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Evidence Check

Addressing the social and commercial determinants of healthy weight

An **Evidence Check** rapid review brokered by the Sax Institute for Queensland Department of Health on behalf of the national obesity strategy Working Group.
October 2019

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This report was prepared by:

Sharon Friel and Sharni Goldman.

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Suggested Citation:

Friel S and Goldman S. Addressing the social and commercial determinants of healthy weight: an Evidence Check rapid review brokered by the Sax Institute (www.saxinstitute.org.au) for the Queensland Department of Health on behalf of the national obesity strategy Working Group, 2019

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List of abbreviations

CSDH	World Health Organization Commission on the Social Determinants of Health
NCD	Noncommunicable diseases
NOS	National obesity strategy
PRISMA	Preferred reporting items for systematic reviews and meta-analyses
SES	Socioeconomic status
UNDP	United Nations Development Program
VicHealth	Victorian Health Promotion Foundation
WHO	World Health Organization

Executive Summary

In this report we examine the social and commercial determinants of obesity. Dietary practices, levels of physical activity and the conditions in which people are born, learn, live, work and age are shaped by deeper social structures and processes, including economic, social and health policies and priorities; commercial policies, practices and products; the governance arrangements that develop and implement policy and action; and the cultural norms and values that pervade society.

It is within this context that we understand how choosing to eat healthy food, being physically active and maintaining energy balance requires people to be empowered to make these choices. It means that the healthy choice must be physically, financially and socially the easier and more desirable choice relative to the less healthy option. This is not always the case, particularly with decreasing social position, rendering unequal choices.

This evidence review will inform the development of a national obesity strategy for Australia and forms a companion Evidence Check review to: Sacks G, Looi E, Cameron A, Backholer K, Strugnell C et al. Population-level strategies to support healthy weight: an Evidence Check rapid review brokered by the Sax Institute (www.saxinstitute.org.au) for the Queensland Department of Health on behalf of the national obesity strategy Working Group. [1]

Review aims

The aim of the review is to synthesize the international evidence describing the social and commercial determinants of healthy eating, physical activity and obesity, and to identify effective and promising interventions focused on the social and commercial determinants of health that could be implemented in Australia to improve healthy weight. The research questions addressed by the review are:

Question 1: What social and commercial determinants have been shown to impact on healthy eating, physical activity and healthy weight?

Question 2: What population level interventions, programs or policy approaches have been shown to be effective, or are promising, in addressing the social and commercial determinants of healthy weight?

Summary of methods

The foundation for the review was the report from the WHO Commission on the Social Determinants of Health (CSDH) (2005-2008). [2] The CSDH collated the global evidence on policy actions to address the social determinants of health and health inequities, organised according to structural drivers and intermediary daily living conditions. The Review also connects with a nascent field of research and policy action, termed the commercial determinants of health, where the activities of commercial players are recognised as influencing the environments in which people eat and expend energy.

A search strategy was developed to assess the literature specifically related to the social and commercial determinants of obesity, dietary behaviour and physical activity. For question 1, studies were included if they were systematic/ scoping/ narrative reviews published between 2010 and June 2019 and examined the *associations* between social and commercial factors and the three outcomes, healthy eating, physical activity and obesity.

In question 2, studies were included if they examined the *effectiveness* of interventions related the social and commercial determinants of obesity. The evidence was supplemented with a targeted search of the primary literature, plus evidence from authoritative reports relevant to obesity prevention in Australia.

Key findings

Question 1: Associations

Thirty-two review level studies met the inclusion criteria. Determinants identified from the review were exclusively social - no commercial determinants were identified - and were classified using the CSDH analytical focus of structural drivers and intermediary daily living conditions. Fourteen articles examined the relationships between *structural* factors (*socioeconomic status, income, education, occupation, sociocultural*) and healthy eating, physical activity and obesity outcomes. Thirteen review articles focus on the relationship between peoples *daily living conditions* (*early child development; physical environment, and social capital*) and obesity, physical activity and healthy eating. The remaining five review articles contain a mix of determinants – some structural and some daily living conditions - and examine the relationship with each of the outcomes – healthy eating, physical activity and obesity.

The evidence shows that higher **socio-economic status** (either as a composite measure or separately as income, occupational status, or education) is inversely associated with obesity. This is true at the household and neighbourhood level. Higher SES neighbourhoods are positively associated with healthier eating and greater levels of physical activity in children. There is convincing evidence that the cumulative exposure to higher SES in childhood and adulthood is associated with higher leisure time physical activity among adults. **Cultural and societal norms and values** constitute an important part of the structural context in which peoples' behaviours are developed. There was very little review level evidence examining these factors in relation to obesity/healthy eating/physical activity. The one review article found that acculturation into Australian society is associated with weight gain among migrants. The **early years of life** set a critical foundation for peoples' entire life course - influencing basic learning, school success, economic participation, and social citizenry. Each of these provides skills and resources that influence dietary behaviour, physical activity and obesity. Through the Evidence Check rapid review we identified one systematic review of 15 studies focused on childcare among young children. This found that that informal childcare is associated with an increased risk of child overweight/obesity. The evidence is generally convincing that the **built environment** is important for physical active. Specifically, the evidence shows an association between adults who live in neighbourhoods with a large availability of destinations within walking/cycling distance and being more engaged in physical activity. Objectively measured distance to transit, destinations and land use measures supported this conclusion. Convenient access to greenspace is also positively associated with being physically active among children and adults. **Social participation** is defined as supportive relationships, involvement in community activities, civic engagement, and participation in decision-making and implementation processes. The review articles examined the association between different forms of social participation and obesity among adults. Most attention is given to social capital (which broadly refers to interpersonal relationships, a shared sense of identity, a shared understanding, shared norms, shared values, trust, cooperation, and reciprocity), with studies finding that area-level social capital is associated with lower levels of obesity. Social support is also associated with physical activity.

Question 2: Effectiveness

Sixteen reviews met the inclusion criteria. Thirteen distinct interventions identified from the review were classified according to their thematic determinant (*early child development & education; income; infrastructure & built environment;* and *social participation*) and key action areas (*public policy; community*

action; and skill development). For each intervention type identified in the review, evidence of effectiveness was synthesised in relation to weight/obesity; diet-related outcomes; and physical activity-related behaviour. Six of the interventions relate to **infrastructure** and the **built environment**, three focus on **early child development and education**, two on **income** and two on **social participation**. The majority of the interventions are types of public policy, with just a few related to community level action and skills development. No review-level articles were identified relating to the commercial determinants (food system commercial determinants were included in the Sacks et al. review. [1]

Almost every **infrastructure and the built environment** related intervention demonstrated positive improvements in physical activity-related outcomes. Each of these public policy interventions included the provision of light rail/rapid bus transport; transport financial incentives; increased walking and cycling infrastructure and neighbourhood design. The interventions related to walking and cycling infrastructure were also positive in terms of weight-related outcomes. The evidence related to each of the three **early child development and education** type interventions – extended duration of education; government funded holistic school programs and parenting skills programs – showed positive impacts on weight-related outcomes. The parenting programs also had positive impacts on dietary outcomes. There were two types of intervention, both public policy, which focused on **income**. The review-level evidence associated with the in-work tax credits did not show any impact on the outcomes of interest here. Food subsidy programs had a positive impact on womens dietary-related outcomes. There were mixed findings from the primary data review on the use of unconditional cash transfers (a form of income payment) and the impact on weight, although the use of a rent subsidy did have positive effects among women. The evidence related to community level actions that were concerned with building **social participation** and social capital showed positive effects on weight-related outcomes. Interventions focused on urban agriculture as a way of building community engagement had a positive effect on dietary-related outcomes. Interventions that built community engagement through participatory processes such as inclusion on community boards also had positive effects on physical activity.

Kickbusch et al. define the **commercial determinants** of health as "strategies and approaches used by the private sector to promote products and choices that are detrimental to health". [3] They go on to describe how corporate influence is exerted through four channels: i) Marketing, which enhances the desirability and acceptability of unhealthy commodities; ii) Lobbying, which can impede policy barriers such as plain packaging and minimum drinking ages; iii) Corporate social responsibility strategies, which can deflect attention and whitewash tarnished reputations; and iv) Extensive supply chains, which amplify company influence around the globe. The review-level and primary data searches did not identify literature on interventions to address these commercial determinants other than articles related to food advertising and marketing, and trade and investment. Interventions related to food advertising and marketing are captured in the Sacks et al. review. Commercial supply chains are closely connected with trade and investment policy. The review drew on a body of evidence showing how trade agreements promote foreign direct investment into various parts of the food supply chain including food processing, manufacturing, retail, and advertising. [4-6]

The review also considered the work by Buse et al. who reviewed three **models of governance** of NCD risk pertaining to the commercial determinants: self-regulation by industry; hybrid models of public-private engagement; and public sector regulation. [7] They set out a number of reforms that will be needed to improve these mechanisms, including "to strengthen its ability to consolidate the collective power of diverse stakeholders, its authority to develop and enforce clear measures to address risks, as well as establish monitoring and rights-based accountability systems across all actors to drive measurable, equitable and sustainable progress". The adoption and implementation of these recommendations would

provide a robust governance structure to ensure commercial interests do not undermine the goals of action to address obesity.

Discussion and conclusions

Empowering all people to pursue healthy eating, be physically active and maintain a healthy weight requires addressing the social and commercial determinants of health. There is a strong international call for such action to be taken to address the systemic drivers of obesity. This Evidence Check rapid review provides evidence that is applicable in the Australian context and which supports that international call.

The evidence presented in this review highlights the critical leadership and stewardship roles of the health sector in the pursuit of action on the social and commercial determinants, with many of the necessary actions located outside of health. Each of the tables below outline actions that could be championed by the health sector to prevent obesity and its social distribution. The first table is based on the limited but good quality evidence showing the positive impacts on obesity, physical activity and healthy eating through intersectoral policy action on the social determinants of health. The second table draws on the evidence related specifically to structural drivers of health that was generated through authoritative policy reports and primary data. The third table draws on seminal publications and is focused on the commercial determinants of obesity and NCDs.

Actions at the structural level are inherently aimed at addressing the distribution of money, power and resources across the population. They typically require more direct government intervention and are unsurprisingly the most difficult to evaluate (and least evaluated) for their impact on obesity, healthy eating and physical activity. That said, there were a number of education, welfare and infrastructure policies that were shown to have had positive impacts on obesity, healthy eating and physical activity. The review-level evidence shows the effectiveness of policies that focus on the social needs of people through e.g. rent subsidies and food vouchers. Other types of evidence highlight the importance of action to remediate income inequality through adequate wages and social welfare. The adequacy of welfare rates is a key issue in tackling inequities in dietary behaviours. Unemployment benefits in Australia have declined steadily compared to other benefits and to community standards regarding costs of living. Increasing the payment level for Newstart would significantly improve the equity of income distribution. The review evidence clearly shows the importance of early child development and lifelong education. Retaining students within Australias existing Year 10 compulsory education system will be critical to the prevention of obesity. Australian national and State/Territory policy has had a significant focus on infrastructure and transport. As the evidence highlights, it is vital that these policies pay attention to community liveability and active public transport rather than private vehicle use. Intervention at the daily living conditions level often occurs via settings and neighbourhoods, where actions are taken to improve access to and demand for healthy foods and opportunities to be physically active. The evidence showed a number of promising actions within schools and communities.

Suite of interventions on the social determinants of health and obesity, based on review-level evidence

Layers of influence	Examples of effective/promising actions
Structural drivers	Welfare policy (e.g. rent subsidies, food vouchers) Education policy (extended compulsory education) Infrastructure and transport policy (e.g. walking/cycling infrastructure, light rail/rapid bus transits; walking/cycling infrastructure; transport financial incentives)

Daily living conditions	Comprehensive childcare initiatives combining capacity-building, skill-building, and childcare/school policy changes Urban agriculture / community gardens initiatives Safe and clean parks and greenspace Participatory community governance (e.g. community advisory boards, multisectoral coalitions)
Individual skills development	Parental skill building programs

Plausible interventions on the structural social determinants of health, informed by authoritative reports and primary level evidence

Layers of influence	Examples of plausible actions
Structural drivers	Trade negotiations that are transparent and actively engage with health interests (including Ministries of Health and public interest NGOs)
	Integrated health impact assessment (HIA) of economic policy (e.g., HIA of the text of trade agreements as they are being negotiated)
	Adjust minimum wage levels and social protection floor according to regularly costed healthy basket of foods
	Taxation policy focused on reducing income inequality
	Participatory and inclusionary governance (better collaboration mechanisms between health and social sectors, involve people from excluded groups in the development of policies that relate to obesity prevention)
	Governments acknowledge, legitimise and support Indigenous peoples, in policy, legislation and programs that support autonomy and self-determination

Plausible interventions on the commercial determinants of health, informed by authoritative publications

Actions on the commercial determinants of NCDs	Limit the impact of commercial activities (e.g., corporate activity in marketing; lobbying; corporate social responsibility strategies and activities along the food supply chain) that promote products and choices that may be detrimental to health

Strengths and limitations

This Evidence Check rapid review followed a systematic process to search for literature on a broad range of social and commercial determinants as they related both to healthy weight and potential modes of intervention. It identified a reasonable amount of review level evidence showing the relationships between a number of social determinants and the outcomes of interest – obesity, healthy eating and physical activity. The scope of these determinants is however quite constrained, with almost nothing relating to macroeconomic factors or sociocultural values.

There were no review-level articles focusing on the commercial determinants other than those related to food systems, and these have been covered in the Sacks et al. review. [1]

The extent of review-level information on the effectiveness of actions to address the social determinants of obesity, healthy eating and physical activity (research question two) was more limited compared to the

evidence demonstrating associations (from review question one). Notably, the search did not identify any interventions relating to Aboriginal and Torres Strait Islander peoples. It would be incorrect to think that this is an area in which research and action is absent. It just does not exist in review-level evidence form. The search did not identify any interventions – beyond the food environment – that focused on the commercial determinants. This gap highlights another challenge inherent to a rapid review. The type of evidence that is being requested of such a search strategy does not lend itself well to the types of evidence that currently exist in this field. It is a relatively nascent field of research, with much of the emerging evidence focused on the conceptual development of the issues and descriptive analysis of specific commercial entities and products. It is understandable that there are no reviews existing to date of the effectiveness of actions to address these determinants.

Further limitations of the review stem from the extremely tight timeframe (5 weeks), which placed a number of restrictions on the search. Only one scholarly database was searched, and literature was limited to review-level evidence complemented by a limited targeted search of primary literature for interventions relating to review question two. We were also unable to conduct a comprehensive search of grey literature and were thus limited to the inclusion of a small number of seminal reports identified by the research team.

There are significant gaps in the Australian literature. This could be overcome through support for new research and evaluation of strategies addressing macroeconomic and socio-cultural values relating to obesity, physical activity and healthy eating, including those impacting on commercial determinants (beyond those related to the food system). Similarly, support is needed for a collaborative analysis of research on interventions and strategies (from the review, primary and grey literature) addressing healthy eating, physical activity and obesity outcomes for Aboriginal and Torres Strait Islander peoples.

Background

Reframing action on obesity: addressing the underlying social and commercial causes

Major research and policy initiatives globally have stressed the significance of social and commercial factors on population health and health equity. [2, 8-11] This is important to consider in Australia where, as in other high-income countries, health-related outcomes including obesity and non-communicable diseases (NCDs) are linked in a graded way with measures of social disadvantage. [12, 13]

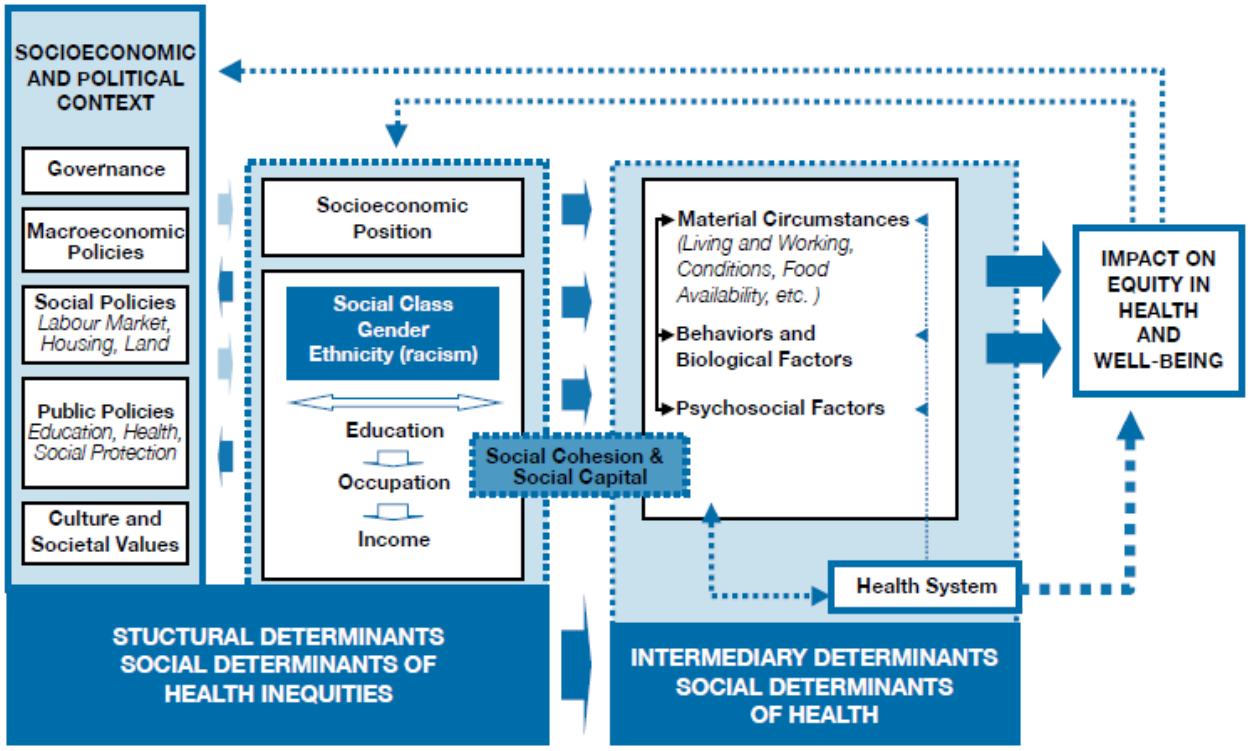
The WHO Commission on Social Determinants of Health (CSDH) demonstrated that to improve population health and reduce health inequities between and within countries required action on the social determinants of health. The CSDH developed a conceptual framework for action, describing two key layers of determinants - structural drivers and intermediary daily living conditions (Figure 1). We use this conceptual framework to guide the analysis in this Evidence Check rapid review report. The CSDH and others demonstrated that technical and medical solutions such as disease control and medical care are, without doubt, necessary for health but they are insufficient. Any serious effort to promote well-being, prevent ill-health and reduce health inequities must address the social determinants. Doing so will empower all people equally to live long and healthy lives.

Empowerment operates along three interconnected dimensions: material, psychosocial, and political. People need the basic material requisites for a decent life, they need to have control over their lives, and they need voice and participation in decision-making and implementation processes. The three dimensions of empowerment are influenced by the social determinants of health, which are defined as a system of policies, institutions and values by which society manages political, economic, social and health affairs through interaction within and among the state, civil society and private sector; the mix of economic, social and health policies and priorities, and prevailing cultural and social norms and values. These structural factors create a process of social stratification and shape the quality and distribution of peoples living conditions. Depending on the nature of these daily living conditions and practices, people are exposed differentially to health damaging or promoting risk factors, including healthy eating and physical activity. Action on the social determinants can therefore improve peoples' material conditions, psychosocial resources, and behavioural opportunities.

When launching the CSDH Final Report, Dr Margaret Chan, Director General of WHO said:

'This ends the debate decisively. Health care is an important determinant of health. Lifestyles are important determinants of health. But it is factors in the social environment that determine access to health services and influence lifestyle choices in the first place.'

Figure 1. WHO CSDH conceptual framework



The social determinants of obesity: daily living conditions

Public health approaches to obesity have given primary emphasis to the role of individuals and their eating and physical activity behaviours. Individual factors such as functional differences and personal skills can indeed facilitate (or constrain) behaviour change. [14] However, what, and how much, people eat and how they expend energy are also responses to their environments. We see this empirically through the systematic evolution, continuation and, occasionally, improvement in the levels and the distribution of obesity and related health outcomes. These data illustrate that people's ability to pursue healthy behaviour is compromised, increasingly so with decreasing social status.

Choosing to eat healthy food and being physically active requires that people are empowered to make these choices. It means that the healthy choice must be physically, financially and socially the easiest and most desirable choice to make, among all social groups. The empowerment of all social groups to live healthy lives and pursue healthy behaviours is influenced by conditions of everyday life – those daily social experiences; physical environments; financial resources, and material living conditions - which together shape how people live their lives throughout the life course. There are social inequities in daily living conditions, which lead to inequities in health outcomes. Of particular relevance to obesity, healthy eating and physical activity is the quality of the physical and social experiences in early life; access to and quality of education, particularly that of females; the nature of the built environment - how cities are planned and designed; the transport options available; the financial, psychosocial and physical conditions of working life, and the degree of social participation.

The social and commercial determinants of inequities in obesity

Promoting health equity through healthy weight also means tackling some of the fundamental economic, commercial and cultural factors (the structural determinants) that affect peoples living conditions, their daily practices and behaviour-related risks. That means dealing with matters of economic priorities; trade arrangements; foreign direct investment; fiscal policy, and the degree to which policies, systems and processes are inclusionary. In addition to these whole of government policy areas that affect obesity, the term commercial determinants of health has been used increasingly to focus attention on commercial activities [3, 7], with recognition that food and beverage companies (and others including tobacco and alcohol) – through both their market and non-market activities - are important drivers of obesity and NCDs worldwide. [7] The research community has argued that the highly processed food industries have contributed to the escalating NCD crisis globally through their products being readily available, accessible and highly desirable for human consumption. [7, 15-20] While some of this research, and associated policy attention, has focused on tools for regulating specific products such as product taxes and labelling requirements [21, 22], increasingly the commercial determinants scholars examine the strategies and tactics of these industries. Evidence is accumulating on the way the commercial actors use their structural and instrumental power to influence government and the general public, ultimately shaping the environments and social conditions in which people make choices related to food behaviours. Some of the findings show how the industries attack legitimate science, manufacture false debate through disinformation campaigns, influence political parties through corporate donations, and shape government regulation through industry representation on policy development and standard setting bodies. [23-30]

Addressing these structural determinants of obesity would not only empower individuals and communities but would also empower national governments and other key public sector institutions. For example, good regulatory frameworks create national policy space thereby enabling government to introduce policies that tackle corporate pressures such as irresponsible marketing. [31]

Policy action on the social and commercial determinants of obesity

The World Health Organization has consistently noted that to address obesity, improve diets and increase physical activity requires action on the social determinants of health through government policy and regulation across a wide range of sectors including health, education, agriculture, transport, and finance, as well as wide-scale action from the private sector and community groups. [32, 33] It is also well documented that different policy designs are required to reduce inequities in obesity. [34] These include interventions that target socioeconomically disadvantaged groups to reduce the socioeconomic gap in the barriers to healthy eating and physical activity (e.g. addressing affordability of a healthy diet); and population-wide obesity strategies that act across the entire population to improve dietary intake and increase energy expenditure, thus addressing the socioeconomic gradient in obesity.

If as a nation we want to tackle obesity and its unequal social distribution then we must tackle the social determinants of obesity, we must tackle inequality. The types of actions that are needed are actions addressing the causes and barriers to change, and actions that disrupt entrenched cycles that maintain social disadvantage and prevent ready access to healthy choices. In addition, if we want to tackle obesity we must tackle the commercial drivers that benefit from creating the environments in which obesity flourishes. However, a disconnect remains between policy recommendations that are based on public health messages about maintaining a balanced calorie intake, eating healthily and being physically active and the daily realities for people and communities to pursue those recommendations. This is especially true for communities living in low-socioeconomic settings or who are socially excluded or discriminated against.

Yet system-wide efforts to improve the social and commercial determinants of health are yet to take root in many parts of the world including in Australia. The current policy interest in obesity prevention provides an important opportunity to redress this inaction.

Aim of the review

The aim of this report is to review the evidence base on the social and commercial determinants of health in relation to obesity prevention, and provide a summary of the current state of knowledge on population-level policies, interventions and programs focused on the social and commercial determinants of health as they relate to healthy eating, physical activity and obesity. It is intended to provide evidence-informed recommendations for promoting healthy weight in a format that will support policymakers and practitioners across Australia. The review has two specific objectives:

1. To synthesize the international evidence describing the social and commercial determinants of healthy eating, physical activity and obesity.
2. To identify promising interventions focused on the social and commercial determinants of health that could feasibly be implemented across Australia to improve healthy weight.

The research questions addressed by the review are:

Question 1: What social and commercial determinants have been shown to impact on healthy eating, physical activity and healthy weight? (associations)

Question 2: What population level interventions, programs or policy approaches have been shown to be effective, or are promising, in addressing the social and commercial determinants of healthy weight? (effectiveness)

Methods

Review approach

The rapid review method was used to review the relevant evidence. Rapid reviews are one of the evidence synthesis methods classified under the family of systematic reviews which aim to provide a broad overview of the evidence base to inform policy making. [35] Whilst rapid reviews are undertaken in a considerably shorter time frame[36], the same systematic review protocols are applied to ensure methodological rigour. This rapid review was conducted following PRISMA guidelines.

Search strategy

The foundation of the review was the recommendations of the WHO CSDH. [2] The CSDH report was developed over three years (2005-2008), with recommendations based on a global evidence synthesis and extensive consultation with academic experts in the field, WHO Members states, other UN agencies and non-government organisations. In addition to the CSDH report, the review drew on the findings and recommendations of the Marmot Review, an authoritative report for action on the social determinants of health [37] , and a 2015 VicHealth rapid review of the social determinants of inequities in healthy eating. [38]

Separate strategies were developed for the two review questions based on their aims. Specifically, the search strategy for review question 1 was designed to find evidence delineating the *associations* between various social and commercial determinants and obesity/healthy eating/physical activity. The search strategy for review question 2 was designed to find evidence on *policies, interventions* and *programs* (hereafter interventions) targeting the social and commercial determinants of health which have been shown to be effective or promising in addressing obesity/healthy eating/physical activity.

The research team developed the search strategy in consultation with a health research librarian at the Australian National University. The selection of search terms was informed by the review's foundation publications for the social determinants of health, and the commercial determinants of health conceptual model by Kickbusch et al. [3] Search terms were developed iteratively by trialling terms through scholarly databases to refine sensitivity to the target article content. The final search strategy was executed through the Scopus database. Restricting the search to a single database was a practical limitation necessitated by the short time frame (5 weeks) to conduct the review. Nonetheless, as the largest abstract and citation database of peer-reviewed research literature, Scopus provides comprehensive coverage of literature from the health, public policy and social science fields.

Search parameters for the review questions focused on four identified concepts: (i) relationships or associations (question 1); policies, programs or interventions (question 2); (ii) social and commercial determinants of health; (iii) healthy or unhealthy eating, physical activity (including sedentary behaviour) and weight status; and (iv) systematic, scoping or narrative reviews. The search was restricted to English language only publications from 2010 onwards and to searching title and abstract fields. The search strategy is detailed in Appendix 1.

To better target intervention-based literature on the social and commercial determinants of health, search terms for this concept were amended slightly from question 1 to question 2. Despite this, the bulk of literature identified in the question 2 search focused on associations between social and commercial determinants and healthy weight rather than on interventions to address determinants, or examined interventions targeting the food environment rather than structural determinants and daily living conditions. Therefore, a second phase targeted search of primary level literature was conducted based on

specific policies and interventions recommended by the CSDH/Marmot Review/VicHealth evidence review. Key terms used for this search are detailed in Appendix 1.

Search results were retrieved and screened using the reference manager Endnote. Due to time constraints, titles and abstracts for the full record of retrieved articles were screened by one reviewer (SG) against the selection criteria described below to identify a list of potentially relevant articles. This list was then independently reviewed for relevance by the second reviewer (SF) with any discrepancies resolved through discussion. This process was repeated for full-text screening to arrive at the final pool of included articles.

Inclusion criteria

The review included systematic reviews, meta-analyses, narrative reviews, literature reviews and scoping reviews. Primary studies of any research design were included in the second phase targeted search for review question 2. Studies that met the following general and review question specific criteria were included:

General

- Published from 2010 to the end of June 2019
- Published in English language
- Had a majority of included studies conducted in Australia or comparable countries (e.g. Canada, NZ, the UK, USA).

Review question 1

- Examined a social or commercial determinant other than the food environment or food system (these determinants were examined in the Sacks et al. review)
- Reported on the relationship or association between the social or commercial determinant examined and diet (healthy or unhealthy eating), physical activity (including sedentary behaviour) or weight status.

Review question 2

- Examined an intervention (policy, program, initiative) targeting a social or commercial determinant of health shown in review question 1 to impact on diet, physical activity, or weight status
- Reported on the actual or potential impact of the intervention on diet, physical activity or weight status.

Studies on a broad range of population groups were eligible for inclusion including key life stages (e.g. childhood, older adulthood) and priority populations (e.g. low-SES groups, rural communities).

Exclusion criteria

Studies were excluded if they:

1. Were non-reviews (not applicable to the second phase question 2 search)
2. Were conducted in countries non-comparable to Australia (e.g. focused on low-income countries)
3. Focused predominately on the food environment or food system (e.g. food promotion, pricing, placement)
4. Focused on population groups with specific diseases or medical conditions
5. For question 2, examined interventions that:
    - Targeted individual-level behaviour change rather than the social or commercial determinants of health
    - Focused on implementation strategies or process-related outcomes (e.g. barriers to policy implementation, satisfaction with interventions).

Additional literature

The review included seminal scholarly works on the social and commercial determinants of health known to the research team to supplement literature identified in the database search. This included: the final report of the WHO CSDH [2], the UK Marmot Review [37], the Discussion Paper of the UNDP on Addressing the Social Determinants of Noncommunicable Diseases[9] , the VicHealth Evidence Review on Addressing the Social Determinants of Inequities in Healthy Eating [38], and a conceptual framework for governing the commercial determinants of health by Buse et al. [7]

Data extraction

Data from included articles were extracted by one reviewer into a Microsoft Word form (SG), with extractions for a sample of articles reviewed by the second reviewer (SF) for quality checking. Data were extracted on the following:

- Title of the study
- Lead author
- Year published
- Study type
- Population studied
- Years studied
- Number of included studies
- Country/countries studied
- Exposure (question 1)
- Intervention (question 2)
- Outcome examined related to healthy weight
- Effects on outcomes
- Authors conclusion
- Quality of reviewed studies where reported (question 2).

In instances where studies reported the effects of exposures or interventions related to the food environment as well as other social or commercial determinants, only data on the latter was extracted. Similarly, if a study reported on other health outcomes (e.g. smoking, mental health) in addition to healthy weight, only healthy weight related outcomes were extracted.

Evidence synthesis

A narrative synthesis was conducted by one reviewer (SF) with findings reviewed by the full research team.

For question 1, findings were summarised by layer of influence (structural drivers and intermediary daily living conditions) and determinant (e.g. socioeconomic status). Due to substantial heterogeneity in healthy weight related outcomes reported, findings were synthesised as high-level outcomes: food; physical activity; and weight.

For question 2, findings were synthesised separately for review and primary level evidence. Identified interventions were summarised by determinant and type of action (public policy, settings, community action and individual skills) Interventions are also grouped as they relate to proposed strategic priorities for the national obesity strategy (provided by the Queensland Department of Health on behalf of the national obesity strategy Working Group). As the bulk of included reviews did not report an aggregated effect measure (mostly due to study heterogeneity), it was not possible to indicate the likely magnitude of effect for each intervention. Subsequently, evidence of effectiveness for each intervention and each respective outcome was assessed using the classification described in Table 1.

Table 1. Classification of evidence of effectiveness on weight, healthy eating, and physical activity related outcomes

Level of effectiveness	Description
Positive	The balance of evidence was judged to indicate a *clear positive (favourable)* effect, based on consistently positive results showing improvements in the measured outcome, in settings relevant to the Australian context.
Indicative positive	The balance of evidence was judged to indicate *that there is likely to be a positive (favourable)* effect on the measured outcome, although results from relevant studies are not consistently positive and/or the intervention has not been well-evaluated in settings relevant to the Australian context.
Inconclusive	The balance of evidence was judged to be *inconclusive*. Based on the evidence assessed, it was not possible to determine a clear direction of effect due to inconsistent findings.
Indicative negative	The balance of evidence was judged to indicate that *there is likely to be a negative (unfavourable)* effect on the measured outcome, although results from relevant studies are not consistently negative.
Negative	The balance of evidence was judged to have a *negative (unfavourable)* effect, based on consistently adverse impacts on the measured outcome, in settings relevant to the Australian context.
No effect	The balance of evidence was judged to indicate that there is likely to be *no effect* on the measured outcome.
Not assessed / Not applicable	This outcome has not been evaluated or is not applicable

Findings

Question 1: What social and commercial determinants of health have been shown to impact on physical activity, healthy eating and healthy weight?

The Evidence Check rapid review for question one draws on 32 review (systematic, narrative and scoping) articles. Studies within the included review articles were mostly from OECD countries, particularly Australia, the USA and the UK. Seventeen of the reviews relate to adults, and 7 to the general population (including children, adolescents and adults), 7 focus exclusively on children. Appendix 2. shows the PRISMA flow chart for the study selection, and full details of each of the included articles are provided in Appendix 4.

In the remainder of this section we describe the evidence organised according to the WHO Commission on the Social Determinants of Health conceptual framework for action, which contains two key layers of influence - structural drivers and intermediary daily living conditions (previously in Figure 1). Table 2. provides an overview of the review results, by layer of influence and determinant. Fourteen of the reviews are concerned with *structural determinants* (socioeconomic status, income, educational attainment, employment and sociocultural), with seven of them focused on the impact on obesity, four on physical activity and one on food. Two of the reviews examine the relationship between socioeconomic status and healthy eating, physical activity and obesity.

Thirteen review articles focus on the relationship between peoples *daily living conditions* and the outcomes obesity, physical activity and healthy eating. One article reviews the evidence on early childhood development and obesity, six articles focus on social participation and its relationship with obesity and physical activity, and six articles focus on the physical environment and obesity, physical activity and healthy eating. The remaining five review articles contain a mix of determinants – some structural and some daily living conditions - and examine the relationship with each of the outcomes – healthy eating, physical activity and obesity.

Table 2. Overview of question 1 studies by determinant and outcome

Conceptual layer	Determinant	Food	Physical activity	Weight status	All	Total
Structural (n=14)						
	SES/income	1	3	5	2	11
	Education			1		1
	Occupational status		1			1
	Sociocultural			1		1
Intermediary daily living conditions (n=13)						
	ECD			1		1
	Employment		1			1
	Social capital		2	4		6
	Physical environment	1	3	1	1	6
Mixed (n=5)		1	1		3	5

The structural determinants of healthy eating, physical activity and obesity

Most societies are hierarchical, stratified along a range of intersecting social categories, such as socioeconomic status (including income, education and occupation) and ethnicity, in which economic and social resources, including money, power and prestige are distributed unequally. Pursuit of better health and reduced inequities recognises the need to redress the unequal distribution of these resources.

Socioeconomic status

The most common relationship examined in the review articles is that of socioeconomic status (SES) and obesity. Four review articles focus on childhood obesity, finding that, overall, higher SES, at the household and neighbourhood levels, is inversely associated with obesity. Higher SES neighbourhoods are positively associated with healthier eating and greater levels of physical activity in children. Two of the reviews also show that low SES in childhood is associated with increased risk of obesity in adulthood. The evidence indicates that children from lower income households are more likely to become obese.

Two reviews identify that unhealthy eating increases in neighbourhoods with increased numbers of fast food outlets and that these are more likely in low socioeconomic status neighbourhoods. In another review, increased sugar-sweetened beverage consumption among children is found to be associated with low parental SES. Two of the reviews include healthy eating as an exposure of interest alongside physical activity and obesity. One found that higher neighbourhood SES is positively associated with healthy dietary habits. Another review examines the relationship between wage levels and fruit and vegetable consumption plus physical activity and obesity. While suggestive of a positive association between higher wages and positive health factors, the results are not statistically significant. Australian studies have indicated that families or households who are on low incomes or are welfare-dependent find it difficult to afford a healthy diet. [39] Compared with households on average or above-average income, low-income households spend a greater proportion of their money on food, although in real terms the amount spent is less. [39-41] Therefore, even if an individual or household strives for a healthy diet, there may be serious financial constraints limiting their ability to achieve this.

Four of the reviews identify associations between SES and physical activity, each finding convincing evidence that the cumulative exposure to higher SES in childhood and adulthood is associated with higher leisure time physical activity among adults. A similar finding is observed in the one review that focused on occupational status and leisure time physical activity (LTPA), with white collar / professionals showing the higher levels of leisure time physical activity compared to blue-collar workers. Long work hours appear to have a negative effect on LTPA and increased sedentary behaviour – one review found that this low level of physical activity is higher in high income jobs - and some preliminary evidence found psychosocial work demands (e.g. job strain) to be negatively associated with LTPA levels.

Education is critical for an individual's wellbeing and success in the economy, with more education associated with better labour market outcomes. Children from disadvantaged backgrounds are more likely to do poorly in school and drop out early - and subsequently as adults are more likely to have lower incomes, higher fertility, and be less empowered to provide good health care, nutrition, and stimulation to their own children, thus contributing to the intergenerational transmission of disadvantage. [42] Education is also associated with obesity. The search uncovered one systematic review that contains more than 200 studies examining the relationship between educational attainment and obesity. In 87% of the studies, in high-income countries, women with higher levels of education are less likely to be obese, and for men in high-income countries, educational attainment is inversely associated with obesity in 64% of studies. Whilst not captured as review evidence, maternal education has been shown not only to improve childrens nutritional status but it also improves school attendance. [43]

Cultural and social norms

Cultural and societal norms and values constitute an important part of the structural context in which people's behaviours are developed. Culture refers most broadly to the language and accumulated knowledge, beliefs, assumptions, and values that are passed between individuals, groups, and generations. [44]The dominant societal and cultural norms of a society lead to processes of socialisation i.e. the transfer of attitudes, beliefs, and behaviours between and within generations, and the means by which societies shape patterns of behaviour.

The only review article that examined some sort of sociocultural factor and obesity/ diet/ physical activity is the one by Alidu and colleagues [45], which reviewed the evidence on acculturation, obesity and health behaviours among migrants to high-income countries. Their systematic review found that acculturation into Australian society is associated with weight gain among migrants in the majority of studies examined.

The intermediary daily living conditions and the relationship with healthy eating, physical activity and obesity

The structural factors described above ultimately shape the nature of the daily living conditions in which people are born, live, learn, work and age, including their homes and communities, and their access to quality health care, education, work, and social safety nets. These conditions, in turn, influence healthy eating, physical activity and weight status.

Early childhood development and education

What children experience during the early years sets a critical foundation for their entire life course - influencing basic learning, school success, economic participation, and social citizenry. Each of these provides skills and resources that influence healthy eating, physical activity and obesity. Disadvantage in pregnancy and in utero effects, low birth weight and improper infant feeding, and deprivation in early childhood are associated with poor nutritional status and associated health outcomes in later life. [46] Early child development which includes not only physical and cognitive development but also social and emotional development can play an important protective role. [47]

Through the Evidence Check rapid review we identified one systematic review of 15 studies focused on childcare among young children. This found that the type of care, hours spent in care, maternal education and occupation, parental overweight/obesity, and breastfeeding are all associated with weight gain and adiposity among children. Informal childcare appears to be associated with increased risk of child overweight/obesity. This may be due to informal carers lacking childcare qualifications and being less exposed to child health advice.

As recognised by the WHO Health Promoting Schools Framework [48], the education and school setting can play an important role in positively influencing childrens health behaviours. Schools can function to socialise healthy norms around physical activity and healthy eating through the school built environment, physical activity and nutrition-related school policies, and formal and informal curricula that are health promoting. One review, a systematic review of reviews on policy determinants of physical activity across the life course, examined the relationship between school policies and physical activity. This review found that organised activities, the promotion of physical education and school sport, and longer school break times were positively associated with physical activity levels.

Employment and working conditions

The relationship between people's employment, working conditions and health is multi-dimensional. Unemployment is rarely good for one's health, but while good work is linked to positive health outcomes, enduring exposure to long or irregular hours, shift work, extended sitting and sedentary work, and

psychosocial hazards including stress and low-worker control has a corrosive effect on health and wellbeing. Only one review, a systematic review of reviews, examining the impact of working conditions on healthy weight related outcomes was identified by the Evidence Check rapid review. This found that long working hours and an inflexible working environment were negatively associated with physical activity levels.

Physical environment

The obesogenic environments concept, coined by Swinburn et al. in the 1990s [49] has been widely used to refer to neighbourhoods in which there is an overabundance of unhealthy food options and relative lack of affordable healthy food options, and in which there is a lack of opportunities or incentives for active transport and physical activity. There are six review articles that touched on this with their focus on the physical environment. Three relates to physical activity, one to obesity, one examined both and one focuses on dietary quality. The evidence is generally convincing that the built environment is important for supporting adults walking and being physically active. Specifically, the evidence shows an association between adults who live in neighbourhoods with a large availability of destinations within walking/cycling distance and being more engaged in physical activity. Objectively measured distance to transit, destinations and land use measures supported this conclusion. Convenient access to greenspace is also positively associated with being physically active among children and adults. Studies across North America consistently show that less dense, sprawling cities are positively associated with higher levels of obesity. In terms of diet quality, while many studies in the review article found a positive association between diet quality and the built environment, the results are very mixed as to which aspects of the built environment mattered.

Social participation

Social participation is defined as supportive relationships, involvement in community activities, civic engagement, and participation in decision-making and implementation processes. Four review articles examined the association between different forms of social participation and obesity among adults. Most attention is given to social capital, with studies finding that not all types of social capital are positive and that it is area-level social capital which is associated with lower levels of obesity. Social capital broadly refers to interpersonal relationships, a shared sense of identity, a shared understanding, shared norms, shared values, trust, cooperation, and reciprocity. Among the beneficial consequences of social capital is social control, the provision of family or kinship support and the benefits derived from network membership. Social capital is not without its downside, it may place excessive demands on network members; restrict individual freedom and reinforce delinquent behaviour where this is the defining characteristic of group membership.

One review article examines physical activity and social support among older adults. The evidence is not conclusive but suggests that social support provided by family members is more likely to be associated with leisure time physical activity. Social support is also found to be consistently positively associated with physical activity among adolescents, except when the support is provided by siblings and mothers.

Gaps in the evidence

There are a number of known gaps in the evidence related to the associations between obesity and its structural drivers. This is due to a lack of review-level literature focussed on these issues. While the review-level evidence consistently identified the relationships between SES and the three outcomes of interest (obesity, healthy eating and physical activity), it was relatively light on the other known structural drivers of health including macroeconomics and sociocultural values. For example, evidence exists in Australia and globally showing that trade liberalisation and the removal of barriers to foreign investment in food

manufacturing and distribution has increased the availability, affordability, and desirability of less healthy foods. [4, 50-53] The worlds food and beverage industries, including those in Australia, are dominated by multinational manufacturers and retail chains, resulting in significant changes to the nature of the food supply, with increased availability of cheap to produce processed and fast foods through the growth in food processing companies and large transnational supermarkets and fast food outlets.

Evidence associated with sociocultural factors beyond the issue of acculturation identified in the review article, shows how such factors reproduce behaviours and identities. Socio-cultural norms and values defining what is socially acceptable, desirable and appropriate to eat and feed others (as well as when, where, and in what quantities) have been shown to be important in determining diet quality.[54] Socio-cultural norms include norms around, for example, consumption of takeaway food, convenience and snack foods, as well as sugary beverages [55]; meal times, occasions, and family eating rituals [56]; eating away from the home; gender norms around food shopping and cooking, and food allocation within families and households; openness to new foods; valuing of thrift or displays of wealth and status in food purchasing; and social acceptability (or desirability) of body fat. Food industry actors proactively work to shape these norms, most visibly through advertising, but also less obviously through the increasingly powerful position of manufacturers and retailers as cultural authorities on food, nutrition, and lifestyle. [57]

While the review-level evidence identified the association between social participation and obesity risk, it did not pick up evidence on social exclusion, a known risk factor for poor health among marginalised groups in society. People with a history of homelessness, imprisonment, substance use, sex work, or serious mental illness experience much higher rates of ill-health and premature death than the general population.[58] Improving population health and preventing inequities in obesity means that all peoples must have a voice i.e. they have the right to participate, the capacity to do so, and are represented in decision-making about how society operates, particularly in relation to its effect on health, including health-related behaviours. [59]

Racism has been identified as an important structural determinant of health for Indigenous populations and minority ethnic groups. [60] At the heart of the persistent poor life expectancy, high levels of obesity, poor dietary behaviours and associated health conditions of Indigenous Australians is the relationship between racism and power. [61] Colonization imposed social, political and economic structures upon Indigenous Peoples without their consultation, consent or choice. This has happened to no other group in society. As such, Indigenous Peoples have distinct status and specific needs relative to others. Regaining personal and cultural continuity has major implications for the well-being of these communities. [62]

Question 2: What population level interventions, programs or policy approaches have been shown to be effective, or are promising, in addressing the social and commercial determinants of healthy eating, physical activity and obesity?

Question 1 identified associations between a number of societal level factors and healthy eating, physical activity and obesity. In question 2 we assess the evidence of policies and other types of actions that have and can be taken to address these social factors.

Sixteen systematic, narrative and scoping review articles are included in this analysis. Appendix 3 shows the PRISMA flow chart for the study selection, and full details of each of the included reviews are provided in Appendix 4. Studies within the included reviews are mostly from North America, Europe, and Australia. Twelve of the reviews relate to adults, two to the general population (including children, adolescents and adults), and two focus exclusively on children. Seven include effects on obesity, eight address food, and nine of them include the effect on physical activity. The report also draws on six additional academic publications identified through a primary data search plus the report from the WHO CSDH [2], the Marmot

Review, an authoritative report for action on the social determinants of health [37], and a 2015 VicHealth rapid review of the social determinants of inequities in healthy eating. [38] Each of these reports identifies common action areas in the social determinants that will improve health, reduce health inequities and prevent obesity. These include early childhood education and parenting skills; education and lifelong learning; working and employment conditions; poverty reduction and ensuring a healthy standard of living, and quality housing and built environment. As shown below, our review of reviews and primary literature identifies effective and promising interventions in many of these social determinants of health.

The review-level and primary data searches did not identify literature on the commercial determinants other than articles related to food advertising and marketing, and trade and investment. Food advertising and marketing is captured in the Sacks et al. review [1] and the trade and investment review article related to developing countries. A targeted search of authors and works related to the commercial determinants known to the review team was undertaken.

Findings from review level evidence and the social determinants of health

In synthesising the evidence from the included studies, thirteen interventions are described. Tables 3 and 4 provide an overview of the identified interventions organised by determinant and type of action. Interventions are also grouped as they relate to proposed strategic priorities for the national obesity strategy (provided by the Queensland Department of Health on behalf of the national obesity strategy Working Group and shown in Figure 2). This report focuses on the first three strategic priorities. See Sacks et al. review [1] for interventions specific to building a healthier and resilient food system.

Figure 2. Proposed national obesity strategy strategic priorities

In terms of the structural drivers of healthy eating, physical activity and obesity, the included reviews focus on education, income subsidies, and infrastructure policies. The most common intervention at the daily living condition level relate to initiatives in the built environment, followed by early child development and community level social participation.

Two of the reviews describe public policies related to **income and financial support** that would enable healthier eating and greater physical activity. Financial support at the setting level is assessed in two reviews. One review assesses the public policy evidence relating to **education** and its effects on health including weight. **Early child development** through a settings-based lens is the focus of one review. In addition, parenting skills development programs are assessed in two reviews. **Infrastructure** and the **built environment** feature strongly in the review literature. Seven review articles assess infrastructure public policies, two focus on community-level action and one on skill development. The effectiveness of community and individual level actions relating to **social participation** is assessed in three review articles. These relate mainly to building social capital, with none of the review-level evidence identifying actions that address sociocultural factors and issues of discrimination.

Table 3. Overview of review-level interventions by determinant and type of action

Determinant	Action area				* NOS proposed priority area	Total
	Public policy	Settings	Community action	Individual skills	A: Supporting children & families B: Mobilising people & communities C: Enabling active living	
ECD & Education	1	1		1	A; B	3
Income	2				A; B	2
Infrastructure & Built environment	7		2	1	B; C	10
Social participation			2	1	A; B; C	3
Total	10	1	4	3		

Note: some of the reviews included multiple types of intervention, hence the column and row totals are not the same as the total number of review level articles. *NOS = national obesity strategy

Findings from primary-level data sources

Six relevant articles were identified through an additional targeted search of primary level data. Five of the six papers are from North America, one from Denmark and one from Australia. The articles focus on interventions that address the social determinants of healthy eating, physical activity and obesity. The papers relate to public policy associated with income, infrastructure and built environment.

Table 4. Overview of primary-level interventions by determinant and type of action

Determinant	Action area	NOS proposed priority area
	Public Policy	A: Supporting children & families B: Mobilising people & communities C: Enabling active living
Income	4	A, C
Infrastructure & Built environment	2	B; C
Total	6	

Effectiveness of interventions on the social determinants

Tables 5 and 6 provide a summary of the effectiveness of the identified interventions from the review and primary level studies.

Early child development and education

Three types of interventions concerning early child development and lifelong learning are described, two of which have a public policy focus and one is about skill development among parents. Both the educational reform intervention (extended compulsory education) and comprehensive school programs showed positive effects on obesity. The setting-based nutrition education program as part of the school program did not show any conclusive impact on healthy eating. The parenting skills program approach did appear to have positive effects on all three outcomes (obesity, healthy eating and physical activity).

Social and welfare policy

Policies to address socioeconomic disadvantage come in different forms. One intervention identified in the review level evidence – in-work tax credits – offers the potential to reduce poverty and income inequality but does not appear to affect weight status. Tax credits are financial benefits provided by the government to people who are in work but have a low income.

Food subsidies, via a food voucher to low income households, have been shown to have a positive effect on dietary behaviour, demonstrating increases in fruit and vegetable intake.

In the primary studies evidence base, a randomised controlled trial investigating the use of rent subsidies showed a positive impact on the prevalence of obesity among women who moved to a more affluent neighbourhood.

The primary studies evidence also suggests the use of unconditional cash transfers (income to households with children) as a way of reducing obesity.

Infrastructure and built environment

Public transport interventions have positive effects on physical activity. Providing light rail or rapid bus transport increases walking among users by approximately 30 minutes per week. Traffic calming measures appear favourable in terms of increasing physical activity among people living close to such interventions.

Transport interventions that provide positive financial incentives (free/share bicycle schemes; and public transport subsidies) result in increases in walking and cycling. Negative price interventions (congestion pricing and car parking charges) also have positive effects on cycling and pedestrian activity.

Active transport interventions that provide more and better infrastructure for walking and cycling increase physical activity and improve weight status.

Urban planning interventions that include food growing infrastructure e.g. community gardens and access to farmers markets, appear to lead to increased fruit and vegetable consumption as well as greater physical activity. There is strong evidence that dense and compact residential neighbourhoods that are inclusive of public services lead to increased physical activity.

In low income neighbourhoods, greenspace/ parks that are well kept lead to increases in physical activity, especially when combined with promotional materials about the improvements that have taken place in the community built environment, and skills development for park recreation staff.

Social participation and community engagement

Urban agriculture can be a powerful community intervention that improves social connectedness and social capital – each of which is good for health in general. Urban agriculture encompasses home, community and residential gardens, rooftop gardens and also urban/peri-urban small-scale commercial farming. The evidence also shows that the impact of such community action also reduces obesity and increases food security.

Community engagement initiatives among disadvantaged groups that focus on establishing community advisory boards; community stakeholder meetings and forums; multi-sectoral coalitions; and collaborative community partnerships show positive effects on physical activity levels and decrease body mass index (BMI).

Gaps in the review-level evidence related to interventions

Sacks et al. [1] reviewed the evidence of policies directly affecting the food system. This Evidence Check rapid review identified little review-level evidence focused on interventions beyond the food system that address the structural drivers of health. Behaviours, community practices and conditions of daily living are shaped by deep social structures and processes. A fully encompassing social determinants approach to obesity prevention would address conditions of e.g. trade, labour, fiscal and social policy, and aim to counter exclusionary systems and processes, each of which affect health and health inequities.

There is a body of evidence showing how trade agreements promote foreign direct investment into various parts of the food supply chain including food processing, manufacturing, retail, and advertising. [4-6] This is enabled through trade provisions that liberalise services, investments, and enhanced intellectual property rights. [63] Trade agreements may also constrain the policy space that governments have to implement policy options to improve diets, due to provisions relating to regulatory practices and investor protection. Putting health in international trade arrangements is critical. This means good national and global governance – addressing the balance of economic and health interests in agenda-setting and decision-making in relation to trade agreements.

A key action is to make trade negotiations more transparent and have greater involvement of health interests including Ministries of Health and public interest NGOs. [6, 64-66] Integrated health impact assessment of the text of trade agreements as they are being negotiated would help ensure they favour the production and distribution of healthy foods and control that of energy-dense nutrient-poor foods.

Evidence tells us that employment arrangements and working conditions can provide financial security, social status, personal development, social relations, and protection from physical and psychosocial hazards and harmful behaviours. [37] Time pressures associated with precarious employment conditions correlate with sedentary work, disinclination to use active transport, and ready access to energy dense foods. [67] [68] Ensuring economic and social policy provides both sufficient income in order to comply with behaviour-related health guidelines and job security such that workers have a greater sense of control over their lives are fundamental requirements to support people make healthy behaviour choices. The development of labour and social policies are needed that provide secure and decent work for all and a living wage that takes into account the real and current cost of living for health - including adequate nutritious food, shelter, and social participation. [69]

Creating the conditions that enable all social groups to make healthy behavioural choices depends vitally on the empowerment of individuals and groups to represent effectively their needs and interests. Inclusive and participatory processes require changes in how top-down policy-making is made and it also requires bottom-up community led action. It is through the democratic processes of civil society participation and public policy-making, and with accountable and responsible private actors, that real action for obesity prevention and health equity is possible. This will require social structures, supported by the government, that mandate and ensure the rights of groups to be heard and to represent themselves – such as legislation and institutional capacity; and it depends on specific programs supported by those structures, through which active participation can be realized. In particular, it is important that governments acknowledge, legitimise and support Indigenous peoples, in policy, legislation and programs that support autonomy and self-determination. [2]

Key areas for action in the commercial determinants

Kickbusch et al. define the commercial determinants of health as "strategies and approaches used by the private sector to promote products and choices that are detrimental to health". [3] They go on to describe how corporate influence is exerted through four channels:

1. Marketing, which enhances the desirability and acceptability of unhealthy commodities
2. Lobbying, which can impede policy barriers such as plain packaging and minimum drinking ages
3. Corporate social responsibility strategies, which can deflect attention and whitewash tarnished reputations
4. Extensive supply chains, which amplify company influence around the globe.

Action is needed that addresses each of these commercial channels. The review-level and primary data searches did not identify literature on interventions to address these commercial determinants other than articles related to food advertising and marketing, and trade and investment. Interventions related to food advertising and marketing are captured in the Sacks et al. review. [1] The channel related to supply chains is closely connected with trade and investment policy (see above for trade and investment policy discussion).

In an endeavour to understand ways to control the impact of the commercial determinants of NCDs, Buse et al. reviewed three models of governance of NCD risk: self-regulation by industry; hybrid models of public-private engagement; and public sector regulation. [7] They set out a number of reforms (described in Box 1 on the following page) that will be needed to improve these mechanisms, including to strengthen the governance framework's ability to consolidate the collective power of diverse stakeholders, its authority to develop and enforce clear measures to address risks, as well as establish monitoring and rights-based accountability systems across all actors to drive measurable, equitable and sustainable progress.

The adoption and implementation of these three recommendations would provide a robust governance structure that would ensure commercial interests do not undermine the goals of obesity prevention action.

Box 1: Criteria, conditions and safeguards to govern commercial drivers of NCD risk

Source: Buse et al. [7]

Self-regulation

Self-regulation will persist into the foreseeable future. With stronger consumer demand for healthier products, the tremendous leverage of industry could have a substantial impact on reducing population risk exposure. Private regulation can be anticipated particularly where states have weak oversight of transnational determinants of such risk. This approach has proven to carry significant challenges to public health goals. Consequently, the public health community should demand that such regulation exhibit the following four characteristics:

1. Appropriate targets: ambitious targets/standard that are evidence - informed and rights-based, in the interest of public health and have been developed in a transparent manner (be they on product reformulation, promos, product placements, endorsements, marketing, etc.) and are SMART in nature (i.e. specific, measurable, attributable, realistic and time bound)
2. Independent monitoring: review of compliance, progress and public health impact
3. Transparent reporting: with remedial action as necessary and an independent oversight body to ensure accountability
4. Sufficient scope for impact: include the leading corporate players and cover a significant proportion of the risk of exposure and the market - ideally applied globally to reduce cross border spill-overs.

Hybrid regulation

There is widespread support globally for public-private partnership to address the overarching Sustainable Development Goal Agenda 2030 development framework and interest in leveraging such partnerships in health, including in the prevention of NCDs. We can only expect such cooperation to grow at country and global levels. But safeguards must be put in place to ensure public health concerns receive adequate attention. Consequently, the public health community should demand:

1. Appropriate targets: ambitious targets/standard that are evidence- informed and rights-based, in the interest of public health and have been developed in a transparent manner (be they on product reformulation, promos, product placements, endorsements, marketing, etc) and are SMART in nature (i.e. specific, measurable, attributable, realistic and time bound)
2. Independent monitoring: provide for independent third party monitoring of compliance, progress and public health impact
3. Transparent reporting: with remedial action as necessary and an independent oversight body to ensure accountability
4. Sufficient scope for impact: include the leading corporate players (and should certainly not exclude firms were this to create an uneven and uncompetitive playing field) and cover a significant proportion of the risk of exposure and the market—ideally globally
5. Manage conflicts of interest: ensure that safeguards are in place to avoid potential or actual conflicts of interest or reputational threats to the public sector through partnership with firms or industries which do not conform to minimum acceptable standards
6. Assess alternatives: ensure that the same objectives cannot be achieved more quickly and effectively through other means, and that the interests pursued by private partners would not threaten the longer-term public health objectives.

Public regulation

Public regulation is the favoured approach of many public health experts as they consider that experience with self- and hybrid-regulation has had insufficient public health impact on the prevention of NCDs. In the case of public regulation, the public health community should demand:

1. Appropriate targets: ensure evidence-informed, rights-based targets for NCD risk mitigation that conform to international standards and laws, free of undue private sector influence – ones that stretch industry but are realistic and attainable and recognize that changes to industrial practices can take time
2. Inclusive target setting: ensure the mechanism to set and review targets and apportion roles and responsibilities including non-state actors and all relevant sectors of government so that regulation and action is focused on the fundamental drivers.
3. Safeguards: ensure that measures and procedures are in place to manage apparent or real conflicts of interest and

Table 5: Classification of evidence of effectiveness

Level of effectiveness	Description
Positive	The balance of evidence was judged to indicate a ***clear positive (favourable)*** effect, based on consistently positive results showing improvements in the measured outcome, in settings relevant to the Australian context
Indicative positive	The balance of evidence was judged to indicate ***that there was likely to be a positive (favourable)*** effect on the measured outcome, although results from relevant studies were not consistently positive and/or the intervention had not been well evaluated in settings relevant to the Australian context
Inconclusive	The balance of evidence was judged to be ***inconclusive***. Based on the evidence assessed, it was not possible to determine a clear direction of effect because of inconsistent findings
Indicative negative	The balance of evidence was judged to indicate that ***there was likely to be a negative (unfavourable)*** effect on the measured outcome, although results from relevant studies were not consistently negative
Negative	The balance of evidence was judged to have a ***negative (unfavourable)*** effect, based on consistently adverse impacts on the measured outcome, in settings relevant to the Australian context
No effect	The balance of evidence was judged to indicate that there was likely to be ***no effect*** on the measured outcome
Not assessed / not applicable	This outcome had not been evaluated or was not applicable

Table 6. Summary of effectiveness of identified interventions (review studies)

ID	Determinant	Type of action	Intervention	Effectiveness			Supporting evidence
				Weight status	Food	Physical activity	
1	Early child development & Education	Public policy	Extended duration of education through prolonging compulsory education.	Indicative positive (men)	NA	NA	1 systematic review including meta-analysis (Ljungdahl et al. 2015).
2	Early child development & Education	Public policy	Government funded school programs focused on connection to social services; parenting programs; home visits; nutrition education/support.	Positive	Inconclusive	NA	1 systematic review of 37 experimental studies (D'Onise et al. 2010).
3	Early child development & Education	Skills development	Parenting skills development including authoritative parenting.	Positive	Positive effects on energy intake, intake of EDNP foods	Positive effects on time spent in SB, and time spent in PA	1 lit review including 7 RCTs (Gerards et al. 2011).
4	Income	Public policy	In-work tax credits.	No effect	NA	NA	1 systematic review of 5 studies (Pega et al. 2013).
5	Income	Public policy	Food subsidy programs for socioeconomically disadvantaged groups.	NA	Positive (women)	NA	1 systematic review (Black et al. 2012).
6	Infrastructure & Built environment	Public policy	Light rail transit or bus rapid transport lines.	NA	NA	Positive	1 systematic review and meta analysis (Xiao et al. 2019).
7	Infrastructure & Built environment	Public policy	Traffic calming measures.	NA	NA	Indicative positive	2 Systematic reviews (Stappers et al. 2018; Macmillan et al. 2018). 1 Umbrella review (Bird et al. 2018).
8	Infrastructure & Built environment	Public policy	Transport financial incentives.	NA	NA	Positive	Systematic review (Martin et al. 2012).

9	Infrastructure & Built environment	Public policy	Increased infrastructure for walking and cycling.	Positive	NA	Positive	3 Systematic reviews (Stappers et al. 2018; Macmillan et al. 2018; Mayne et al. 2015). 1 Umbrella review (Bird et al. 2018). 1 Rapid review (Newman et al. 2015).
10	Infrastructure & Built environment	Public policy	Urban planning policy including neighbourhood design and food growing infrastructure.	NA	Positive	Positive	Umbrella review (Bird et al. 2018). 2 Rapid reviews (Friel et al. 2015; Newman et al. 2015).
11	Infrastructure & Built environment	Public policy & skills	Park renovations plus community promotional campaigns related to the built environment change; and PA programming and skills development for park recreation staff.	NA	NA	Indicative positive	Systematic review (Hunter et al. 2015).
12	Social participation	Community action	Urban agriculture.	Indicative positive	Positive	NA	Scoping review (Audate et al. 2019).
13	Social participation	Community action	Participatory community engagement initiatives	Indicative positive	Inconclusive	Positive	Systematic review (Cyril et al. 2015).

Table 7. Summary of effectiveness of identified interventions (primary studies)

ID	Determinant	Type of action	Intervention	Effectiveness			Supporting evidence
				Weight	Food	Physical activity	
1	Income	Public policy	Unconditional cash transfers	Positive (mothers) Negative (low income households)			Lebihan et al. 2019. Cross sectional study Akee et al. 2013. Longitudinal study American Indians
2	Income	Public policy	Annual universal and unconditional income payment for all residents.	Positive (middle income households)			Watson et al. 2019. Cohort study
3	Income	Public policy	Rent subsidy voucher, with conditionality on moving to low-poverty neighbourhood.	Positive (women)			Ludwig et al. 2011. RCT
4	Infrastructure & Built environment	Public policy	Urban renewal (new urban green spaces, playgrounds, park renovations, and establishment of a civic centre for social gatherings and sport).			Positive	Anderson et al. 2017. Natural experiment
5	Infrastructure & Built environment	Public policy	Liveable neighbourhood planning policies including community design; movement network; lot layout; public parkland.			Indicative positive	Hooper et al. 2014. Cross sectional study

Discussion and conclusion

Empowering all people to pursue healthy diets, be physically active and maintain a healthy weight requires addressing the social and commercial determinants. There is a strong international call for such action to be taken to address the systemic drivers of obesity. This Evidence Check rapid review provides evidence that is applicable in the Australian context and which supports that international call.

The evidence presented in this review highlights the critical leadership and stewardship roles of the health sector in the pursuit of action on the social and commercial determinants, with many of the necessary actions located outside of health. Each of the tables below outline actions that could be championed by the health sector to prevent obesity and its social distribution. The first table is based on the limited but good quality evidence showing the positive impacts on obesity, physical activity and healthy eating through intersectoral policy action on the social determinants of health. The second table draws on the evidence related specifically to structural drivers of health that was generated through authoritative policy reports and primary data. The third table draws on seminal publications and is focused on the commercial determinants of obesity and NCDs.

Actions at the structural level are inherently aimed at addressing the distribution of money, power and resources across the population. They typically require more direct government intervention and are unsurprisingly the most difficult to evaluate (and least evaluated) for their impact on obesity, healthy eating and physical activity. That said, there were a number of education, welfare and infrastructure policies that were shown to have had positive impacts on obesity, healthy eating and physical activity. The review-level evidence shows the effectiveness of policies that focus on the social needs of people through e.g. rent subsidies and food vouchers. Other types of evidence highlight the importance of action to remediate income inequality through adequate wages and social welfare. The adequacy of welfare rates is a key issue in tackling inequities in healthy eating. Unemployment benefits in Australia have declined steadily compared to other benefits and to community standards regarding costs of living. Increasing the payment level for Newstart, for example, would significantly improve the equity of income distribution. The review evidence clearly shows the importance of early child development and lifelong education. Retaining students within Australias existing Year 10 compulsory education system will be critical to the prevention of obesity. Australian national and State/Territory policy has had a significant focus on infrastructure and transport. As the evidence highlights, it is vital that these policies pay attention to community livability and active public transport rather that private vehicle use. Intervention at the daily living conditions level often occurs via settings and neighbourhoods, where actions are taken to improve access to and demand for healthy foods and opportunities to be physically active. The evidence showed a number of promising actions within schools and communities.

Suite of interventions on the social determinants of health and obesity, based on review-level evidence

Layers of influence	Examples of effective/ promising actions
Structural drivers	Welfare policy (e.g. rent subsidies, food vouchers) Education policy (extended compulsory education) Infrastructure and transport policy (e.g. walking/cycling infrastructure, light rail/rapid bus transits; walking/cycling infrastructure; transport financial incentives)
Daily living conditions	Comprehensive childcare initiatives combining capacity-building, skill-building, and childcare/school policy changes Urban agriculture / community gardens initiatives Safe and clean parks and greenspace Participatory community governance (e.g. community advisory boards, multisectoral coalitions)
Individual skills development	Parental skill building programs

Plausible interventions on the structural social determinants of health, informed by authoritative reports and primary level evidence

Layers of influence	Examples of plausible actions
Structural drivers	Trade negotiations that are transparent and actively engage with health interests (including Ministries of Health and public interest NGOs)
	Integrated health impact assessment (HIA) of economic policy (e.g., HIA of text of trade agreements as they are being negotiated)
	Adjust minimum wage levels and, and social protection floor according to regularly costed healthy basket of foods
	Taxation policy focused on reducing income inequality
	Participatory and inclusionary governance (better collaboration mechanisms between health and social sectors, involve people from excluded groups in the development of policies that relate to obesity prevention)
	Governments to acknowledge, legitimise and support Indigenous peoples, in policy, legislation and programs that support autonomy and self-determination

Plausible interventions on the commercial determinants of health, informed by authoritative publications

Actions on the commercial determinants of NCDs	Limit the impact of commercial activities (e.g., corporate activity in marketing; lobbying; corporate social responsibility strategies and activities along the food supply chain) that promote products and choices that may be detrimental to health.

Strengths and limitations

This Evidence Check rapid review followed a systematic process to search for literature on a broad range of social and commercial determinants as they related both to healthy weight and potential modes of intervention. It identified a reasonable amount of review level evidence showing the relationships between a number of social determinants and the outcomes of interest – obesity, healthy eating and physical activity. The scope of these determinants is however quite constrained, with almost nothing relating to macroeconomic factors or sociocultural values.

There were no review-level articles focusing on the commercial determinants other than those related to food systems, and these have been covered in the review by Sacks et al. [1] The extent of review-level information on the effectiveness of actions to address the social determinants of obesity, healthy eating and physical activity was more limited compared to the evidence demonstrating relationships from review question one. Notably, the search did not identify any interventions relating to Aboriginal and Torres Strait Islander peoples.

It would be incorrect to think that this is an area in which research and action is absent. It just does not exist in review-level evidence form. The search did not identify any interventions – beyond the food environment – that focused on the commercial determinants. This gap highlights another challenge inherent to a rapid review. The type of evidence that is being requested of such a search strategy does not lend itself well to the types of evidence that currently exist in this field. It is a relatively nascent field of research, with much of the evidence focused on the conceptual development of the issues and descriptive analysis of specific commercial entities and products. It is understandable that there are no reviews existing to date of the effectiveness of actions to address these determinants.

Further limitations of the review stem from the extremely tight turnaround time (5 weeks), which placed a number of restrictions on the search. Only one scholarly database was searched, and literature was limited to review-level evidence complimented by a limited targeted search of primary literature for interventions relating to review question two. We were also unable to conduct a comprehensive search of grey literature and were thus limited to the inclusion of a small number of seminal reports identified by the research team.

There are significant gaps in the Australian-based literature. This could be overcome through support for a collaborative analysis of research on interventions and strategies (from the review, primary and grey literature) addressing healthy eating, physical activity and obesity outcomes for Aboriginal and Torres Strait Islander peoples. Similarly, much more support is needed for new and emerging research and evaluation of strategies addressing macroeconomic and socio-cultural values relating to obesity, physical activity and healthy eating, including those impacting on commercial determinants (beyond those related to the food system).

References

References to literature cited in the review

1. Sacks G, Looi E, Cameron A, Backholer K, Strugnell C. Population-level strategies to support healthy weight: an Evidence Check rapid review brokered by the Sax Institute for Queensland Health. The Sax Institute; 2019.
2. Commission on Social Determinants of Health (CSDH). Closing the gap in a generation: health equity through action on the social determinants of health. Final report of the Commission on the Social Determinants of Health. Geneva: World Health Organisation; 2008.
3. Kickbusch I, Allen L, Franz C. The commercial determinants of health. Lancet Glob Health. 2016;4(12):e895-e96.
4. Friel S, Hattersley L, Townsend R. Trade Policy and Public Health. Annual Reviews of Public Health. 2015;36(1):325-44.
5. Schram A, Labonte R, Baker P, Friel S, Reeves A, et al. The role of trade and investment liberalization in the sugar-sweetened carbonated beverages market: a natural experiment contrasting Vietnam and the Philippines. Globalization and Health. 2015;11(1):41.
6. Thow AM, Snowdon W, Labonte R, Gleeson D, Stuckler D, et al. Will the next generation of preferential trade and investment agreements undermine prevention of noncommunicable diseases? A prospective policy analysis of the Trans Pacific Partnership Agreement. Health Policy. 2015;119(1):88-96.
7. Buse K, Tanaka S, Hawkes S. Healthy people and healthy profits? Elaborating a conceptual framework for governing the commercial determinants of non-communicable diseases and identifying options for reducing risk exposure. Globalization and Health. 2017;13(34)
8. Marmot M, Bell R. Fair society, healthy lives. Public Health. 2012;126, Supplement 1(0):S4-S10.
9. UNDP. Discussion Paper: Addressing the Social Determinants of Noncommunicable Diseases. New York: United Nations Development Programme; 2013.
10. Loring B, Robertson A. Obesity and inequities: Guidance for addressing inequities in overweight and obesity. Copenhagen: WHO Regional Office for Europe; 2014.
11. Swinburn BA, Kraak VI, Allender S, Atkins VJ, Baker PI, et al. The Global Syndemic of Obesity, Undernutrition, and Climate Change: The Lancet Commission report. Lancet (London, England). 2019
12. Backholer K, Mannan HR, Magliano DJ, Walls HL, Stevenson C, et al. Projected socioeconomic disparities in the prevalence of obesity among Australian adults. Australian and New Zealand Journal of Public Health. 2012;36(6):557-63.
13. Australian Institute of Health and Welfare. Australian Burden of Disease Study: Impact and causes of illness and death in Aboriginal and Torres Strait Islander people 2011. Canberra, Australia: Australian Institute of Health and Welfare; 2016 Series no. 6. Cat. no. BOD 7. Available from: https://www.aihw.gov.au/getmedia/e31976fc-adcc-4612-bd08-e54fd2f3303c/19667-bod7-atsi-2011.pdf.aspx?inline=true
14. Forde I, Raine R. Placing the individual within a social determinants approach to health inequity. Lancet 2008;372:1694–96.
15. O'Brien P, Kypri K. Alcohol industry sponsorship and hazardous drinking among sportspeople. Addiction. 2008;103(12):1961-66.
16. Kickbusch I. Addressing the interface of the political and commercial determinants of health. Health Promot Int. 2012;27

17. Moodie R, Stuckler D, Monteiro C, Sheron N, Neal B, et al. Profits and pandemics: prevention of harmful effects of tobacco, alcohol, and ultra-processed food and drink industries. Lancet. 2013;381
18. Clapp J, Desmarais A, Margulis M. State of the world food system. Canadian Food Studies/La Revue canadienne des études sur l'alimentation. 2015;2(2):7-8.
19. Baker P, Friel S. Transnational food and beverage corporations, ultra-processed food markets and the nutrition transition in Asia. Globalization and Health. 2016;12(1):80.
20. McKee M, Stuckler D. Responding to the Corporate and Commercial Determinants of Health. American Journal of Public Health. 2018;0(0):e1-e4.
21. Falbe J, Thompson HR, Becker CM, Rojas N, McCulloch CE, et al. Impact of the Berkeley Excise Tax on Sugar-Sweetened Beverage Consumption. American Journal of Public Health. 2016;106(10):1865-71.
22. Popkin BM, Hawkes C. Sweetening of the global diet, particularly beverages: patterns, trends, and policy responses. The Lancet Diabetes & Endocrinology. 2016;4(2):174-86.
23. Collin J. Tobacco control, global health policy and development: towards policy coherence in global governance. Tobacco Control. 2012;21(274-280)
24. Collin J, Hill SE, Smith KE. Merging alcohol giants threaten global health. BMJ. 2015;351:h6087.
25. Moscetti C, Taylor A. Take me to your liter: politics, power and public-private partnerships with the sugar-sweetened beverage industry in the post-2015 development agenda. Wash Int Law J. 2015;24
26. Cullerton K, Donnet T, Lee A, Gallegos D. Exploring power and influence in nutrition policy in Australia. Obesity Reviews. 2016;17(12):1218-25.
27. Reubi D, Herrick C, Brown T. The politics of non-communicable diseases in the global South. Health Place. 2016;39:179-87.
28. Anaf J, Baum FE, Fisher M, Harris E, Friel S. Assessing the health impact of transnational corporations: a case study on McDonald's Australia. Globalization and health. 2017;13(1):7.
29. Moodie R. What public health practitioners need to know about unhealthy industry tactics. American Public Health Association; 2017. p. 1047-49
30. Battams S, Townsend B. Power asymmetries, policy incoherence and noncommunicable disease control - a qualitative study of policy actor views. Critical Public Health. 2018:1-14.
31. Chopra M, Darnton-Hill I. Tobacco and obesity epidemics: not so different after all? BMJ. 2004;328(7455):1558-60.
32. World Health Organization. Global Action Plan for the Prevention and Control of Non-communicable Diseases 2013-2020. Geneva: World Health Organization; 2013. Available from: http://apps.who.int/iris/bitstream/10665/94384/1/9789241506236_eng.pdf?ua=1
33. World Health Organization. Global action plan on physical activity 2018-2030: More active people for a healthier world. Geneva: World Health Organization; 2018 CC BY-NC-SA 3.0 IGO. Available from: https://apps.who.int/iris/bitstream/handle/10665/272722/9789241514187-eng.pdf?ua=1
34. Peeters A, Backholer K. Reducing socioeconomic inequalities in obesity: The role of population prevention. The Lancet Diabetes & Endocrinology. 2015;3(11):838-40.
35. Tricco AC, Langlois EV, Straus SE, editors. Rapid reviews to strengthen health policy and systems: a practical guide. Geneva: World Health Organization; 2017.
36. Khangura S, Konnyu K, Cushman R, Grimshaw J, Moher D. Evidence summaries: The evolution of a rapid review approach. Systematic reviews. 2012;1(1):1-9.
37. Marmot M. Fair society, healthy lives. The Marmot Review. Strategic review of health inequalities in England post-2010. London: University College London; 2010. Available from: www.ucl.ac.uk/gheg/marmotreview/Documents
38. Friel S, Hattersley L, Ford L, O'Rourke K. Addressing inequities in healthy eating. Health Promotion International. 2015;30(suppl 2):ii77-ii88.

39. Kettings C, Sinclair A, Voevodin M. A healthy diet consistent with Australian health recommendations is too expensive for welfare-dependent families. Australian and New Zealand Journal of Public Health. 2009;33(6):566-72.
40. Burns C. A review of the literature describing the link between poverty, food insecurity and obesity with specific reference to Australia. Melbourne: VicHealth; 2004. Available from: http://www.vichealth.vic.gov.au
41. Burns C, Bentley R, Thornton L, Kavanagh A. Reduced food access due to a lack of money, inability to lift and lack of access to a car for food shopping: A multilevel study in Melbourne, Victoria. Public Health Nutrition. 2011;14(6):1017-23.
42. Grantham-McGregor S, Cheung YB, Cueto S, Glewwe P, Richter L, et al. Developmental potential in the first 5 years for children in developing countries. Lancet. 2007;369(9555):60-70.
43. Smith LC, Ramakrishnan U, Ndiaye A, Haddad L, Martorell R. The importance of women's status for child nutrition in developing countries. Research Report 131. Washington: International Food Policy Research Institute; 2003.
44. Boyden S. The Biology of Civilisation: Understanding Human Culture as a Force in Nature. Sydney: UNSW Press; 2004.
45. Alidu N, Grunfeld EA. A systematic review of acculturation, obesity and health behaviours among migrants to high-income countries. Psychology and Health. 2018;33(6):724-45.
46. Smith J, Cattaneo A, Iellamo A, Javanparast S, Atchan M. Review of effective strategies to promote breastfeeding: an Evidence Check rapid review brokered by the Sax Institute for the Department of Health. 2018. Available from: https://consultations.health.gov.au/population-health-and-sport-division/breastfeeding/supporting_documents/Review%20of%20effective%20strategies%20to%20promote%20breastfeeding.pdf
47. Early Child Development Knowledge Network. Early child development: a powerful equalizer. Final report of the Early Child Development Knowledge Network of the Commission on Social Determinants of Health. . Geneva: World Health Organization; 2007.
48. World Health Organization. Promoting Health Through Schools – The World Health Organization's Global School Health Intiative. Geneva: World Health Organization; 1996.
49. 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.
50. Blouin C, Chopra M, van der Hoeven R. Trade and social determinants of health. The Lancet. 2009;373(9662):502-07.
51. Thow AM, McGrady B. Protecting policy space for public health nutrition in an era of international investment agreements. Bulletin of the World Health Organization. 2014;92(2):139-45.
52. Hawkes C, Delia Grace, Thow AM. Trade liberalization, food, nutrition and health In: Richard Smith, Chantal Blouin, Zafar Mirza, Peter Beyer, Drager N, editors. rade and Health: Towards building a National Strategy. Geneva: World Health Organization; 2015
53. Barlow P, Labonte R, McKee M, Stuckler D. Trade challenges at the World Trade Organization to national noncommunicable disease prevention policies: A thematic document analysis of trade and health policy space. PLOS Medicine. 2018;15(6):e1002590.
54. Brug J, Kremers SP, Van Lenthe F, Ball K, Crawford D. Environmental determinants of healthy eating: in need of theory and evidence: symposium on 'Behavioural nutrition and energy balance in the young'. Proceedings of the Nutrition Society. 2008;67(3):307-16.
55. Thornton L, Pearce J, Ball K. Sociodemographic factors associated with healthy eating and food security in socio-economically disadvantaged groups in the UK and Victoria, Australia. Public Health Nutrition. 2014;17(1):20-30.

56. de Wit JBF, Stok FM, Smolenski DJ, de Ridder DDT, de Vet E, et al. Food Culture in the Home Environment: Family Meal Practices and Values Can Support Healthy Eating and Self-Regulation in Young People in Four European Countries. Applied Psychology: Health and Well-Being. 2015;7(1):22-40.
57. Dixon J. Authority, power and value in contemporary industrial food systems. International Journal of Sociology of Agriculture and Food. 2003
58. Tweed E, Sumpter C, Thomson R, Lewer D, Southworth P, et al. OP41 The health of people experiencing multiple forms of social exclusion: a systematic review. BMJ Publishing Group Ltd; 2019
59. Popay J, Escorel S, Hernandez M, Johnston H, Mathieson J, et al. Understanding and Tackling Social Exclusion: Final Report to the WHO Commission on Social Determinants of Health From the Social Exclusion Knowledge Network. Geneva: WHO; 2008.
60. Williams DR, Mohammed SA, Leavell J, Collins C. Race, socioeconomic status, and health: Complexities, ongoing challenges, and research opportunities. Annals of the New York Academy of Sciences. 2010;1186(The Biology of DisadvantageSocioeconomic Status and Health):69-101.
61. Paradies Y, Harris R, Anderson I. The Impact of Racism on Indigenous Health in Australia and Aotearoa: Towards a Research Agenda, Discussion Paper No. 4. Darwin: Cooperative Research Centre for Aboriginal Health & Flinders University; 2008.
62. Chandler MJ, Lalonde CE. Cultural continuity as a hedge against suicide in Canada's First Nations. Horizons. 1998;10:68-72.
63. Hawkes C. The role of foreign direct investment in the nutrition transition. Public Health Nutr. 2005;8(4):357-65.
64. Jarman H. Trade policy governance: What health policymakers and advocates need to know. Health Policy. 2017;121(11):1105-12.
65. Delany L, Signal L, Thomson G. International trade and investment law: a new framework for public health and the common good. BMC Public Health. 2018;18(1):602.
66. Studlar D, Cairney P. Multilevel governance, public health and the regulation of food: is tobacco control policy a model? Journal of Public Health Policy. 2019
67. Broom D, Strazdins L. The harried environment: is time pressure making us fat? In: Dixon J, Broom D, editors. The 7 Deadly Sins of Obesity. Sydney: University of New South Wales Press; 2007
68. Roos E, Sarlio-Lahteenkorva S, T L, Lahelma E. Associations of work-family conflicts with food habits and physical activity. Public Health Nutrition. 2007;10(3):222-29.
69. ACOSS, UNSW Sydney. Inequality in Australia. Sydney: Australian Council of Social Service and University of New South Wales; 2018.

References to studies included in question 1

1. Kim Y, Cubbin C, and Oh S. A systematic review of neighbourhood economic context on child obesity and obesity-related behaviours, Obes Rev. 2019;20(3):420-431
2. Wu S, Ding Y, Wu F, Li R, Hu Y, Hou J, et al. Socio-economic position as an intervention against overweight and obesity in children: A systematic review and meta-analysis. Scientific Reports. 2015; 5:11354.
3. Kim, TJ. and Von Dem Knesebeck, O. Income and obesity: What is the direction of the relationship? A systematic review and meta-analysis, BMJ Open. 2018; 8(1).
4. Barriuso L, Miqueleiz E, Albaladejo R, Villanueva R, Santos, JM. and Regidor E. (2015) Socioeconomic position and childhood adolescent weight status in rich countries: A systematic review, 1990-2013, BMC Pediatrics, 15(1).
5. Newton, S, Braithwaite D. and Akinyemiju TF. (2017) Socio-economic status over the life course and obesity: Systematic review and meta-analysis, PLoS ONE, 12(5).

6. Tamayo T, Christian H. and Rathmann W. (2010) Impact of early psychosocial factors (childhood socioeconomic factors and adversities) on future risk of type 2 diabetes, metabolic disturbances and obesity: A systematic review, BMC Public Health, 10.
7. Elhakeem A, Hardy R, Bann D, Caleyachetty R, Cosco TD, Hayhoe RPG, et al. (2017) Intergenerational social mobility and leisure-time physical activity in adulthood: A systematic review, Journal of Epidemiology and Community Health, 71(7), 673-680.
8. Juneau CE, Benmarhnia T, Poulin AA, Côté S. and Potvin L. (2015) Socioeconomic position during childhood and physical activity during adulthood: a systematic review, International Journal of Public Health, 60(7), 799-813.
9. Fleischhacker SE, Evenson KR, Rodriguez DA. and Ammerman AS. (2011) A systematic review of fast food access studies, Obesity Reviews, 12(501), e460-e471.
10. Leigh PJ, Leigh WA. and Du J. (2019) Minimum wages and public health: A literature review, Preventive Medicine, 118, 122-134.
11. Beenackers MA, Kamphuis CBM, Giskes K, Brug J, Kunst AE, Burdorf A, et al. (2012) Socioeconomic inequalities in occupational, leisure-time, and transport related physical activity among European adults: A systematic review, International Journal of Behavioral Nutrition and Physical Activity, 9.
12. Kirk MA. and Rhodes RE. (2011) Occupation correlates of adults' participation in leisure-time physical activity: A systematic review, American Journal of Preventive Medicine, 40(4), 476-485.
13. Cohen AK, Rai M, Rehkopf DH. and Abrams B. (2013) Educational attainment and obesity: A systematic review, Obesity Reviews, 14(12), 989-1005.
14. Alidu L. and Grunfeld EA. (2018) A systematic review of acculturation, obesity and health behaviours among migrants to high-income countries, Psychology and Health, 33(6), 724-745.
15. Alberdi G, McNamara AE, Lindsay KL, Scully HA, Horan MH, Gibney ER, et al. (2016) The association between childcare and risk of childhood overweight and obesity in children aged 5 years and under: a systematic review, European Journal of Pediatrics, 175(10), 1277-1294.
16. Carrillo-Álvarez E, Kawachi I. and Riera-Romaní J. (2019) Neighbourhood social capital and obesity: a systematic review of the literature, Obesity Reviews, 20(1), 119-141.
17. Rodgers J, Valuev AV, Hswen Y. and Subramanian SV. (2019) Social capital and physical health: An updated review of the literature for 2007–2018, Social Science and Medicine, 236.
18. Moore S. Social Networks, Social Capital and Obesity: A Literature Review. In: Dubé L, Bechara A, Dagher A, Drewnoski A, Lebel J, James P et al. editors. Obesity Prevention. Online: Academic Press; 2010. Available from: https://www.sciencedirect.com/science/article/pii/B9780123743879000544
19. Glonti K, Mackenbach JD, Ng J, Lakerveld J, Oppert JM, Bárdos H, et al. (2016) Psychosocial environment: Definitions, measures and associations with weight status - a systematic review, Obesity Reviews, 17, 81-95.
20. Lindsay Smith G, Banting L, Eime R, O'Sullivan G. and van Uffelen JGZ. (2017) The association between social support and physical activity in older adults: A systematic review, International Journal of Behavioral Nutrition and Physical Activity, 14(1).
21. Mendonça G, Cheng LA, Mélo EN. and De Farias Júnior JC. (2014) Physical activity and social support in adolescents: A systematic review, Health Education Research, 29(5), 822-839.
22. Farkas B, Wagner DJ, Nettel-Aguirre A, Friedenreich C. and McCormack GR. (2019) Evidence synthesis - A systematized literature review on the associations between neighbourhood built characteristics and walking among Canadian adults, Health promotion and chronic disease prevention in Canada: Research, policy and practice, 39(1);1-14.
23. Zapata-Diomedi B. and Veerman JL. (2016) The association between built environment features and physical activity in the Australian context: a synthesis of the literature, BMC Public Health, 16(1), 484.

24. Bancroft C, Joshi S, Rundle A, Hutson M, Chong C, Weiss CC, et al. (2015) Association of proximity and density of parks and objectively measured physical activity in the United States: A systematic review, Social Science and Medicine, 138, 22-30.
25. Lachowycz K. and Jones AP. (2011) Greenspace and obesity: A systematic review of the evidence, Obesity Reviews, 12(501), e183-e189.
26. Mackenbach JD, Rutter H, Compernolle S, Glonti K, Oppert JM, Charreire H, et al. (2014) Obesogenic environments: A systematic review of the association between the physical environment and adult weight status, the SPOTLIGHT project, BMC Public Health, 14(1).
27. Rahmanian E, Gasevic D, Vukmirovich I. and Lear SA. (2014) The association between the built environment and dietary intake - a systematic review, Asia Pacific Journal of Clinical Nutrition, 23(2), 183-196.
28. Prince SA, Reed JL, McFetridge C, Tremblay MS. and Reid RD. (2017) Correlates of sedentary behaviour in adults: a systematic review, Obesity Reviews, 18(8), 915-935.
29. Janssen HG, Davies IG, Richardson LD. and Stevenson L. (2017) Determinants of takeaway and fast food consumption: a narrative review, Nutrition Research Reviews, 1-19.
30. Vargas CM, Stines EM. and Granad, HS. (2017) Health-equity issues related to childhood obesity: a scoping review, Journal of Public Health Dentistry, 77, S32-S42.
31. Mazarello Paes V, Hesketh K, OMalley C, Moore H, Summerbell C, Griffin S, et al. (2015) Determinants of sugar-sweetened beverage consumption in young children: A systematic review, Obesity Reviews, 16(11), 903-913.
32. Puggina A, Aleksovska K, Buck C, Burns C, Cardon G, Carlin A, et al. (2018) Policy determinants of physical activity across the life course: A DEDIPAC umbrella systematic literature review, European Journal of Public Health, 28(1), 105-118.

References to studies included in question 2

33. Ljungdahl S. and Bremberg SG. (2015) Might extended education decrease inequalities in health? A meta-analysis, European Journal of Public Health, 25(4), 587-592.
34. Pega F, Carter K, Blakely T and Lucas PJ. (2013) In-work tax credits for families and their impact on health status in adults, Cochrane Database of Systematic Reviews, 2013(8).
35. Black AP, Brimblecombe J, Eyles H, Morris P, Vally H. and O'Dea K. (2012) Food subsidy programs and the health and nutritional status of disadvantaged families in high income countries: a systematic review, BMC public health, 12, 1099.
36. Xiao C, Goryakin Y and Cecchini M. (2019) Physical Activity Levels and New Public Transit: A Systematic Review and Meta-analysis, American Journal of Preventive Medicine, 56(3), 464-473.
37. Stappers NEH, Van Kann DHH, Ettema D, De Vries NK and Kremers SPJ. (2018) The effect of infrastructural changes in the built environment on physical activity, active transportation and sedentary behavior – A systematic review, Health and Place, 53, 135-149.
38. Gerards SMPL, Sleddens EFC, Dagnelie PC, De Vries NK. and Kremers SPJ. (2011) Interventions addressing general parenting to prevent or treat childhood obesity, International Journal of Pediatric Obesity, 6(2 -2), e28-e45.
39. D'Onise K, Lynch JW, Sawyer MG. and McDermott RA. (2010) Can preschool improve child health outcomes? A systematic review, Social Science & Medicine, 70(9), 1423-1440.
40. Martin A, Suhrcke M and Ogilvie D. (2012) Financial Incentives to Promote Active Travel An Evidence Review and Economic Framework, American Journal of Preventive Medicine, 43(6), E45-E57.
41. Bird EL, Ige JO, Pilkington P, Pinto A, Petrokofsky C and Burgess-Allen, J. (2018) Built and natural environment planning principles for promoting health: An umbrella review, BMC Public Health, 18(1).

42. Macmillan F, George ES, Feng X, Merom D, Bennie A, Cook A, et al. (2018) Do natural experiments of changes in neighborhood built environment impact physical activity and diet? A systematic review, International Journal of Environmental Research and Public Health, 15(2).
43. Hunter RF, Christian H, Veitch J, Astell-Burt T, Hipp JA and Schipperijn J. (2015) The impact of interventions to promote physical activity in urban green space: A systematic review and recommendations for future research, Social Science and Medicine, 124, 246-256.
44. Mayne SL, Auchincloss AH. and Michael YL. (2015) Impact of policy and built environment changes on obesity-related outcomes: a systematic review of naturally occurring experiments, Obesity Reviews, 16(5), 362-375.
45. Audate PP, Fernandez MA, Cloutier G and Lebel A. (2019) Scoping review of the impacts of urban agriculture on the determinants of health, BMC Public Health, 19(1).
46. Cyril S, Smith BJ, Possamai-Inesedy A. and Renzaho AMN. (2015) Exploring the role of community engagement in improving the health of disadvantaged populations: a systematic review, Global Health Action, 8, 1-12.
47. Friel S, Hattersley L, Ford L and O'Rourke K. (2015) Addressing inequities in healthy eating, Health Promotion International, 30(S2), ii77-ii88.
48. Newman L, Baum F, Javanparast S, O'Rourke K and Carlon L. (2015) Addressing social determinants of health inequities through settings: a rapid review, Health Promotion International, 30, 126-143.
49. Lebihan L. and Mao Takongmo CO. (2019) Unconditional cash transfers and parental obesity, Social Science and Medicine, 224, 116-126.
50. Watson B, Guettabi M and Reimer M. (2019) Universal Cash Transfers Reduce Childhood Obesity Rates. SSRN Electronic Journal. 2019.
51. Akee R, Simeonova E, Copeland W, Angold A and Jane Costello E. (2013) Young adult obesity and household income: Effects of unconditional cash transfers, American Economic Journal: Applied Economics, 5(2), 1-28.
52. Ludwig J, Sanbonmatsu L, Gennetian L, Adam E, Duncan GJ, Katz LF et al. (2011) Neighborhoods, obesity, and diabetes - A randomized social experiment, New England Journal of Medicine, 365(16), 1509-1519.
53. Andersen HB, Christiansen LB, Klinker CD, Ersbøll AK, Troelsen J, Kerr J et al. (2017) Increases in Use and Activity Due to Urban Renewal: Effect of a Natural Experiment, American Journal of Preventive Medicine, 53(3), e81-e87.
54. Hooper P, Giles-Cort, B and Knuiman M. (2014) Evaluating the implementation and active living impacts of a state government planning policy designed to create walkable neighborhoods in Perth, Western Australia, American Journal of Health Promotion, 28(SUPPL 3), S5-S18.

Appendices

Appendix 1. Search Strategy

Research question 1

Search #1: concept 1 AND concept 2 AND concept 3 AND concept 4

Research question 2

Search #2: concept 1 AND concept 2 AND concept 3 AND concept 4

Search #3: concept 1 AND concept 2 AND concept 3

Search terms

Question 1

Concept 1 – relationships or associations
impact* OR relationship* OR effect* OR effects* OR association*
Concept 2 – social and commercial determinants of health
social determinant* OR daily living conditions OR standard of living OR agricultur* polic* OR economic polic* OR fiscal polic* OR labour market* OR labor market* OR social polic* OR sociocultural OR racism OR discrimination OR social capital OR social participation OR social inclusion OR social exclusion OR infrastructure OR built environment* OR urban planning OR livability OR transport* OR welfare OR social protection OR work* conditions OR occupation OR employment OR income OR socioeconomic status OR education polic* OR educational attainment OR rural OR poverty OR disadvantage OR housing OR cost* of living OR homeless* OR early child* development OR early child* education OR trade agreement* OR trade and investment OR trade polic* OR commercial determinant* OR unhealthy commodity industr* OR agrifood business OR transnational corporation* OR corporate practices OR corporate activities OR corporate influence OR industr* influence OR conflicts of interest OR lobby*
Concept 3 – healthy weight
healthy eating OR unhealthy eating OR dietary behaviour* OR "dietary behavior* OR dietary intake OR physical activity OR overweight OR obesity OR obese
Concept 4 – reviews
systematic review OR meta-analysis OR literature review OR narrative review OR scoping review AND NOT protocol

Question 2 (review literature)

Concept 1 – interventions

intervention* OR polic* OR program* OR legislat* OR regulat* OR law* OR initiative*

Concept 2 – social and commercial determinants of health

social determinant* OR agricultur* polic* OR infrastructure polic* OR social polic* OR labour market polic* OR labour market program* OR labor market polic* OR labor market program* OR education polic* OR lifelong learning OR racism OR discrimination OR social inclusion OR social exclusion OR built environment OR urban planning OR livability OR transport polic* OR welfare OR pension OR social protection OR work* conditions OR occupation OR employment OR income OR minimum wage OR living wage OR socioeconomic status OR standard of living OR early child* education OR early child* development OR parenting program* OR paid parental leave OR rural OR poverty OR low income OR disadvantage OR housing OR cost* of living OR homeless* OR social capital OR social participation OR trade agreement* OR trade and investment OR trade polic* OR commercial determinant* OR unhealthy commodity industr* OR agrifood business OR transnational corporation* OR corporate practices OR corporate activities OR corporate influence OR conflicts of interest OR lobby*

Concept 3 – healthy weight

healthy eating OR unhealthy eating OR dietary behaviour* OR dietary behavior* OR dietary intake OR physical activity OR overweight OR obesity OR obese

Concept 4 – reviews

systematic review OR meta-analysis OR literature review OR narrative review OR scoping review AND NOT protocol

Question 2 (targeted primary literature)

Concept 1 – interventions

intervention* OR polic* OR program* OR legislat* OR regulat* OR law* OR initiative*

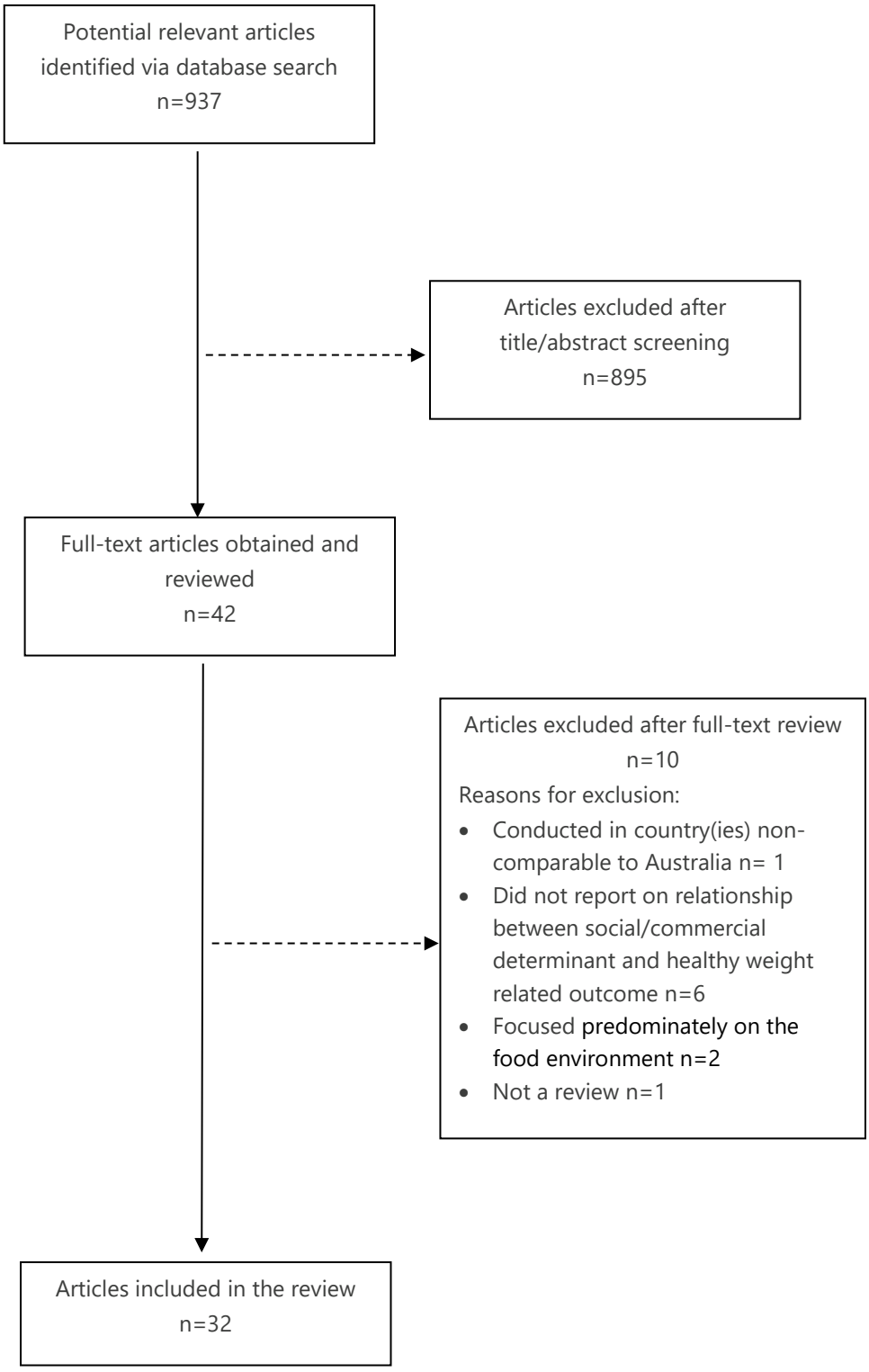
Concept 2 – specific policies and interventions recommended by the Marmot Review

early child* education OR parenting program* OR paid parental leave OR learning opportunit* OR labour market programs OR employment security OR employment opportunit* OR minimum wage OR living wage OR income support OR housing OR pension* OR social protection OR welfare payment* OR tax system OR social participation OR community regeneration

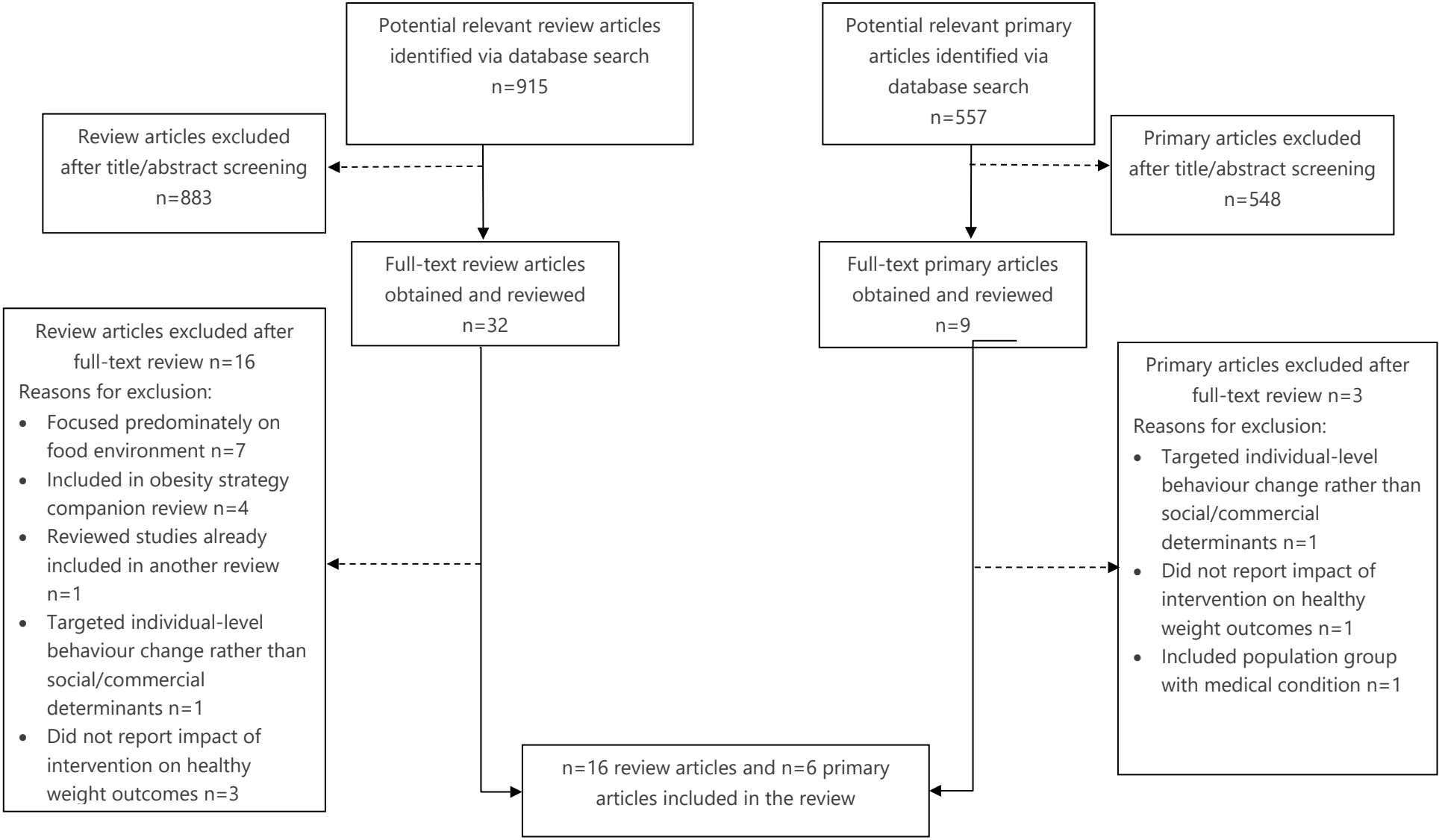
Concept 3 – healthy weight

healthy eating OR unhealthy eating OR dietary behaviour* OR dietary behavior* OR dietary intake OR physical activity OR overweight OR obesity OR obese

Appendix 2. PRISMA flowchart for article selection for question 1



Appendix 3. PRISMA flowchart for article selection for question 2



Appendix 4. Data extracted from included studies for questions 1 and 2

Question 1

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
STRUCTURAL DRIVERS (n=14)										
Socioeconomic status / socioeconomic position / income										
1	Kim et al. 2018 A systematic review of neighbourhood economic context on child obesity and obesity-related behaviours	Systematic review	Children (3-17yrs)	Inception to 2018	39	Australia, Canada, USA, Belgium	Neighbourhood economic context. Constructs examined included: • median income level • occupational status • disadvantage index • unemployment • SES index • deprivation index • poverty • home ownership • affluence index.	Weight status. Diet. PA and sedentary behaviour.	12 out of 20 studies examining weight status found higher neighbourhood SES was inversely associated with obesity. 2 out of 6 studies examining diet found higher neighbourhood SES was positively associated with healthy dietary habits. 2 out of 11 studies examining PA found higher neighbourhood SES was positively associated with PA. Associations in the remainder of studies were NS.	Neighbourhood economic context may affect child obesity and obesity-related behaviours. There is a need to further examine theory-driven moderators to clarify the mechanisms by which neighbourhoods influence child obesity to develop tailored policies.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
									Gender, age, ethnicity, individual-level economic status, rurality and social connectedness were found to be significant moderators in the association between neighbourhood economic context and obesity.	
2	Wu et al. 2015 Socio-economic position as an intervention against overweight and obesity in children: a systematic review and meta-analysis.	Systematic review and meta-analysis	Children (0-15yrs)	1990-2014	62	High, middle and low-income countries. Majority of included studies were conducted in high-income countries.	Socioeconomic position.	Weight status.	Risk of both overweight and obesity was higher in children with lowest SES compared to those with the highest: pooled estimate (all country income levels included): (OR, 1.10, 95% CI: 1.03 to 1.17); and (OR, 1.41, 95% CI: 1.29 to 1.55) respectively. In subgroup analyses by country income-level, children with the lowest SES had	Findings suggest that low SEP is associated with a 10% higher risk of overweight and a 41% higher risk of obesity in children aged 0–15 years. However, after sub-group analyses by income level of countries, this relationship was only observed in high-income countries.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
									16% (95% CI: 9% to 24%) higher risk of overweight, and 43% (95% CI: 30% to 58%) higher risk of obesity in high-income countries. There was NS difference in middle income countries.	
3	Kim et al. 2018 Income and obesity: what is the direction of the relationship? A systematic review and meta-analysis.	Systematic review and meta-analysis	Children Adolescents Adults	Inception to 2017	21	Canada, UK, USA	Income Review examined bi-directional hypotheses for links with obesity: i. social causation (effects of income on obesity); and ii. reverse causality (effects of obesity on income).	Weight status.	Pooled estimates on social causation indicated lower income was associated with subsequent obesity (OR 1.27, 95% CI 1.10 to 1.47; RR 1.52, 95% CI 1.08 to 2.13) though this association became NS once adjusted for publication bias. Pooled estimates on reverse causality indicated a consistent relationship between obesity and subsequent income, even after taking publication	This review revealed statistically significant effects of income on obesity (social causation) as well as of obesity on income (reverse causality). Individuals exposed to lower income are more likely to develop obesity, and the obese have lower wages when compared with their non-obese counterparts. However, after adjustments for publication bias, only the reverse causality hypothesis remained significant.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
									bias into account (SMD −0.15, 95% CI −0.30 to 0.01).	
4	Barriuso et al. 2015 Socioeconomic position and childhood-adolescent weight status in rich countries: a systematic review, 1990-2013.	Systematic review	Children/ adolescents (age 0-21yrs)	1990-2013	158	Australia, USA, UK, Canada, Germany, France, Spain, Sweden, Greece, Holland, Belgium, Italy, Finland, Portugal, Denmark, Ireland, Czech Republic, Iceland, Israel, Norway, Switzerland, Korea	Family socioeconomic position. Constructs examined included: family income; mothers' and/or fathers' education or occupation; and composite indicators.	Weight status.	Bivariable analyses found an inverse association between family SEP and child-adolescent weight status in 60.4% of cases; NS association in 18.7%; and an association that varied depending on another variable (generally age, sex or ethnicity) in 20.9%. Corresponding results for multivariable analyses were 51.1%; 20.0%; and 27.8% respectively. A positive association was found in 1.1 % of cases.	The results of this review would seem to confirm trends suggested in two previous reviews that the relationship between SEP and childhood-adolescent weight status in rich countries is predominantly inverse.
5	Newton et al. 2017 Socio-economic status over the life course and obesity: systematic review and meta- analysis.	Systematic review and meta-analysis	Adults	1990-2015	14	Australia, UK, USA, Denmark, Brazil, Spain, Singapore	Life-course SES. Derived from measure of SES in child and adulthood.	Weight status	Women of lower life course SES had significantly higher odds of obesity compared with those of higher life	The inverse relationship between life course SES and obesity in women was consistent, whilst findings among men were less so.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
							Constructs examined included: Family financial status + own education; Fathers occupation/ education + own occupation/educati on; Childhood family income + own income; Parental material endowments & social capital + own of same; Parental occupation/ education + own education, occupation & housing status.		course SES (Summary OR: 1.76, 95% CI: 1.38 to 2.25). There was NS difference in the odds of obesity by life course SES among males (Summary OR: 0.92, 95% CI: 0.60 to 1.40). For men and women combined mean BMI was higher among individuals with lower life course SES compared with those of higher life course SES (Summary mean BMI difference: 0.65, 95% CI: 0.59 to 0.71).	
6	Tamayo, et al. 2010 Impact of early psychosocial factors (childhood socioeconomic factors and adversities) on future risk of type 2 diabetes, metabolic	Systematic review	Adults	1994-2010	21 11 studies examined obesity thus results reported	UK, USA, Canada, Netherlands, Denmark, Sweden, Finland	Childhood socioeconomic adversity. Constructs examined included: fathers/mothers/pa rental occupation; fathers/mothers/pa	Weight status	4 out of 11 studies observed an independent association of low childhood SES and risk of overweight and obesity later in life.	There is some evidence to suggest adverse SES in childhood is associated with obesity risk in later life. More population-based longitudinal studies and international standards to assess psychosocial

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
	disturbances and obesity: a systematic review.				for these only.		rental education level; and/or family income.			factors are needed to clarify the mechanisms leading to the observed health disparities.
7	Elhakeem et al. 2017 Intergenerational social mobility and leisure-time physical activity in adulthood: a systematic review.	Systematic review	Adults	Inception to 2015	13	Australia, UK, Finland, Sweden, USA, Brazil	Intergenerational social mobility. Derived from measures of SEP in child (≤18yrs) and adulthood. Constructs examined included: parent vs. own occupational class; educational attainment; and income.	Leisure-time PA. Defined as sports, exercise and recreational -based PA.	There was consistent evidence in 9 out of 13 studies that stable high-SEP groups tended to report the highest levels of participation in LTPA and stable low-SEP groups the lowest. Upward and downwardly mobile groups participated in LTPA at levels between these stable groups.	Cumulative exposure to higher SEP in childhood and adulthood was associated with higher LTPA among adults. Policies which aim to minimise exposure to socioeconomic adversity at any point in life may have the potential to improve LTPA status in adulthood.
8	Juneau et al. 2015 Socioeconomic position during childhood and physical activity during adulthood: a systematic review.	Systematic review	Adults	1974-2014	42	Australia, UK, USA Denmark, NZ, Sweden, Finland, Belgium, Norway, Spain Slovakia, Brazil, China	SES position in early life. Derived from life course approach: SES position assessed in early life (<18yrs) and PA in adulthood (≥18yrs). Constructs examined included: parent social class; parent education	PA Assessed in 2 categories: 1) any type (included work-related PA, active transport, domestic work, sports	26 of the 42 studies that included a measure of any type of PA reported a significant association with early life SES. Remainder were NS. 21 of the 31 studies that	The evidence reviewed supported the hypothesis that there is a life course association between SES position early in life and PA in adulthood. This hypothesis was supported more consistently for leisure-time PA and in studies using more rigorous methodologies.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
							level; household amenities; income; car access; attendance of fee-paying school; and neighbourhood SES level.	and exercise). 2) leisure-time PA only (included leisure activities, sport and exercise).	included a measure of leisure-time PA reported a significant association with early life SES. Remainder were NS. For 21 studies included in a subset analysis of studies considered more methodologically rigorous, a significant association with early life SES was reported in 15 of the 21 studies that included a measure of any type of PA, and 12 of the 15 that included a measure of leisure-time PA only.	
9	Fleischhacker et al. 2011 A systematic review of fast food access studies.	Systematic review	Children Adults	1998-2008	40	Australia, NZ, UK, Canada, USA	Socioeconomic status. Constructs examined included: income; SES index; deprivation score;	Fast food access. Density of fast food restaurants most	16 out of 21 studies examining restaurant density found fast food restaurants were more likely to be present in low-	The findings of this review demonstrate fast food restaurants are more prevalent in low-income areas.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
							house value; school classification system; and combined parameters (e.g. income and unemployment).	commonly assessed outcome across studies.	income areas compared to middle to higher-income areas.	
10	Leigh et al. 2019 Minimum wages and public health: a literature review.	Literature review	Adults	Inception to 2018	15 4 studies examined healthy weight-related outcomes thus results reported for these only.	Studies were included if conducted in US, UK, Canada, or Europe	Low-wages.	Weight status. Fruit and vegetable consumption. PA.	2 studies each examined obesity/BMI; F&V consumption; and exercise/PA. Findings across studies generally showed positive trends for effects of $1 or 10% increase in minimum wage on diet, PA and BMI/obesity outcomes (increase in wage health promoting), however, most associations did not reach statistical significance.	Evidence for associations between minimum wages and health are inconsistent and marked by generally poor study designs.
11	Beenackers et al. 2012 Socioeconomic inequalities in occupational, leisure-time, and transport related	Systematic review	Adults	2000-2010	131	Most studies conducted in Scandinavian countries and the UK.	Socioeconomic Position. Constructs examined included: income (individual,	PA. Categorised under 4 types: i.) Total PA (TPA):	70 associations across 30 studies examined TPA. Of these, 40% reported a positive association (higher SEP associated	This review showed that leisure-time PA, and specifically vigorous leisure-time PA, is less prevalent while occupational PA is more

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
	physical activity among European adults: a systematic review.						household or area-level); educational attainment; and occupation-based social class (e.g. white/blue collar).	studies that examined general PA, or included combined measures of leisure-time as well as occupational PA. ii.) Occupational PA (OPA): studies that examined occupational-related PA. iii.) Total leisure-time PA (TLTPA): studies that examined leisure-related PA. iv.) Vigorous leisure-time PA (VLTPA): studies that specifically examined high intensity LTPA.	with higher TPA); 33% reported a negative association; and 27% reported NS association. 19 associations across 10 studies examined OPA. Corresponding results: 11% positive; 63% negative; and 26% NS. 200 associations across 75 studies examined TLTPA. Corresponding results: 68% positive; 1% negative; and 32% NS. 110 associations across 37 studies examined VLTPA. Corresponding results: 76% positive and 24% NS.	prevalent among people with lower SEP. Leisure-time PA should be an important focus in improving physical activity levels and reducing inequalities.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
Occupational status										
12	Kirk et al. 2011 Occupation correlates of adult participation in leisure-time physical activity: a systematic review.	Systematic review	Adults (18-64yrs)	Inception to 2010	62	Australia, Canada, USA, Finland, UK, Japan, Spain, Poland, Sweden, Denmark, Germany, Greece, Ireland, Portugal, Nigeria	Occupation-related factors. Constructs examined included: occupation status (e.g. blue collar vs. white collar); work hours; and work demands.	Leisure time PA.	44 studies examined occupation status and LTPA. 34 found that higher occupational status was associated with higher levels of LTPA. However, those employed in lower status occupations demonstrated greater total PA compared to higher status workers. 17 studies examined work hours/arrangements. Of these, LTPA was negatively associated with total work hours in 6 of 7 studies, and overtime work in 2 of 3 studies. 9 studies examined full-time versus part-time working status and reported mixed results.	This review found occupation factors correlated with LTPA. Occupation category/status was directly associated with LTPA, with white collar/ professionals showing the highest LTPA compared to blue-collar workers. Work hours appeared to have a negative threshold effect on LTPA, and some preliminary evidence found psychosocial work demands (e.g. job strain) to be negatively associated with LTPA levels.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
									12 studies examined work demands. Of these, LTPA was inversely associated with job strain in 8 studies, and positively associated with decision latitude in 2 studies.	
Educational attainment										
13	Cohen et al. 2013 Educational attainment and obesity: a systematic review.	Systematic review	Adults	1977-2012	289 203 studies in high-income countries.	91 countries Results stratified by country income status and gender thus outcomes reported for high-income countries only.	Educational attainment. Various measures including: years of education; degree completion; and achievement in school.	Weight status.	Of the 203 studies that reported results for women in high-income countries, educational attainment was inversely associated with obesity in 87% of studies; positively associated in 1%; and had NS association in 12%. Of the 196 studies that reported results for men, educational attainment was inversely associated in 64% of studies;	This review found that the relationship between educational attainment and obesity depends on the countrys level of development, such that inverse associations are more common in more developed countries, and positive associations are more common in less developed countries. Furthermore, within countries the relationship appears to differ by gender, such that the association is often stronger among women.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
									positively associated in 5%; had NS association in 29%; and a U-shaped association in 2%.	
Cultural and societal norms										
14	Alidu, et al. 2018 A systematic review of acculturation, obesity and health behaviours among migrants to high-income countries.	Systematic review	Adult migrants	2001-2016	35	Australia, Canada, USA, Netherlands, Norway, Sweden, England	Acculturation to host high-income country. Constructs examined included: specific acculturation scales and proxy measures (e.g. duration of residence).	Weight status.	5 of the 8 studies that utilised acculturation scales reported higher acculturation scores were positively associated with greater BMI or rates of obesity. 17 of the 26 studies that examined duration of residence found longer residence duration was positively associated with higher rates of overweight or obesity. Findings for the remainder of studies were mixed.	Acculturation (whether determined via acculturation scale or proxy measure) was associated with weight gain among migrants in the majority of studies examined. The evidence from this review suggests that health interventions should target early migrants (first generation) to avoid uptake of unhealthy dietary behaviours associated with high-income host countries.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
DAILY LIVING CONDITIONS (n=13)										
Early childhood development										
15	Alberdi et al. 2016 The association between childcare and risk of childhood overweight and obesity in children aged 5 years and under: a systematic review.	Systematic review	Young children (birth-6yrs)	2000-2016	15	Australia, Canada, UK, USA, Denmark, Netherlands, Germany, Japan	Childcare. Factors examined included: hours spent in care and type of care (centre-based or informal).	Weight status.	For hours spent in care, 4 studies found an association with increased risk of overweight/obesity . 3 found no association. For centre-based care, 2 studies found an association with increased risk of overweight/obesity ; 2 found it to be protective of healthy weight; and 7 found no association. For informal care, 6 studies reported an association between care by a relative and increased risk of overweight/ obesity. Factors found to mediate the relationship between childcare	This review highlights the existence of an important relationship between childcare and child weight status. Type of care, hours spent in care, maternal education and occupation, parental overweight/obesity, and breastfeeding are all associated with weight gain and adiposity among children. In terms of childcare, informal care (relative and non-relative) appears to be the most risky childcare environment for child overweight/obesity. This may be due to informal carers lacking childcare qualifications and being less exposed to child health advice.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
									and child weight status were parent overweight/obesity ; maternal education and employment; and breastfeeding.	
Social participation										
16	Carrillo-Alvarez et al. 2019 Neighbourhood social capital and obesity: a systematic review of the literature.	Systematic review	Children Adolescents Adults	Inception to 2017	22	Australia, UK, USA, Canada, Denmark, Belgium, France, Hungary, Netherlands, China	Neighbourhood social capital. Most commonly examined constructs included: trust; social participation; informal control; and social cohesion.	Weight status.	15 studies found higher levels of social capital were associated with lower BMI (protective effect); 8 found NS association; and 3 identified a health-damaging association.	Findings suggest an association between neighbourhood social capital and obesity exists, but that it depends on the social capital indicators and covariates examined. Heterogeneity in study design, social capital measures, and adjustment for covariates precludes clear understandings of the relationship between social capital and weight status.
17	Rodgers et al. 2019 Social capital and physical health: an updated review of the literature for 2007–2018.	Systematic review	Adults	2007-2018	145 10 studies examined obesity thus results reported for these only.	Canada, UK, USA, Japan, China, Western Europe	Social capital. Constructs examined included: social networks; trust; volunteering; community cohesion; social control; political participation; social relationships; and	Weight status.	1 study found a significant positive association between social capital and lower risk of obesity; 3 studies found negative or NS associations; and 6 studies reported	The most common finding for individual physical health outcomes was nuance in the relationship with social capital. Most studies yielded both positive and null results due to variations in associations by different social capital constructs and individual

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
							connectedness. Most studies utilised multi-item measures of social capital.		mixed positive or NS associations.	characteristics. These results suggest that social capital may be a protective factor for some physical health outcomes, but not others.
18	Moore et al. 2010 Social networks, social capital and obesity: a literature review".	Literature review	General	2004-2009	17	Majority of studies conducted in high-income countries.	Social networks. Social capital. (constructs examined included participation; trust; support; collective efficacy; social cohesion).	Weight status.	Findings were generally mixed across reviewed studies with results both within and between studies reporting both positive and null associations. Results also varied depending on the social capital or network construct examined. Findings appeared to be most consistent for studies examining area-level social capital, where higher area-level social capital was associated with lower risk of overweight/ obesity.	Early findings suggest social networks and social capital may hold promise for the potential design of public health interventions leveraging social connection in the prevention of obesity.
19	Glonti et al. 2016 Psychosocial environment:	Systematic review	Adults	1995-2015	19	Australia, USA, Canada, UK, Portugal	Psychosocial environment.	Weight status.	Of the 22 associations on psychosocial	There is limited evidence that greater social capital and collective efficacy

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
	definitions, measures and associations with weight status: a systematic review.						Constructs examined included: collective efficacy; social cohesion; social capital; and social support.		environment and weight status examined across included studies, 13 were significant. The strongest associations with weight status were found for social capital and collective efficacy.	are associated with healthier weight status. Clearer definitions and measurements of psychosocial constructs as well as longitudinal research to identify mechanisms through which social environments exert effects on weight status is needed.
20	Lindsay Smith et al. 2017 The association between social support and physical activity in older adults: a systematic review	Systematic review	Older adults (≥60yrs)	Inception to 2014	27	Australia, UK, USA, Canada, Germany, South Korea, Thailand, Israel, Singapore, China, Japan	Social support (SS) and loneliness. SS variants examined included: general SS and SS specific to PA (SSPA).	PA. Types of PA examined included: leisure-time PA (LTPA); exercise; active transport; household work; and occupational-related.	For general SS, a positive association with PA was reported in 2 of 4 studies. For SSPA, at least 1 significant positive association was reported with PA in 11 of 17 studies. For loneliness, a negative association with PA was reported in 4 of 7 studies. When measured separately, LTPA was associated with SS in a greater percentage of studies than when	Evidence surrounding the relationship between SS or loneliness and PA in older adults suggests that people with greater SS specific to PA are more likely to do LTPA. In terms of general SS, there does not seem to be an association with PA, however far fewer studies have investigated this relationship. Finally, loneliness focused studies suggest a negative association between loneliness and PA levels.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
									a number of PA domains were measured together.	
21	Mendonca et al. 2014 Physical activity and social support in adolescents: a systematic review.	Systematic review	Adolescents (10-19yrs)	Inception to 2011	75	Australia, USA, NZ, UK, Denmark, Canada, Norway, Cyprus, Belgium, Korea, Brazil, Singapore, Iran	Social support (SS) for PA. Sources of SS included: General; Parents; Father Mother; Siblings; Family; Friends; and Teacher.	PA.	Across cases examined, SS was consistently positively associated with PA for General SS (6 of 9 cases); Parent SS (21 of 34); Father SS (13 of 18); Friends SS (42 of 59); and Family SS (21 of 34). Associations for Siblings and Mother SS were inconsistent. Associations for Teacher SS were NS.	The evidence reviewed indicates that social support is an important factor associated with PA levels in adolescents and should be targeted in intervention programs that aim to increase PA levels in this population group.
Physical environment										
22	Farkas et al. 2019 A systematized literature review on the associations between neighbourhood built characteristics and walking among Canadian adults	Literature review	Adults	Inception to 2016	25	Canada	Built environment. Categorised under 4 characteristics: i. Functional (e.g. walkability). ii. Destination (e.g. land use). iii. Safety (e.g. traffic).	PA (walking). Walking categorised as for transport; recreation; or any purpose.	For functional characteristics, of the 144 associations examined 38% were positive, 2% were negative and 60% were NS. For destination characteristics, of	Findings suggest the built environment is potentially important for supporting adult walking and that different built environment characteristics may be more important for certain types of walking.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
							iv. Aesthetics (e.g. architecture).		the 98 associations examined 24% were positive, 6% were negative and 70% were NS. For safety characteristics, of the 16 associations examined 13% were positive and 87% were NS. For aesthetic characteristics, of the 10 associations examined 1 was positive and the remainder were NS.	
23	Zapata-Diomedi et al. 2016 The association between built environment features and physical activity in the Australian context: a synthesis of the literature.	Literature review	Adults	2009-2015	23	Australia	Built environment. Attribute categories examined (objective): i. Density (population or jobs density). ii. Diversity (land use mix). iii. Design (street connectivity). iv. Destination (distance from destination).	PA. Walking and cycling most commonly assessed PA-related outcomes.	The proportion of studies that reported positive associations with PA for each built environment attribute category were – Density: 33%; Diversity: 67%; Design: 28%; Destinations: 70%; Distance to transit: 80%; Safety: 33%; and Aggregated neighbourhood measures: 74%.	This review found convincing evidence that people who live in neighbourhoods with a large availability of destinations within walking/cycling distance are more likely to engage in PA. Findings emphasise the importance of urban planning for health via impacts on population levels of PA.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
							v. Distance to transit (distance to public transport). vi. Safety (neighbourhood crime, lighting and traffic). vii. Aggregated neighbourhood chracteristics (walkability index/environmental score).			
24	Bancroft et al. 2015 Association of proximity and density of parks and objectively measured physical activity in the United States: a systematic review	Systematic review	General	1990-2013	20	USA	Proximity and/or density of neighbourhood parks.	PA (measured objectively).	Of the 20 included studies, 5 reported a significant positive association between park density and/or proximity and PA; 9 found no association; and 6 reported mixed findings.	Current evidence on the relationship between objectively measured PA and park proximity and/or density is inconsistent.
25	Lachowycz et al. 2011 Greenspace and obesity: a systematic review of the evidence.	Systematic review	Children Adolescents Adults	2000-2010	60	Australia, NZ, Canada, England, USA, Europe (multi-country), Portugal, Sweden, Netherlands	Access to greenspace. Most commonly assessed indicators included: distance to nearest greenspace or greenspace count within certain distance of home.	PA. Weight status.	Of the 50 studies that examined PA and greenspace access, 20 reported a positive (health-promoting) association; 15 reported no association; 2 reported a negative	There is some evidence for an association between greenspace access and obesity-related health outcomes.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
									association; and 13 reported equivocal (mixed or weak) associations. Of the 13 studies that examined weight status, 3 reported a positive association; 4 reported no association; and 6 reported equivocal associations.	
26	Mackenbach et al. 2014 Obesogenic environments: a systematic review of the association between the physical environment and adult weight status, the SPOTLIGHT project.	Systematic review	Adults	1995-2013	93	Majority of studies conducted in North America.	Physical environment. Factors examined included: PA-related environment (e.g. parks, greenspace); food-related environment (e.g. fast-food restaurant density); transport-related environment (e.g proximity to public transport); and urban form characteristics (e.g. urban sprawl, land-use mix).	Weight status.	No consistent pattern was observed for associations between physical environment factors and weight status. Of the 93 studies included, 36 reported results in the hypothesised direction (i.e. health promoting physical environments associated with protective effects on weight status); 5 reported results opposite to the hypothesised direction; 14	With the exception of urban sprawl and land use mix in North America, the results of the current review confirm that the available research does not allow robust identification of ways in which that physical environment influences adult weight status.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
									reported NS results; and 38 reported mixed results. Exceptions were urban sprawl and land-use mix, which were consistently associated with weight status (more urban sprawl and less diverse land-use mix related to more obesity) in studies conducted in North America.	
27	Rahmanian, et al. 2014 The association between the built environment and dietary intake: a systematic review.	Systematic review	Adults	2000-2013	24	Australia, NZ, UK, USA, Scotland, Netherlands, Japan	Built environment (BE). Aspects of BE examined included: in-store F&V and healthy food availability; access to food stores (small stores, supermarkets, farmers markets, convenience stores); distance to primary food stores and accessibility (e.g. transport	Diet.	Majority (88%) of included studies showed a significant association between diet and some aspect of the BE, however, findings were not consistent across or within studies. Some studies found availability of F&V and healthy food in local food stores; access to farmers markets;	The majority of studies reviewed found a statistically significant relationship between diet and some aspect of the BE, but the results across studies were not consistent. These inconsistencies may be attributable to methodological challenges, including inconsistent approaches to measuring BE features and diet.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
							options); density of food stores; and density/access to fast food restaurants.		access to food stores; and proximity to food stores were positively associated with F&V consumption and diet quality, whilst others reported NS association. Higher access to convenience stores and greater perceived opportunities to purchase fast food in the neighbourhood were associated with lower diet quality and higher fast food consumption in a few studies.	
STUDIES EXAMINING MULTIPLE DETERMINANTS (n=5)										
28	Prince et al. 2017 Correlates of sedentary behaviour in adults: a systematic review.	Systematic review	Adults (≥18yrs)	Inception to 2014	257	Majority of studies conducted in USA, UK, Australia and Canada	Interpersonal factors (e.g. occupation, education). Social environment factors (e.g. area SES, social cohesion).	PA. Sedentary behaviour (SB) categorised as leisure-time SB; occupation SB; and	Consistent evidence found for significant associations between being employed full time and greater transportation SB and lower leisure time SB; higher	This review identified the majority of adult correlates of SB examined in the literature to date are interpersonal, with few studies having examined social and physical/built environmental factors, and even fewer having

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
							Physical environment factors (e.g. urbanisation, walkability). Policy environment.	transportation SB. Total sitting time. Total sedentary time (ST).	income/SES and greater transportation and occupation SB; and living in more urban areas and greater sitting time and total SB. Evidence consistently showed a lack of association between education level and transportation SB; area SES and transportation SB; social support and leisure SB, sitting and total ST; and crime/safety and leisure, sitting and total SB.	examined the effects of policy. The review supports the need for further research on the influence of factors in the physical, social and policy environments on SB.
29	Janssen et al. 2018 Determinants of takeaway and fast food consumption: a narrative review.	Narrative review	General	Inception to 2017	14	Australia, UK, NZ, USA, Canada, Germany Netherlands, Greece, Poland, Portugal	Societal influences (e.g. social food norms). Individual activity (e.g. time spent preparing food) The food environment.	Diet. (takeaway and fast food consumption)	The evidence reviewed suggests that the strongest determinants of out-of-home food availability are the density of food outlets and deprivation within the built environment. Socioeconomic	Overall there is a strong warrant for further attention to the constellation of factors that influence out-of-home food consumption to support the development of effective interventions to reduce the impact of out of home foods on public health.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
							Socioeconomic factors. Demographic factors.		disadvantage also appears to be a strong determinant of access to out-of-home foods in the food environment and consequent intake, with reviewed evidence showing a strong link between increased area deprivation and a higher density of fast food outlets. Findings indicated biological and psychological drives, when combined with a culture where overweight and obesity are becoming the norm, makes it fashionable to consume out-of-home food. There was a lack of consensus in reviewed evidence on the effects of demographic influences.	

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
30	Vargas, et al. 2017 Health-equity issues related to childhood obesity: a scoping review.	Scoping review	Children (<12yrs)	2005-2016	39	USA	Food environment (distribution-processing- retail; advertising; price; food deserts; food insecurity; school food). Natural and built environment (urban design; land-use; facilities; transport). Social environment (social capital; food norms; socioeconomic position; time).	Weight status.	16 included studies examined food environments, 11 the built environment and 12 the social environment. Evidence examining food-environments found elements including food advertising and higher food prices associated with obesity. A relationship was not observed however between food insecurity, food deserts and obesity. Evidence examining the built environment found environments that hindered access to PA resources and access to healthy foods increased risk of childhood obesity. Similarly, evidence examining social environments found a deficit	Most elements of food, natural and built, and social-environments were associated with weight in children under age 12, except food insecurity and food deserts.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
									social environment (socioeconomic disadvantage, unhealthy social norms and eating habits, limited social cohesion and time) was associated with obesity. Despite the extensive literature regarding equity issues in obesity, the authors noted a dearth of literature examining the impact of housing conditions.	
31	Mazarello Paes et al. 2015 Determinants of sugar-sweetened beverage consumption in young children: a systematic review.	Systematic review	Young children (0-6yrs)	Inception to 2014	44	Australia, UK, Canada, Belgium, Spain, USA, Thailand, Germany, Finland, Netherlands, Sweden, Mexico	Study examined multiple determinants related to structural drivers and daily living conditions.	Diet (SSB consumption).	Determinants associated with higher SSB consumption were: screen time; parents lower SES, lower age and SSB consumption; early introduction of solids; using food as rewards; attending out-of-home care; living near a fast food/ convenience store. Determinants associated with	There is consistent evidence to support potentially modifiable determinants of SSB consumption in young children.

No	Author, Year, Title	Study type	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Exposure	Outcomes examined	Impacts	Authors conclusions
									lower SSB consumption were: parental positive modelling; parents co-habiting; school nutrition policy and staff skills; and supermarket nearby.	
32	Puggina et al. 2018 Policy determinants of physical activity across the life course: a DEDIPAC umbrella systematic literature review.	Umbrella systematic literature review	Children through to older adults	2004-2016	14 reviews	Majority of primary studies included in reviews conducted in North America and Europe	PA-related school policies (PA policies and organised activities; physical education; school sport; school break times). Employment/work-related policies (working hours and work flexibility).	PA.	Among children, school policies promotive of PA; physical education; school sport; and longer duration break times were positively associated with PA in all studies that examined PA-related school policies. Among adults, long work hours and an inflexible work environment were negatively associated with overall PA levels in 2 studies that examined employment/ work-related policies.	This review provides evidence on modifiable policy determinants of PA. However, given the general poor quality of studies, this evidence is limited.

Question 2 (review studies)

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
STRUCTURAL DRIVERS (n=6)											
Education policy											
33	Ljungdahl et al. 2015 Might extended education decrease inequalities in health? A meta-analysis.	Review and meta-analysis	Adults (exposure was education received in childhood / adolescence).	Incep-tion to 2013	22 5 studies reported outcomes related to healthy weight thus data extracted for these only.	UK, Denmark, Norway, Netherlands, Sweden, Germany, Italy, plus aggregated studies of European countries	Extended duration of education by means of educational policy and/or law change. Reforms among reviewed studies included: i. prolonging of compulsory education. ii. reforms that facilitated secondary level education. Studies examined policy or law reforms implemented years 1903-1990.	Weight status.	BMI values were significantly lower in both women and men who had been affected by an extended educational policy reform, pooled mean effect (women: SE -0.532, 95% CI -0.924 to -0.141; men: -0.497, 95% CI -0.776 to -0.218). There was NS difference in the prevalence of overweight for both genders or obesity for women, however, the prevalence of obesity for men was 3% lower in those affected by extended education	The meta-analysis indicated that extended education of individuals with low education is associated with improved health outcomes. The effects, however, were found to be small. The impact of educational reform was consistently larger in men than in women. It is not clear if extended compulsory education might have a major impact on health in terms of overweight and obesity.	Not assessed.

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
									reforms, pooled mean effect (men: -0.030, 95% CI -0.054. to -0.006).		
Income (through tax transfer and subsidies)											
34	Pega et al. 2013 In-work tax credits for families and their impact on health status in adults: a Cochrane Systematic Review.	Systematic review CBA and ITS designs.	Participants in all included studies were women.	1980-2012	5 1 study examined outcomes related to healthy weight thus data extracted for this study only.	USA	In-work tax credits policy. All included studies examined the federal and/or state Earned Income Tax Credit (EITC). The EITC is means-tested to low-income, providing up to 7% and 11% of an average income from wages for families with 1 and 2 dependent children, respectively.	Weight status.	No evidence of differences in the probability of overweight and obesity after a large increase in EITC in 1996 in eligible women (women with two or more dependent children), compared to women ineligible for such an increase in EITC (women with one dependent child).	The existing body of evidence does not permit a robust conclusion regarding the effect of in-work tax credits for families on health status. High-quality studies in a range of country settings are needed to understand the potential impact of in-work tax credits	The studys estimates were not adjusted for underlying pre/post-intervention trends that differed between women assumed eligible and those assumed ineligible, and were thus judged to have a high risk of bias from confound-ing.
35	Black et al. 2012 Food subsidy programs and the health and nutritional	Systematic review.	Pregnant or post-partum women (11 studies);	1980-2010	14	USA, UK, NZ	Food subsidy programs for socioeconomically	Diet.	Among studies examining the WIC program, subsidies were	This review identified limited high quality evidence on the	Study quality was assessed using the Cochrane

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
	status of disadvantaged families in high income countries: a systematic review.	RCT; CBA; and ITS designs.	children (1 study); and adults (2 studies).				disadvantaged groups. The majority of studies (n=9) investigated the US Nutrition Program for Women, Infants and Children (WIC), which provides monthly food vouchers for designated quantities of nutritious foods.		found to increase F&V intake by 1–2 serves/day in women, and demonstrated increases in consumption of target nutrients by 10-20% in pregnant women. Studies of other comprehensive F&V subsidies showed similar improvements in food intake. Evidence for the effectiveness of these programs for children was lacking.	impacts of food subsidy programs on the health and nutrition of adults and children. This evidence suggests food subsidy programs increase diet quality.	ROB tool for RCTs and the Newcastle-Ottawa Scale for CBA and ITS studies. The majority of studies (n=9) were rated as moderate or high ROB.
Infrastructure policy											
36	Xiao et al. 2019 Physical activity levels and new public transit: a systematic review and meta-analysis.	Systematic review and meta-analysis. All studies had quasi-experimental, longitudinal pre-post design.	General	1997-2018	9 studies included in narrative synthesis; 5 studies included in meta-analysis.	UK, Canada, USA, Mexico	New public transportation options. Interventions included adding light rail transit (LRT) stations to extend existing LRT systems, or	Light to moderate PA (LMPA). Moderate to vigorous PA (MVPA).	Results of the meta-analysis indicated building new public transit options was associated with a significant increase in LMPA levels by 1.76 MET hours/week (pooled estimate	Findings show new public transit options can substantially contribute to increasing low- to moderate-intensity exercise levels, which has the potential to improve health on a population scale.	Study quality was assessed using the EPHPP tool. Of the nine included studies, all were rated moderate for study design dimension as they were

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
							adding bus rapid transport (BRT) lines.		1.76, 95% CI 0.19 to 3.32; p=0.03). This was equivalent to increasing walking and other LMPA by about 30 mins per week, relative to baseline. No significant effect was found for MVPA.		observational studies. Most studies had issues with selection bias, low study participant recruitment, and drop-outs. The confounders dimension was rated strong in several studies either because there were no important differences between groups prior to the intervention, or because they controlled for confounders.
37	Stappers et al. 2018 The effect of infrastructural changes in the built environment on	Systematic review. All studies had quasi- or	General	Incep-tion to 2018	19	Australia, USA, UK, Brazil	Built environment infrastructural changes (BEICs) that directly	Overall PA Walking Bicycling	11 studies evaluated the effects of on- and off-road bicycle and/or walking	This systematic review found that BEICs can lead to changes in overall PA and AT, with the	Study quality was assessed using the Cochrane ROB tool. Of

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
	physical activity, active transportation and sedentary behaviour: a systematic review.	natural experiment pre-post designs.					targeted the increase of active transport (AT) or transport-related PA. Interventions were categorised under 2 types according to the magnitude of the BEICs: i. on- and off-road bicycle and/or walking paths. ii. BEICs affecting the total infrastructural system (included construction of traffic free bridges, and roadways with parallel paths/lanes for walking and cycling).	Sedentary behaviour (SB).	trails, reporting mixed effects. With respect to overall PA, 2 studies reported increased PA and 3 reported NS changes. For walking, 2 studies reported increased walking and 3 reported NS changes. Results were more consistent for cycling, with 5 out of 8 studies reporting significant increases in at least one outcome measure. 8 studies evaluated the effects of BEICs affecting the total infrastructural system. With respect to cycling, 2 studies reported significant increases in	most promising results for cycling. However, the current state of evidence is inconclusive. Improved understanding of the potential of BEICs to increase PA at a population level requires more research with high-quality designs that consider the broader social and environmental context.	the 19 studies, 3 were rated moderate risk of bias; 7 serious; and 9 critical. ROB was lowest in the domains of "departures from intended interventions" and "missing data"; and highest in the domains of "selection of participants", "measurement outcome", and "selection of reported results".

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
									cycling and 2 reported NS changes. Effects were NS for studies examining overall PA and walking. All studies examining BEICs found positive or positive and NS associations between proximity to the intervention area and PA outcomes. No studies evaluated effects on SB.		
DAILY LIVING CONDITIONS (n=8)											
Early childhood development											
38	Gerards et al. 2011 Interventions addressing general parenting to prevent or treat childhood obesity.	Literature review RCT; group randomised repeat measures; and pre-post designs.	Children and adolescents (0-18yrs).	Incep-tion to 2010	7	Australia, UK, USA, Canada	General parenting skills development. Interventions consisted of components relating to general parenting as well as specific	Weight status. Energy balance-related behaviours (PA, SB, diet).	7 studies examined weight status, all reporting significant intervention effects on 1 or more weight related outcomes. 5 studies reported	The existing available evidence whilst limited suggests that general parenting skills development, particularly the promotion of authoritative parenting, is an effective strategy for	Not assessed.

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
							parenting practices related to physical (in)activity and/or nutrition. Included studies used four different standardised general parenting programs.		small to moderate weight change between groups (Cohens d (range): –0.20–0.60). 2 studies (without control groups) reported effects as weight change over time, with effect sizes small to moderate (Cohens d (range): –0.28–1.22). 4 studies examined energy balance-related behaviours, all reporting significant intervention effects on 1 or more behavioural outcomes. Positive effects were reported on energy intake, intake of EDNP foods, time spent in SB, and time spent in PA.	the prevention and management of childhood obesity.	

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
39	DOnise et al. 2010 Can preschool improve child health outcomes? A systematic review.	Systematic review. Cohort and quasi-experimental designs.	Children	1980-2008	37 3 studies reported outcomes related to healthy weight thus data were extracted for these only.	Canada, USA	Early childhood development interventions. Included interventions were either large rolled-out government programs (*Headstart*) or government funded experimental programs (*Better Beginnings, Better Futures – BBBF*). Both programs were multi-component. *Headstart*: preschool; connection to health and social services; parenting programs; nutrition education/support.	Weight status. Diet.	2 studies (both Headstart) evaluated effects on weight status and both reported significant beneficial effects on overweight and obesity. 1 study (BBBF) evaluated effects on diet quality and found NS effect.	The review found generally null effects of preschool early childhood interventions across a range of health outcomes, however, there was some evidence for obesity reduction.	Study quality was assessed using the EPHPP tool. 2 studies were rated moderate ROB, and 1 low-risk.

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
							BBBF: preschool; community development; connection to social services; parenting programs; home visits; nutrition education/support.				
Built environment											
40	Martin et al. 2012 Financial incentives to promote active travel: an evidence review and economic framework.	Literature review. RCT; un-controlled before and after; cross-sectional; and longitudinal study designs.	Adults	1997-2012	5 reviews and 20 primary studies.	Australia, UK, USA, Sweden, Denmark, Germany, Netherlands, Norway, Europe (multi-country study)	Financial incentive interventions/policies to promote active travel. Interventions examined included: positive incentives (free bicycles/bicycle share schemes; public transport subsidies); and negative incentives (road/congesti	PA (active transport-related)	For positive financial incentives, 3 studies identified within included review evidence all reported increases in cycling related to free bicycles/bicycle share schemes. 3 additional primary studies reported similar positive effects. 4 studies examined public transport subsidies, all reporting	This review identified only a limited amount of evidence on financial incentives for active travel, however, this evidence suggests financial incentives may represent an underused but potentially promising method for encouraging PA behaviours.	Not assessed.

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
							ng pricing; carpark fees; fuel prices).		measured increases in PA either indirectly (as reduced car usage and increased public transport utilisation) or directly (as increased minutes or episodes of PA). For negative financial incentives, 3 studies investigating road or congestion pricing reported decreased car journeys and increased cycling and pedestrian activity. 1 study found car park charging, as part of a work place travel plan, led to a threefold increase in cycling to work. 4		

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
									studies found a positive relationship between fuel prices and obesity or PA, suggesting fuel pricing strategies may increase active-commuting related PA and reduce obesity prevalence. However, lower-income groups may be the most responsive to fuel price changes.		
41	Bird et al. 2018 Built and natural environment planning principles for promoting health: an umbrella review	Umbrella review (synthesis of review-level evidence)	General	2005-2016	111 systematicreviews	Majority of studies conducted in high-income countries	Built and natural environment planning principles.. 5 categories examined: i. Neighbourhood design. ii. Housing. iii. Food environment.	Various health outcomes reported. Findings stratified by health outcome thus results reported for healthy weight-related outcomes only.	i. Neighbourhood design: improved walkability and street connectivity; compact residential design; and provision of public realm improvements associated with increased PA in evidence from 15;	This review demonstrates evidence-based built and natural environment planning principles to promote population health outcomes.	The quality of evidence included in the reviews was mixed. 1 review included studies deemed to be high quality; 11 contained evidence of moderate-to-high quality; 25 of

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
							iv. Natural and sustainable environment. v. Transport.		5; and 4 reviews respectively. ii. Housing: provision of affordable and diverse housing associated with increased PA (primarily walking) in evidence from 1 review. iii. Food environment: increased community/urban food growing infrastructure associated with increased opportunities for fruit and vegetable consumption and PA in evidence from 2 reviews. iv. Natural environment: increased access to and engagement opportunities with the natural		moderate quality; 14 of low-to-moderate quality; 9 of low quality; and for 52 reviews the quality of evidence for included studies was NR.

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
									environment associated with increased PA, and reduced obesity in evidence from 5 and 2 reviews respectively. Park improvements associated with increased PA in evidence from 4 reviews. v. Transport: provision of infrastructure for walking and cycling associated with increased PA and improved weight status in evidence from 15 and 3 reviews respectively. Traffic calming measures associated with increased PA in evidence from 4 reviews. Promotion of public transport use associated with increased PA		

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
									in evidence from 1 review.		
42	Macmillan et al. 2018 Do natural experiments of changes in neighborhood built environment impact physical activity and diet? A systematic review	Systematic review All studies had longitudinal natural experiment design. 4 studies were controlled (included a comparison group) and 11 were non-controlled (pre-post evaluation).	General Study participants were residents of the neighbour-hood in which the built environment change occurred.	Incep-tion to 2017	15	NZ, UK, USA, Brazil	Neighbourhood built environment (BE) change interventions. Studies examined changes related to redeveloping or introducing: - Cycle and/or walking trails and routes; - Rail stops/lines; - Supermarkets and farmers markets; and - Park and green space.	PA Diet	Overall, 8 out of the 15 included studies reported significant, beneficial change for at least one PA, diet or associated health outcome related to neighbourhood BE change. Of the 4 controlled studies, 1 study found an upgrade of neighbourhood parks increased PA among children with lower but not higher BMIs; and 1 found the construction of a new supermarket increased F&V consumption. Findings in the	This review found the effects of the neighbourhood BE interventions examined were largely mixed, and that the current evidence base evaluating natural experiments of neighbourhood BE change and impacts on PA and diet is scare.	Study quality was assessed using Cochrane ROB tool. 13 of the 15 studies were rated as high ROB in ≥4 of the 9 ROB items.

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
									other 2 studies were mixed. Of the 11 non-controlled studies walking, cycling or episodes of PA increased in 2 studies post-construction of new walk/cycle trails, and in 1 after the development of recreational green space in an urban centre. F&V consumption increased in 1 study after the introduction of new community farmers markets. Impacts in the remainder of studies were mixed. 9 studies examined effects based on exposure level to the BE change, 5		

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
									of which reported a significant positive relationship between exposure and PA and diet outcomes.		
43	Hunter et al. 2015 The impact of interventions to promote physical activity in urban green space: a systematic review and recommendations for future research.	Systematic review. Quasi-experiment; RCT; and pre-post designs.	General. Several studies were set in areas where the majority of the population were low SES.	Incep-tion to 2014	12	Australia, USA	Urban green space (UGS) interventions. i. Changes to the built environment only including: park renovations; improvements/ addition of recreational facilities; and greening of unused urban land/areas. ii. Built environment changes + additional PA programming including: community	PA	There was some evidence that built environment only interventions related to UGS increased PA: 4 out of 9 studies reported positive effects on the PA outcomes examined. Effects in the remainder of studies were null. The 2 studies that examined effects of UGS built environment interventions plus PA programming both reported increases in PA related to the interventions.	Results from this review show promising evidence to support the use of PA programs and physical changes to the built environment for increasing urban green space use and PA.	Study quality was assessed using the Cochrane ROB tool. 1 study was rated as low ROB, 6 as unclear, and 5 as high. ROB concerns mostly related to lack of allocation concealment and blinding, and not reporting if missing data was accounted for.

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
							promotional campaigns related to the built environment change; and PA programming and skills development for park recreation staff.				
44	Mayne et al. 2015 Impact of policy and built environment changes on obesity-related outcomes: a systematic review of naturally occurring experiments	Systematic review. Natural and quasi-experimental studies.	Adults Children Adolescents	2005-2014	37 17 studies evaluated built environ-ment changes thus data were extracted for these only.	Australia, USA, UK, Canada, NZ, Chile	Built environment (BE) change interventions. Interventions examined included: i. active transport changes: light rail; urban bicycle share programs; bicycle lanes; walking and cycling paths. ii. changes related to greenspace and outdoor recreational facilities: park	PA. Weight status.	1 study evaluated BE impacts on weight status and found light rail for active transport resulted in a reduction in BMI and the odds of obesity. 9 studies assessed impacts related to changes to greenspace and outdoor recreational facilities. Of these, 6 found significant increases in PA related outcomes. In	Current research suggests BE interventions can increase certain types of physical activity. It is not clear, however, whether these changes result in reduced obesity.	Majority of studies rated intermediate quality, based on author-devised methodological criteria and rating (strong, intermediate or weak).

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
							additions/ renovations; play-grounds; exercise and recreational equipment; walking/cycling trails.		general, studies with positive findings had longer follow-up times (>6mo) whilst studies with null or mixed findings had shorter follow-up. 7 studies assessed PA impacts related to active transport interventions, and largely found positive results. However, only 2 of these studies assessed change in total PA, with the remaining 5 assessing utilisation of active transport (process outcomes).		
Social participation and community capacity building											
45	Audate et al. 2019 Scoping review of the impacts of urban	Scoping review	General	1980-2017	101	Global	Urban agriculture (UA) initiatives.	Outcomes related to food	20 quantitative studies investigated	The substantial existing evidence reviewed	Study quality assessed using the

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
	agriculture on the determinants of health	Quantitative studies (n=51) (cross-sectional, before and after, quasi-experimental and RCT designs); qualitative (n=29); and mixed method (n=21).				60% of included studies were conducted in high-income countries; 32% middle income; and 8% low-income.		security; nutrition; food costs; social capital; and self-perceived benefits of UA. Weight status.	outcomes related to food security. Of these, 15 reported findings that demonstrated positive impacts of UA on food security. Impacts of UA were mixed or NS in the other 5 studies. 11 quantitative studies investigated nutrition outcomes. Among them, UA was reported to positively influence F&V intake in 5 studies; the nutritional status of children in 2 studies; and food diversity in 1 study. Impacts of UA were NS in the remaining 3 studies.	corroborates that UA can influence different determinants of health such as food security, social capital, health and well-being in a variety of contexts.	EPHPP tool. The majority of both quantitative and qualitative studies were rated weak or moderate quality. Quality concerns for quantitative studies related to inadequate justification of sample size, and cross sectional designs with repeat measures or control groups, and qualitative studies inadequate information on data collection, theoretical

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
									8 quantitative studies examined effects of UA on social capital, all reporting positive impacts or benefits of UA on the social capital outcomes investigated. 3 quantitative studies conducted in the US reported UA allowed practitioners to save money on food expenses. 1 quantitative study found positive impacts of UA on BMI and obesity risk. Qualitative studies examined participants self-perceived benefits of UA. The most commonly		approach and methods.

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
									reported benefits included: access to fresh or healthier foods; enhanced health and well-being; fostering social capital; nutrition knowledge; and savings on food expenses.		
46	Cyril et al. 2015 Exploring the role of community engagement in improving the health of disadvantaged populations: a systematic review.	Systematic review RCT; longitudinal; and mixed method designs.	Adults and children from disadvanta-ged population groups.	1995-2015	24 5 studies evaluate d healthy weight outcome s in high income countries thus data were extracted for these only.	USA	Community engagement (CE) initiatives to advance health. Initiatives integrated CE through community involvement or co-design of health interventions. This included: community advisory boards; community stakeholder meetings and forums; community	Diet. PA. Weight status.	2 studies examined the effects of CE in initiatives targeting dietary behaviours, 1 reported a significant reduction for salt, cholesterol and fat intake, and the other for childrens consumption of SSB. 4 studies examined effects of CE on PA outcomes, all reporting significant increases in the	The findings suggest that CE models can lead to improved health and health behaviours among disadvantaged populations if designed properly and implemented through effective community consultation and participation.	Study quality assessed using CONSORT criteria (RCTs); STROBE checklist (longitudinal studies); and the evaluative tool for mixed method studies. 2 studies each were rated moderate and good quality, and 1 study was rated poor.

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
							driven needs assessments; building multi-sectoral coalitions; and collaborative community partnerships.		PA outcomes evaluated. 3 studies examined effects of CE with respect to weight status, with significant decreases in weight/BMI reported in 2 studies, and NS effect in the other. Process evaluations of initiatives revealed key CE components that impacted health outcomes included: real power-sharing with the community; collaborative partnerships; bidirectional learning; incorporating the voice and agency		

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
									of beneficiary communities; and mobilisation of appropriate community resources.		
INTERVENTIONS TARGETING MULTIPLE DETERMINANTS (n=2)											
47	Friel et al. 2015 Addressing inequities in healthy eating.	Rapid review. Focus on intervention literature.	General	2000-2013	181	Focus on Australia but also included studies from other high-income countries.	Actions to address the social determinants of inequities in healthy eating at 3 levels: 1. socioeconomic, political and cultural context. 2. daily living conditions. 3. individual health related behaviours.	Diet (healthy eating).	The bulk of evidence identified targeted individual-level factors. Actions addressing the daily living conditions demonstrated some promise in promoting healthy eating among disadvantaged groups. These included: school-based nutrition initiatives (meal programs, nutrition education, vegetable gardens, healthy food policies);	This review highlights a dearth of available evidence on the equity impacts of actions across a range of policy domains related to the socioeconomic, political and cultural determinants of healthy eating. To address inequities in healthy eating, policy and action must tackle the systemic problems that generate poor nutrition.	Not assessed.

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
									workplace initiatives (healthy food policies, nutrition promotion); community-based obesity prevention programs; and changes to the physical environment to increase the availability and accessibility of healthy food (urban planning related to food retail, improving public transport infrastructure, and improving public housing location and quality including food preparation spaces). Such initiatives, however, generally promoted only modest, short-term		

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
									improvements in health-related knowledge and behaviours. Promising interventions identified at the socioeconomic, political and cultural context with the potential for far-reaching impacts included: fiscal policies (food taxes and subsidies); labour policies facilitating flexible work hours and scheduling to support healthy food behaviours; agricultural and trade policies incorporating health goals; and food policy councils.		
48	Newman et al. 2015 Addressing social determinants of health	Rapid review. Included reviews, systematic	General	2004-2014	202	Focus on Australia but also included literature from	Settings-based interventions to address the social	Health inequities	Interventions were identified across 12 different settings.	While a range of health promotion work is occurring in settings, this review	Not assessed.

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
	inequities through settings: a rapid review	reviews, evaluation studies and grey literature.				other developed countries.	determinants of health inequities. Settings-based interventions were defined according to the WHO description of approaches which "modify the physical, social, economic, instructional, organisational, administrative, management, recreational or other aspects of that setting".		In the city setting, forward progress on health inequities has been made through city governance and planning, including investment in active transport, environmental design and regulatory controls. At the community/ neighbourhood level, positive health impacts have been facilitated by governance structures and committees that allow representatives from a wide range of demographic groups. Several examples of meal programs	identified much of this work targets individual behaviour change through settings, rather than changing the setting itself. More effective initiatives to reduce health inequities will require that approaches reduce focus on individual behaviour change interventions, and focus more on interventions which change the structure of setting themselves as this is what constitutes action on broader determinants of health inequities.	

No	Author, Year Title	Study type and study designs included	Population studied	Years studied	N (no. of studies)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions	Study quality (where reported)
									in the education setting showed positive impacts on child nutrition inequities. In the workplace setting, there was strong evidence for improved health when interventions increased workers job control and autonomy. Interventions in green settings including whole of population (e.g. greening cities) as well as targeted (e.g. greening disadvantaged/dilapidated neighbourhoods) demonstrated significant benefits for a range of health equity outcomes including PA.		

Question 2 (primary studies)

No.	Author, Title	Year published	Study design	Population studied	Sample size (n=)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions
STRUCTURAL DRIVERS										
Welfare policy (Income)										
49	Lebihan et al. Unconditional cash transfers and parental obesity.	2019	Cross-sectional	Parents of young children (1-5yrs) aged 25 to 49yrs. Study participants were from the Canadian Community Health Survey, a representative sample of the Canadian population.	pre-policy n=14,894 post-policy n=17,177	Canada	Unconditional cash transfers. Study examined the Universal Childcare Benefit (UCCB) policy, introduced in 2006 by the Canadian government to assist with costs of raising children. The UCCB is CA$100 per month, provided for each child <6yrs. It is subject to income taxes and claimed by the parent with the lowest taxable income. 99% of eligible families receive the benefit.	Weight status.	For mothers, the UCCB reform was associated with a 1.7% decrease in BMI (equivalent to a decrease in average weight of approximately 1.26 kg). Mothers were also 5.4% less likely to be overweight (SE 0.011; p <0.001) and 1.9% less likely to be obese (SE 0.009; p <0.05). Sub-group analyses indicated greater changes among mothers who were less educated and single mothers in higher BMI percentiles. There was no effect of UCCB on weight outcomes among fathers.	The UCCB led to decreases in BMI and the prevalence of overweight and obesity among mothers, particularly those with lower levels of education and single mothers. However, among fathers, we find that in general the policy had no effect on weight outcomes.
50	Watson et al. Universal cash transfers reduce childhood obesity rates.	2019	Cohort study	Children Participants were sampled from an ongoing survey program administered by the Alaska Department of Health and Social Services.	n=1,225	USA	Unconditional cash transfers. Study examined the Alaska Permanent Fund Dividend (PFD) policy, an annual universal and unconditional income payment provided to all Alaskan residents. Between 2000 to 2016 the average PFD value per-person was $US 1,600.	Weight status.	An additional $US 1,000 in accumulated PFD resulted in a significant reduction in the average probability of a child being obese at 3yrs by 4.5 percentage points. Findings showed a non-linear relationship between household income and PFD effect, such that obesity-reduction effects were driven by middle-income	Findings highlight universal income may be a potential tool for addressing obesity.

No.	Author, Title	Year published	Study design	Population studied	Sample size (n=)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions
									families with no evidence of effect for low and high-income families.	
51	Akee et al. Young adult obesity and household income: effects of unconditional cash transfers.	2013	Longitudinal study	Children and adolescents. Participants were sampled from the Great Smoky Mountains Study of Youth, a longitudinal survey of 1,420 children.	n=1,420	USA	Unconditional cash transfers. Study examined household income transfers for American Indian households in North Carolina. Transfers are provided to all enrolled adult tribal members regardless of economic characteristics. Transfers comprise in part income generated from tribal owned business activities.	Weight status.	Findings indicated that unconditional cash transfers had heterogeneous effects on BMI dependent on the childs household SES. Individuals from the initially poorest households tended to gain more weight after the introduction of the transfer payments than their better off neighbours. Differences in BMI outcomes induced by differences in initial household SES remained robust when several potential mediators such as the childs initial health endowment, pre-transfer BMI, and maternal labour force participation were accounted for.	Taken as a whole, findings support the notion that unearned extra household income has heterogeneous effects on children and adolescent weight status dependent on the childs household SES
52	Ludwig et al. Neighborhoods, obesity, and diabetes: a randomized social experiment.	2011	RCT	Families with children in public housing developments in census tracts with poverty rates of 40% or more. Study focused on one woman from each family (usually the household head).	total of n=1,788 assigned to study groups.	USA	Housing support voucher program, with conditionality on moving to low-poverty neighbourhood. Program administered by the Department of Housing and Urban Development. Families in the intervention group received a rent-subsidy voucher for private market housing, but were required to use in a census tract with a	Weight status.	At 10 to 15yrs follow-up, the prevalence of obesity was lower among women assigned to the low-poverty voucher group compared to the control group. Absolute difference for BMI ≥35: 4.61 percentage points (95% CI −8.54 to −0.69; p=0.02); BMI ≥40 3.38 percentage points (95% CI −6.39 to −0.36; p=0.03). There was NS difference in BMI outcomes between the group receiving traditional vouchers	The opportunity to move from a neighbourhood with a high level of poverty to one with a lower level of poverty was associated with modest but potentially important reductions in the prevalence of obesity.

No.	Author, Title	Year published	Study design	Population studied	Sample size (n=)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions
							low poverty rate (<10%). This conditionality was removed after 1yr. Families in the comparison group received a standard voucher (no conditions on where to reside). Control families were offered no new assistance.		and the control group, or between the 2 voucher groups. Dose response modelling indicated women who spent more time in lower-poverty census tract areas had greater improvements in BMI outcomes.	
DAILY LIVING CONDITIONS										
Physical environment										
53	Bondo Anderson et al. Increases in use and activity due to urban renewal: effect of a natural experiment.	2017	Natural experiment	Adolescents (11-16yrs) residing in a deprived district (approximately half of the people living in the area resided in low-rent public housing).	n=319 at follow-up.	Denmark	A multicomponent urban renewal project in a disadvantaged neighbourhood. Project was implemented under the auspices of public housing associations, the local government, and the Ministry of Housing. Renewal included new urban green spaces, playgrounds, park renovations, and establishment of a civic centre for social gatherings and sport.	PA.	Post-renewal, adolescents spent 24.6 mins (95% CI 4.4 to 44.9; p=0.017) more per day in the district. Of this additional time, 7.8 mins (95% CI 1.1 to 14.7; p=0.012) were spent in light PA, and 4.5 mins (95% CI 1.8 to 7.2; p= <0.001) in moderate to vigorous PA.	Findings indicate that a multicomponent urban renewal strategy in a disadvantaged district has the potential to increase the time spent and PA in the district among adolescents living in or close to the district.
54	Hooper et al. Evaluating the implementation and active living impacts of a state	2014	Cross-sectional study of natural experiment.	Adults who had resided in the residential development for at least 2yrs.	n=594	Australia	Liveable neighbourhood planning policies. Study examined WA State government Liveable	PA (walking for transport and for recreation).	Despite incomplete implementation of LNG planning principles in developments (average compliance 47%) odds of	Findings confirm previous research into the importance of the built environment for active living behaviours, providing

No.	Author, Title	Year published	Study design	Population studied	Sample size (n=)	Country(ies) studied	Policy, program or intervention	Outcomes examined	Effects	Authors conclusions
	government planning policy designed to create walkable neighborhoods in Perth, Western Australia.						Neighbourhoods Community Design Guidelines (LNG), which prescribe 128 neighbourhood design criteria across 6 elements, 4 of which (community design; movement network; lot layout; public parkland) aim to promote active living through more compact, pedestrian friendly neighbourhoods, with destination and public transport links. Liveable residential developments deemed by the Department of Planning to have complied with the LNG were evaluated.		walking for transport increased with overall levels of policy compliance (OR 1.53, 95% CI 1.13 to 2.08) and compliance with the community design (OR 1.3, 95% CI 1.13 to 1.42); movement network (OR 2.49, 95% CI 1.38 to 4.50); and lot layout elements (OR 1.26, 95% CI 1.06 to 1.50). There was NS effect, however, on walking for recreation.	evidence for the impact of a planning policy on the walking behaviours of residents in suburban environments.

Abbreviations:

BE: built environment; BMI: body mass index; CBA: controlled before and after study; 95% CI: confidence interval; EDNP: energy dense nutrient poor; EPHPP: Effective Public Health Practice Project; F&V: fruit and vegetables; ITS: interrupted time series study; LTPA: leisure-time physical activity; NS: non-significant; NR: not reported; OR: Odds Ratio; p: probability value; PA: physical activity; RCT: randomised controlled trial; ROB: risk of bias; RR: Risk Ratio; SB: sedentary behaviour; SE: Standard Error; SES: socioeconomic status; SEP: socioeconomic position; SSB: sugar-sweetened beverage; SMD: standardised mean difference.