the obesogenic factors present in communities. For example, one point aims to improve child access to local community facilities for physical activity	'Healthy Ireland' : a policy action as part of “empowering people and communities” is to promote “activity friendly environments” at a community level through infrastructure changes and engagement with local stakeholders at a local level. Alongside this, various vulnerable populations are targeted to improve access to community life and economy, such as older people. These interventions are not specific to obesity however
Healthy environment approach	'A Fitter Future for All' : the background laid out within the policy document talks to the significance of the physical and built environment on health, and the contribution of the obesogenic environment on individual health. Policy action points refer to this, with actions aiming to make physical environments more accessible, healthy and enjoyable, such as improving access to private and public land and pushing for an Active Travel Strategy, which has since been published under the Department for Regional Development	'A Healthy Weight for Ireland' : the influence of environment is emphasised through the policy text, and multiple policy action points relate to the obesogenic environment and regulation for healthier environments. Policy actions include support and guidelines for urban planning, labelling and calories posting, and updated advertising codes
Focus on teens	'A Fitter Future for All' : multiple references are made to interventions targeting “children and young people”, but specific mention of interventions especially targeted at teenagers is not mentioned	'A Healthy Weight for Ireland' : consultation was undertaken specifically with older children and teenagers in drafting the policy, and while the findings of the consultation are described, there seems to be limited reference to these findings in policy actions, though it would be assumed the results of consultation were considered in drafting policy actions
Focus on children (or people) with special needs	'A Fitter Future for All' : mention is made throughout the document around the higher risk of obesity that people with disabilities live with, but no identified adapted intervention is forthcoming for people living with disabilities 'Making Life Better' : makes mention of tailored support to children with disabilities	'A Healthy Weight for Ireland' : It is mentioned that people with disabilities are more at risk of becoming obese. Further, specific mentioning of people with disabilities is done in Steps related to ‘mobilising health services with a focus on prevention’ and ‘develop a service model for specialist care’
Curative		
Helping children (or people) who are overweight to	'A Fitter Future for All' : the initial 'A Fitter Future for All' framework states one of its' aims is to improve obesity management, yet the policy actions for this outcome are	'A Healthy Weight for Ireland' : development of a service model for specialist management of childhood and adult obesity is one of the 10 steps of

Whole systems approach to childhood obesity: A review of the evidence

regain healthy weight	narrow, such as reviewing the recommendations of the cardiovascular framework and the Department of Health and Social Care identifying and providing appropriate interventions to at risk individuals (different policies for young people and adults). However, this outcome is not present in the latest update of the policy. One of the policy actions in the latest update of the policy is to investigate the feasibility of an adult weight management Programme	policy implementation. Within this, ensuring geographic equity of service through an integrated service model and appointing a clinical lead for obesity are specified. A brief intervention model for healthcare professions, and linked to university and training centres integrates chronic disease prevention into learning, which are policy actions of the overarching policy 'Healthy Ireland'
Facilitative		
Learning and research approach	'A Fitter Future for All' : the main policy is broken into four policy blocks, dealing with different stages of the life cycle, except for the final block, which focuses on "Data and Research". While the initial stages of the policy made non-specific recommendations without quantitative outcomes, subsequent policy updates are more specific such as reviewing industry uptake of labelling guidelines and developing a text messaging system for postpartum mothers. The outcomes remain non-quantitative however.	'A Healthy Weight for Ireland' : the final of the 10 steps for implementation of the 'A Healthy Weight for Ireland' policy is to "research and review". Within this policy block, 11 separate actions are proposed for surveillance and monitoring, investigating Programme efficacy, investigation new pharmacological interventions, building research capabilities and reviewing the effects of the 'A Healthy Weight for Ireland' policy
Use of digital facilities	'A Fitter Future for All' : the use of digital facilities is not a specific pillar of the actions throughout the 'A Fitter Future for All Policy', however, the initial policy and subsequent policies stating policy actions that push for electronic surveillance and monitoring, robust "live" electronic databases, use of text messaging and increasing the scope of health-related electronic learning	'A Healthy Weight for Ireland' : the policy refers to the use of social media in communication strategies. Multiple types of surveillance activities are proposed, and although not overtly stated to be electronic, the scope of their audience (for example, GPs), would suggest that these would be digital. 'Healthy Ireland' : improving surveillance, data sets, data reporting and dissemination are part of the 'Healthy Ireland' framework, but are not specific to obesity
Use of communications and methodologies for behavioural insights	'A Fitter Future for All' : multiple policy action points throughout the 'A Fitter Future for All Policy' focus on behavioural insights and change, and how to achieve positive attitudinal and behaviour changes in the target population. Policies look to change behaviours within the environment, such as improving healthy food access and decreasing unhealthy food availability, making environments more attractive for physical activity, and information and education provision to new families to promote early life health. Some of these actions refer to the communication and methodological aspects of how these actions will be achieved, such as assigning ownership of infant nutrition advice to health care professionals, and early life nutritional knowledge and practical abilities to Early Years settings. There is also a cross-over	'A Healthy Weight for Ireland' : the use of a "clear communications strategy" is one of the 10 anchoring steps in implementing the 'A Healthy Weight for Ireland' policy framework to "inform and empower change". Special note is made of the use of social media. In reference to behaviour changes and insights, multiple surveillance efforts regarding different health-related activities are proposed, though they do not specify that these relate to behaviours, but more the outcomes of behaviours. Parental Programmes relating to healthy lifestyles and behaviours is an action point specified and focussed on young people. Encouraging joint proposals to incentivise healthy behaviours is also a policy action point

	between 'communications and methodologies for behavioural insights and the previous pillar of 'use of digital facilities'	
--	---	--

Note: the Amsterdam Programme has a child focus, whereas these policies are whole-of-society focussed. Where possible, relevant child-focussed policy was used preferentially in the above table

*Focus was kept on policies in Northern Ireland, exclusive of UK policies

The policies in both jurisdictions are multi-faceted, multi-level, inter-sectoral and greatly acknowledge the inequalities in society and the vulnerability of sub-groups, such as people living with disability and teenagers. Both strongly rely on strong scientific evidence to inform their policies and have an inbuilt mechanism i.e., assessment components by which to refine programs into the future. Both jurisdictions propose wide-arching changes to the environments in which people live, with a special focus on reducing the obesogenic nature of these environments. Policies in Northern Ireland and Ireland are strong, and cover most of the Ten Pillars set out in the Amsterdam Programme, however, not within one intervention, but fractured across multiple smaller jurisdictions, initiatives, and policies. For example, Northern Ireland has mechanisms by which children living with excess weight can be referred to specialist services, though these do not seem to be built into the central obesity policy. Nor does a special focus on people with disability, despite the policy wording mentioning the disparity in prevalence of obesity between people living with and without disability (31) Similarly, in Ireland, the use of digital facilities is a given, but is not explicitly stated in the central policy. Increasing digital infrastructure and data collection mechanisms is a part of other policies not focussing on obesity, such as Project Ireland 2040 (36). There was no explicit mention of teenager obesity initiatives in the central policy, though this policy would inevitably include teenagers. No actions targeting people with disabilities could be found in these policies.

It is important to reiterate that this exercise considered only the obesity policies in both jurisdictions. Given the breadth of the whole systems approach and the multiplicity of stakeholders it would be necessary to consider the development of whole systems approaches through the lens of a wider policy set. Such policies include the First 5 Strategy for Babies, Young Children and their Families 2019-2028 (37), Wellbeing Policy Statement and Framework for Practice 2018-2023 (38), Framework Policy for Local Community Development in Ireland (39), Framework for The National Healthy Childhood Programme (40) Children and Young People's Strategy (2019-2029) (41), and Children's Services Co-operation Act 2015 (42) in Northern Ireland.

Factors to be considered in developing whole systems approaches in Northern Ireland and Ireland

Whole systems approach to obesity on the island of Ireland must be considered in the context of the separate governance and organisational infrastructure in Northern Ireland and Ireland. A whole systems approach is possible in either jurisdiction or the results could potentially reduce the burden that obesity places on society, however, there are multiple local factors pertaining in both jurisdictions that would need to be considered. Given that the literature did not reference whole systems approaches that were

Whole systems approach to childhood obesity: A review of the evidence

taken at a national level it would be appropriate to develop pilot approaches in towns, cities, or regions on the island of Ireland in the first instance.

There are multiple factors that lend Northern Ireland or Ireland to being a favourable environment for Whole systems approaches:

- **Geography:** government areas are discrete and area relatively small, meaning organisational and infrastructure changes, and any prospective social marketing campaigns, would be able to reach most of the population of an area.
- **Current policy:** current policies in both jurisdictions already cover many of the pillars of whole systems approaches in other locations. Adapting these to a specific local environment would not be as difficult as in other locations where there is less experience with multi-level health intervention. Any prospective policies should complement current policy, and not compete with it.
- **Food environments:** there has already been efforts in both Northern Ireland and Ireland to improve food environments and to ensure access to a variety of fresh food and vegetables, as well as placing taxes on sugar sweetened beverages.
- **Relationship with private enterprise and legislation around industrial lobbying:** both jurisdictions have laws regulating industrial lobbying (43, 44).

Factors that need to be taken into consideration when developing future whole systems approaches in Northern Ireland and Ireland include (but are not limited to):

- **Political structure and lesser role of visible leadership at a municipal/town/city/county level in some regions.** For Whole systems approaches to work, a publicly visible leader is a very important aspect, one who has a long enough tenure to be able to drive the approach. For example, the less public visibility of the Belfast or Dublin Lord Mayors compared to the Amsterdam Alderman (see organisational charts below), and their short tenure (1 year in IOI versus 4 years for an Alderman), and largely, ceremonial, roles. It is important to note that the Chief Executive of the Local Authority in an island of Ireland context is the person with executive powers most aligned to that of City Mayors in Europe.
- **The need for policy alignment and strong leadership over multiple government organisations and structures, especially with the overlapping policies of Northern Ireland and the United Kingdom and also the overlapping local government areas in different metropolitan areas e.g.,** Figure 8 illustrates that the city of Dublin is overlaid by five council areas.
- **The need for local approaches, tailored to local needs of the community, coupled with adequate political power to influence larger regional and national policy and private stakeholders.** Approaches need to be adapted at a local level and involve local communities, with funding allocated at a local level so that communities and regions can determine how best to respond to local needs, not merely as an extension of larger urban areas, for example Belfast and Dublin have very different needs compared to more regional and rural areas.

Whole systems approach to childhood obesity: A review of the evidence

- Commitment to addressing health inequalities is needed for whole systems approaches to be successful as those who bear experience the greatest health inequalities are not able to fully realise their potential.
- Unified understanding of the goals of any interventions between stakeholders and sectors, with consistency of language across departments and sectors.
- Need for ongoing, reliable funding.
- Targeted, culturally appropriate interventions to vulnerable communities, such as socioeconomic groups that experience disadvantage, people living with disabilities, migrants, Travellers and Roma (3, 4, 17, 21).
- Long-term effort and goals that not only realise the length of time taken to see positive changes, and the duration needed to make widespread changes in infrastructure, but also the time taken to build intersectoral bonds and collaborative effort between organisations. Whole systems approach in other countries have taken up to 12 years before appraisal. Ideally, a Whole systems approach would be viewed as a permanent policy, not a time-bound intervention to achieve a certain benchmark.
- Need for community involvement and civic engagement to guide and develop local interventions.
- Programme flexibility that can detect unexpected or underwhelming results, and possibility to quickly reorient Programme interventions This would require monitoring and evaluation that can detect this at early stage and allow for flexibility in redirection.
- Health system and public health system capacity, as these both impact the systems that influence individual health. Influential factors include the strength and visibility of health promotion messaging, ability to receive primary and specialist health care, wait times and service access and availability, especially in rural areas.
- Data collection systems, which consider the availability and reliability of current data and the influence of personal consent and GDPR regulations.

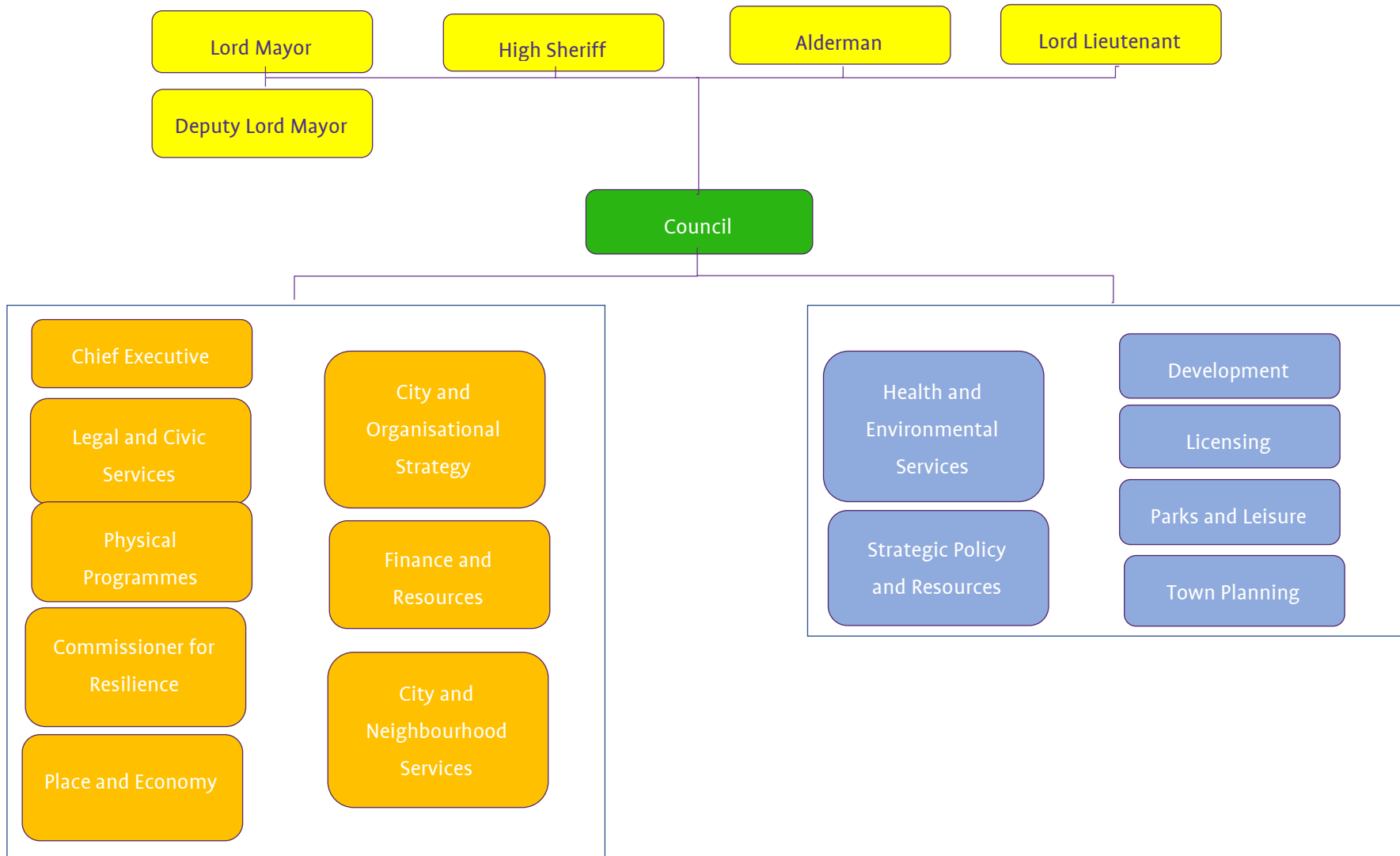
Any whole systems approach needs to involve most sectors and departments of local government. The implementation of the approach needs to be adapted to be relevant to the specific geographical area, as delegation of responsibility varies between town, municipality, county, region, and country levels. However, a sensible initial step may be piloting of a whole systems approach/es in one or a few specifically chosen areas in each jurisdiction. This is due to the complexities of the political and governance systems on the island, and the fact that no other Whole System Approaches have been undertaken at a country level. The evidence of efficacy from Amsterdam and other programmes is equally relevant to both Northern Ireland and Ireland. Like the exercise carried out by the Obesity Policy Research Unit in the United Kingdom, potential areas in both jurisdictions would need to be chosen based on demographics, size, access to funding, local resources, and presence of potentially strong leadership. The implementation would need to be locally relevant, but also generalisable to other locations.

Whole systems approach to childhood obesity: A review of the evidence

Table 2 presents the obesity policies mapped against the 10 pillars identified in the Amsterdam Programme. These policies should also be mapped out against the services and initiatives available in any chosen area for a Whole systems approach. Some consideration should also be given to the existing island of Ireland based networks and structures and how they could act as a platform for shared learning and supports across the island. These include the North South Ministerial Council and organisations that work throughout the island such as **safefood** and Institute of Public Health, and networks such as the All-island Obesity Action Forum and the All-island Food Poverty Network.

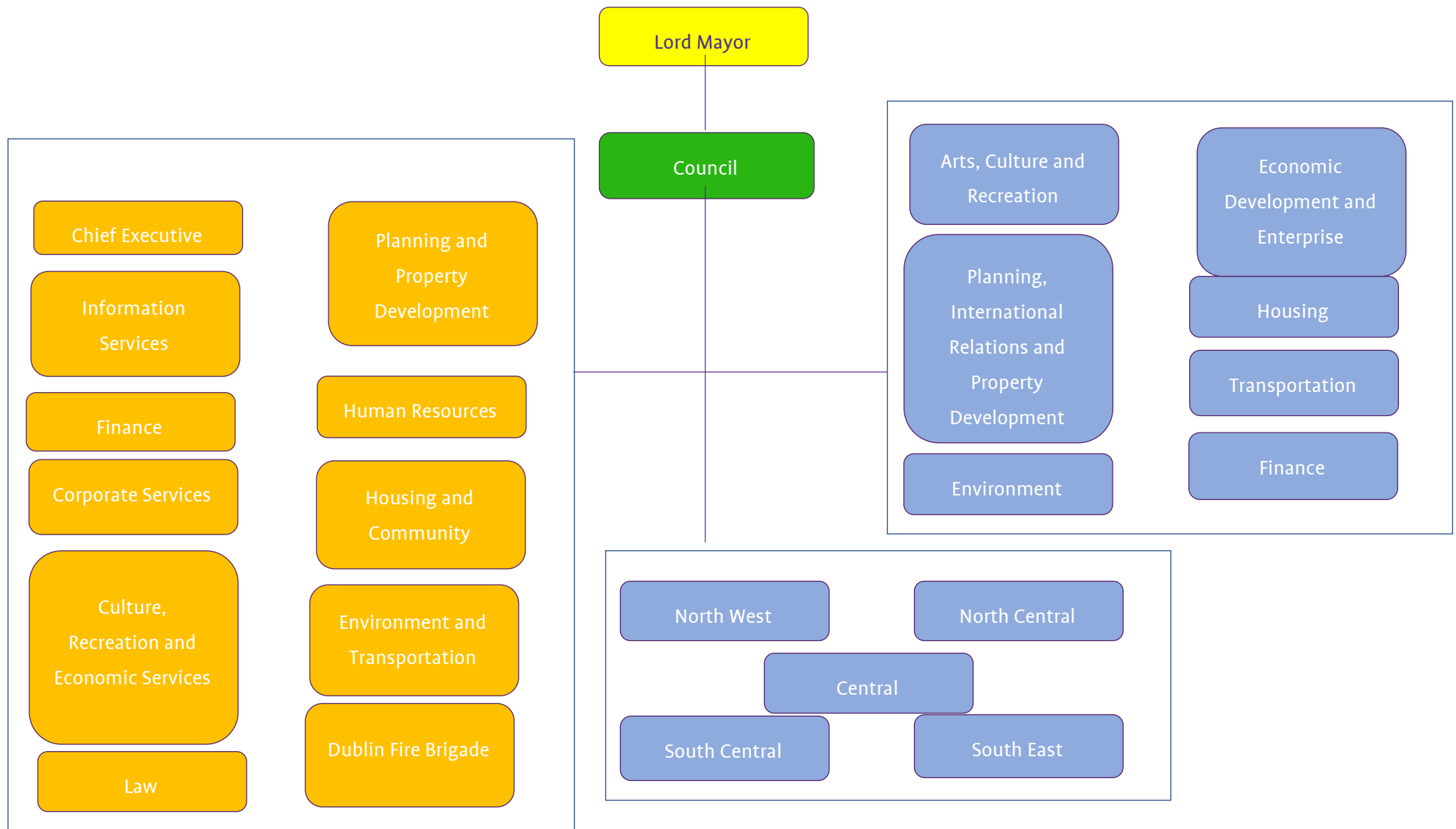
Figure 7 and Figure 8 (present two examples of local government structures on the island of Ireland, Belfast City Council and Dublin City Council, respectively. These structures illustrate the complexity of the infrastructure that need to be considered in the context of developing whole systems approaches (References in Appendix 2).

Figure 7: Example of organisational structure of Belfast City Council



Whole systems approach to childhood obesity: A review of the evidence

Figure 8: Example of organisational structure of Dublin City Council



4 Conclusion

Whole systems approaches to obesity have the potential to improve public health. The literature shows that there are certain criteria that need to be met to improve the chance of success of a whole systems approach:

1. Strong leadership and full engagement of all partners is key for success.
2. Engaging the local community is an important component of a successful approach.
3. Creating successful outcomes requires time to build relationships, trust, and community capacity.
4. Good governance and shared values (results in more participation and intersectoral action).
5. Appropriate partnerships are important to create sustainable multilevel environmental change.
6. Consistency in language across organisations (can overcome differences in organisational beliefs and structures).
7. Embedding initiatives within a broader policy context (helps to integrate and align initiatives).
8. Local evaluations (are important and inform effectiveness of local-level interventions).
9. Sufficient financial support and resources (were identified as essential and lack of resources identified as a barrier to successful implementation).

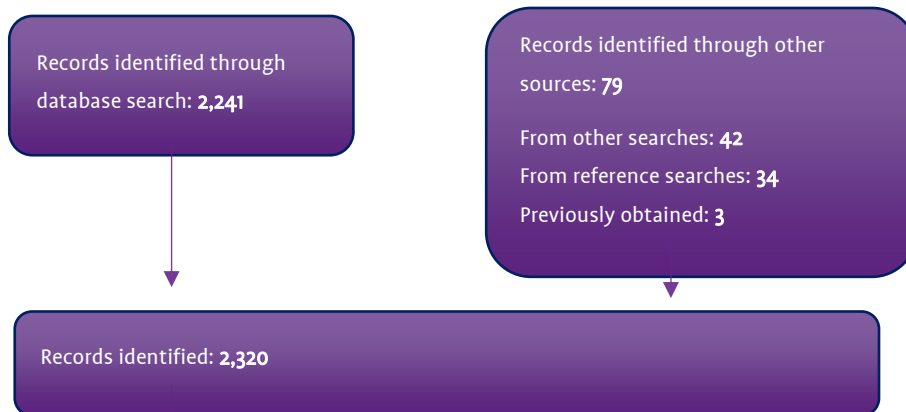
The whole systems approaches would need to be adapted to the context in Northern Ireland and Ireland, with consideration of these factors.

Although whole systems approaches are resource-intensive, require strong political leadership and unity, demand a high degree of collaboration, need to have a long-term vision and goals, and need a large degree of stakeholder engagement, they show promise in improving the lives of the people on the island of Ireland and people living with obesity, as well as likely being cost-effective.

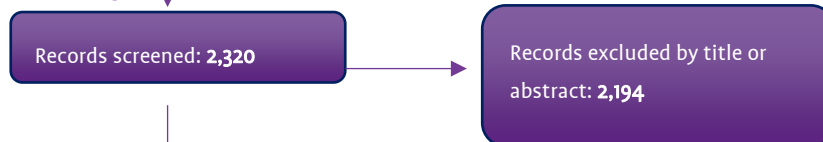
The evidence to date supports whole systems approaches as worthy of further development in Northern Ireland and Ireland. This would likely be a long-term approach, requiring strong evidence-base, evidence, data collection systems and relationship building and a strong commitment to reduce the health inequalities. The consideration of whole systems approaches on the island needs to be framed in the context of the two separate jurisdictions with separate political and government systems. Though there would be multiple factors that would mean that local Programmes would need to be innovative and adaptive, whole systems approaches could make a difference to the quality of life and health of the population on the island. Global evidence shows there is potential for whole systems approaches to work on the island of Ireland.

Appendix 1 Results of database searches and inclusion steps

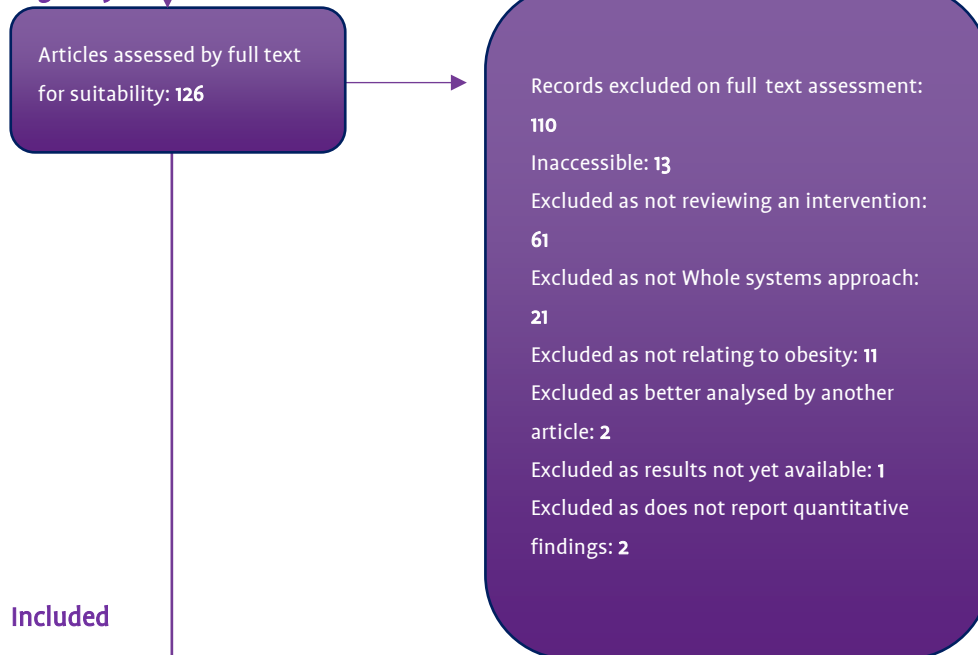
Identification



Screening



Eligibility



Included



Appendix 2 References for organisational structure maps for Ireland and Northern Ireland

Northern Ireland

Department of Health, Social Services and Public Safety. Framework Document. 2011. Retrieved June 15, 2020, from: <https://www.health-ni.gov.uk/sites/default/files/publications/health/dhssps-framework-document-september-2011.pdf>

NI Direct. The Northern Ireland Executive [website]. Retrieved June 15, 2020, from: <https://www.nidirect.gov.uk/articles/northern-ireland-executive>

Public Health Agency. PHA Structure [website]. 2020. Retrieved June 15, 2020, from: <https://www.publichealth.hscni.net/pha-structure>

Ireland

Department of Housing, Planning and Local Government. Local Government Structures and Functions [website]. 2019. Retrieved June 15, 2020, from: <https://www.housing.gov.ie/local-government/administration/local-government-administration>

Gov.ie. About the Department of Health [website]. 2019. Retrieved June 15, 2020, from: <https://www.gov.ie/en/organisation-information/7d70f7-about-the-department-of-health/>

Gov.ie. Departments [website]. 2018. Retrieved June 15, 2020, from: <https://www.gov.ie/en/help/departments/>

Belfast City Council

Belfast City Council. Belfast City Council structure. *Belfast City Council*. 2020. Retrieved June 23, 2020, from: <https://minutes3.belfastcity.gov.uk/documents/s84320/Appendix%206%20-%20BCC%20Management%20Structure.pdf>

Wikipedia. Belfast City Council [website]. 2020. Retrieved June 23, 2020, from: https://en.wikipedia.org/wiki/Belfast_City_Council

Dublin City Council

Dublin City Council. Council Departments [website]. Retrieved June 23, 2020, from: <http://www.dublincity.ie/main-menu-your-council-about-dublin-city-council/council-departments>

Dublin City Council. Publication Scheme: Guide to the functions, structure and records of Dublin City Council. 2016. Retrieved June 23, 2020, from: <https://www.dublincity.ie/sites/default/files/content/YourCouncil/InformationRights/PublicationScheme/Documents/FOIPublicationScheme2016.pdf>

References

1. Bagnall AM, Radley D, Jones R, Gately P, Nobles J, Van Dijk M, et al. Whole systems approaches to obesity and other complex public health challenges: a systematic review. *BMC Public Health*. 2019;19(1):8.
2. Social Care Institute for Excellence. The participation of adult service users, including older people, in developing social care: Whole systems approach 2007 [Available from: <https://www.scie.org.uk/publications/guides/guide17/wholesystems.asp>].
3. Chomitz VR, McGowan RJ, Wendel JM, Williams SA, Cabral HJ, King SE, et al. Healthy Living Cambridge Kids: a community-based participatory effort to promote healthy weight and fitness. *Obesity (Silver Spring)*. 2010;18 Suppl 1:S45-53.
4. European Commission. Health Equity Pilot Project (HEPP): Amsterdam Healthy Weight Programme. Netherlands; 2018.
5. Butland B, Jebb, S., Kopelman, P., McPherson, K., Thomas, S., Mardell, J., Parry, V. Foresight report: tackling obesity: future choices-project report. London: Government Office for Science; 2007.
6. Department of Health. Healthy Ireland: Summary Report 2019. 2019.
7. Department of Health. Health Survey (NI): First Results 2018/19. Information Analysis Directorate. 2020.
8. World Health Organization. Childhood Obesity Surveillance Initiative: Highlights 2015 - 2017. 2018.
9. Safefood. What are the estimated costs of childhood overweight and obesity on the island of Ireland? . 2017.
10. Safefood. The cost of overweight and obesity on the Island of Ireland: Executive Summary. 2012.
11. Mitchell L B-SS, Stanley I, Hegarty T, McCann L, Mehegan J, Murrin C, Heinen M, Kelleher, C. The Childhood Obesity Surveillance Initiative (COSI) in the Republic of Ireland - Findings from 2018 and 2019. 2020.
12. Public Health England. Sugar reduction: Report on progress between 2015 and 2018. 2019.
13. Hawkes C, Russell, S., Isaacs, A., Rutter, H. & Viner, R. What can be learned from the Amsterdam Healthy Weight programme to inform the policy response to obesity in England? : Obesity Policy Research Unit; 2017.
14. Slim K, Nini, E., Forestier, D., Kwiatkowski, F., Panis, Y. & Chipponi, J. Methodological Index for non-randomized studies (MINORS): Development and Validation of a new instrument. *ANZ J Surg*. 2003;73(9):712-6.
15. de Silva-Sanigorski AM, Bell, A.C., Kremer, P., Nichols, M., Crellin, M., Smith, M., Sharp, S., de Groot, F., Carpenter, L., Boak, R., Robertson, N., Swinburn, B.A. Reducing obesity in early childhood: results from romp & chomp, an Australian community-wide intervention program. *American Journal of Clinical Nutrition*. 2010;91(4):831-40.
16. Economos CD, Hyatt RR, Goldberg JP, Must A, Naumova EN, Collins JJ, et al. A community intervention reduces BMI z-score in children: Shape Up Somerville first year results. *Obesity (Silver Spring)*. 2007;15(5):1325-36.
17. Atalla M, Pinto AJ, Mielke GI, Benatti FB, Gualano B. Impact of a Real-World Lifestyle Intervention in an Entire Latin American City with More Than 50,000 People. *Obesity (Silver Spring)*. 2019;27(12):1967-74.

18. Bell L, Ullah S, Leslie E, Magarey A, Olds T, Ratcliffe J, et al. Changes in weight status, quality of life and behaviours of South Australian primary school children: results from the Obesity Prevention and Lifestyle (OPAL) community intervention program. *BMC Public Health*. 2019;19(1):1338.
19. Copeland R, Moullin, M., Reece, L., Gibson, D., Barrett, D. Sheffield - Let's Change4Life: A Whole Systems Approach to tackling overweight and obesity in children, young people and families. A local evaluation report. Sheffield: Sheffield Hallam University; 2011.
20. Gadsby EW, Hotham S, Eida T, Lawrence C, Merritt R. Impact of a community-based pilot intervention to tackle childhood obesity: a 'whole-system approach' case study. *BMC Public Health*. 2020;20(1):1818.
21. Mead EL, Gittelsohn J, Roache C, Corriveau A, Sharma S. A community-based, environmental chronic disease prevention intervention to improve healthy eating psychosocial factors and behaviors in indigenous populations in the Canadian Arctic. *Health Educ Behav*. 2013;40(5):592-602.
22. Raine KD, Plotnikoff R, Schopflocher D, Lytvyak E, Nykiforuk CI, Storey K, et al. Healthy Alberta Communities: impact of a three-year community-based obesity and chronic disease prevention intervention. *Prev Med*. 2013;57(6):955-62.
23. Vinck J, Brohet C, Roillet M, Dramaix M, Borys JM, Beysens J, et al. Downward trends in the prevalence of childhood overweight in two pilot towns taking part in the VIASANO community-based programme in Belgium: data from a national school health monitoring system. *Pediatr Obes*. 2015;11(1):61-7.
24. De Henauw S, Huybrechts I, De Bourdeaudhuij I, Bammann K, Barba G, Lissner L, et al. Effects of a community-oriented obesity prevention programme on indicators of body fatness in preschool and primary school children. Main results from the IDEFICS study. *Obes Rev*. 2015;16 Suppl 2:16-29.
25. Sanigorski AM, Bell, A. C., Kremer, P. J., Cuttler, R., Swinburn, B. A. Reducing unhealthy weight gain in children through community capacity-building: results of a quasi-experimental intervention program, *Be Active Eat Well*. *Int J Obes (Lond)*. 2008;32(7):1060-7.
26. Verbestel V, De Henauw S, Barba G, Eiben G, Gallois K, Hadjigeorgiou C, et al. Effectiveness of the IDEFICS intervention on objectively measured physical activity and sedentary time in European children. *Obes Rev*. 2015;16 Suppl 2:57-67.
27. Swinburn B, Egger, G., Raza, F. Dissecting obesogenic environments: the development and application of a framework for identifying and prioritizing environmental interventions for obesity. *Preventive Medicine*. 1999;29(6):563-70.
28. Gadsby EW, Hotham, S., Eida, T., Lawrence, C. & Merritt, R. Impact of a community-based pilot intervention to tackle childhood obesity: a 'whole-system approach' case study. 2020.
29. Bramlage P, Wittchen HU, Pittrow D, Kirch W, Krause P, Lehnert H, et al. Recognition and management of overweight and obesity in primary care in Germany. *International journal of obesity and related metabolic disorders : journal of the International Association for the Study of Obesity*. 2004;28(10):1299-308.
30. Rasmus SM, Charles B, Mohatt GV. Creating Qungasvik (a Yup'ik intervention "toolbox"): case examples from a community-developed and culturally-driven intervention. *Am J Community Psychol*. 2014;54(1-2):140-52.
31. Department of Health Social Services and Public Safety. A fitter future for all. Framework for preventing and addressing overweight and obesity in Northern Ireland 2012-2022. Belfast; 2012.
32. Department of Health. A Fitter Future For All: Outcome Framework Revised for 2019 - 2022.; 2019-2022.
33. Department of Health Social Services and Public Safety. Making Life Better: A Whole System Strategic Framework for Public Health. 2014.
34. Department of Health. Healthy Ireland-A Healthy Weight for Ireland, Obesity Policy and Action Plan. Dublin; 2016.
35. CHRODIS. Young People at a Healthy Weight 'JOGG' Netherlands. 2017.

36. Government of Ireland. Project Ireland 2040: National Planning Framework. 2018.
37. Department of Children Equality Disability Integration and Youth. First 5 A Whole-of-Government Strategy for Babies, Young Children and their Families 2019-2028. 2019.
38. Government of Ireland. Wellbeing Policy Statement and Framework for Practice 2018-2023. Revised 2019.
39. Department of Rural and Community Development. Framework Policy for Local Community Development in Ireland. 2018.
40. Health Service Executive Healthy Ireland. Framework for The National Healthy Childhood Programme. 2018.
41. Department of Education. Children and Young People's Strategy 2020-2030. 2021.
42. Department of Education. Children's Services Co-operation Act (Northern Ireland) 2015 [Available from: <https://www.legislation.gov.uk/ni/2015/10/contents/enacted>].
43. Transparency of Lobbying Act. Transparency of lobbying, non-party campaigning and trade union administration act UK 2014 [Available from: <https://www.legislation.gov.uk/ukpga/2014/4/contents/enacted>].
44. Government of Ireland. Regulation of Lobbying Act 2015 Ireland 2015 [Available from: <http://www.irishstatutebook.ie/eli/2015/act/5/enacted/en/html>].

safefood

7 Eastgate Avenue, Eastgate, Little Island, Co.Cork, T45 RX01
7 Ascall an Gheata Thoir, An tOiléan Beag, Co. Chorcaí, TT45 RX01
7 Aistyett Avenue, Aistyett, Wee Isle, Co. Cork, T45 RX01

Tel +353 (0)21 230 4100
Fax +353 (0)21 230 4111

Email: info@safefood.net

 [@safefood_net](https://www.facebook.com/safefood_net)

 [@safefood_net](https://twitter.com/safefood_net)

 **Helpline**
ROI 1850 404 567 NI 0800 085 1683