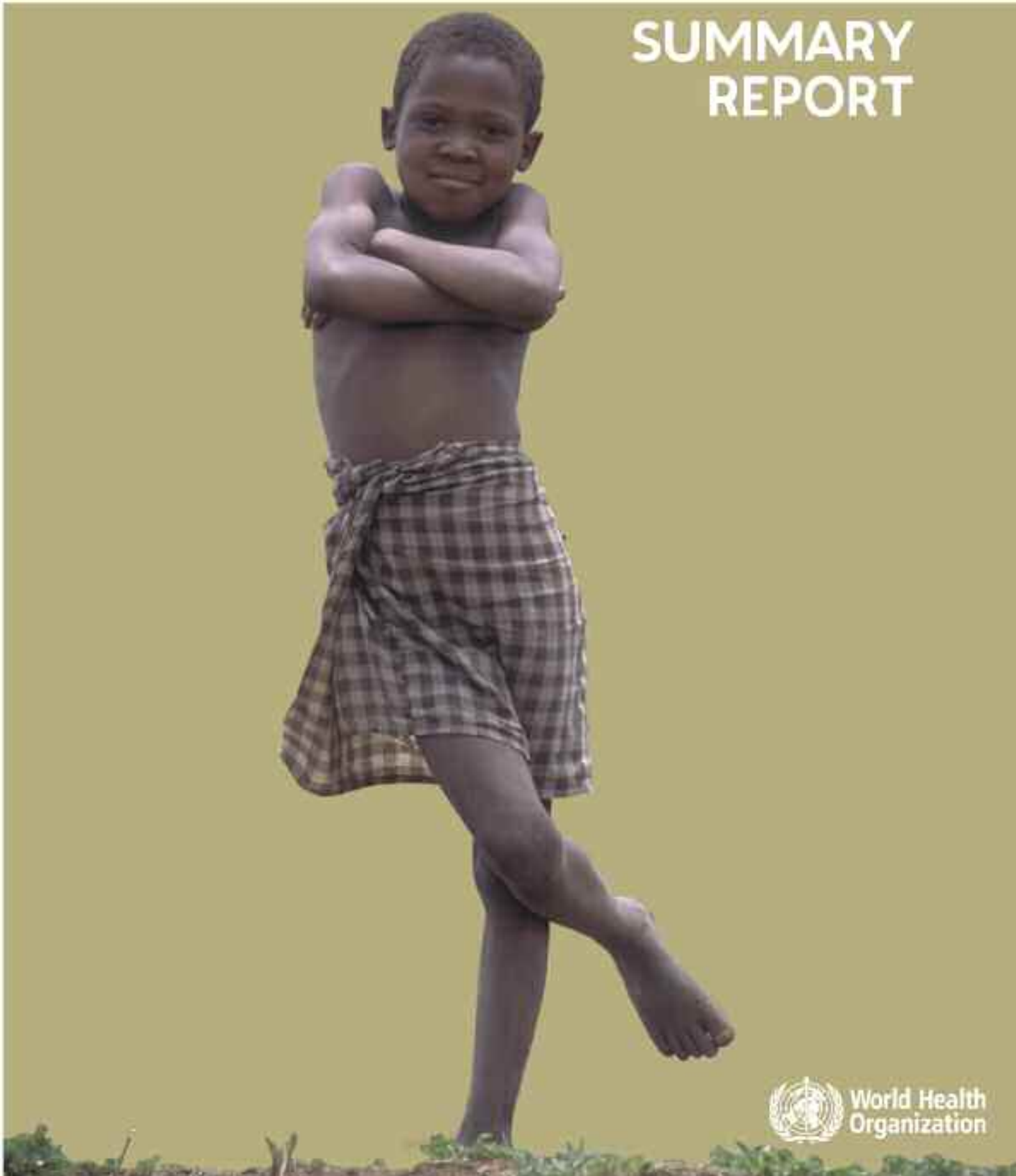
INTERVENTIONS ON DIET AND PHYSICAL ACTIVITY: WHAT WORKS

SUMMARY REPORT



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INTERVENTION ON DIET AND PHYSICAL ACTIVITY: WHAT WORKS

SUMMARY REPORT

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Contents

Executive Summary

Recognizing the heavy and growing burden of chronic noncommunicable diseases (NCDs), the Global Strategy on Diet, Physical Activity and Health (DPAS) was endorsed by the World Health Assembly in 2004 *(1)*. DPAS describes the responsibilities of various stakeholders to take action to improve diet and promote physical activity. One of the responsibilities of the World Health Organization (WHO) is to "identify and disseminate information on evidence-based interventions, policies and structures". This priority is further underlined in the NCD Action Plan that was endorsed by the World Health Assembly in May 2008.

Interventions on diet and physical activity: what works (What Works) addresses this responsibility. It provides policy-makers and other stakeholders with a summary of tried and tested diet and physical activity interventions that aim to reduce the risk of chronic NCDs.

The evidence on effective interventions is presented under the eight categories listed below. These headings are intended to serve as a guide to assist the reader to find interventions of relevance. Once a topic of interest has been identified, the reader can rapidly find a detailed summary of each intervention by consulting the online background *Evidence Tables* to *What Works*.

- policy and environment;
- mass media;
- school settings;
- the workplace;
- the community;
- primary health care;
- older adults;
- religious settings.

Across the categories used in What Works, multi-component interventions that are adapted to the local context were found to be the most successful. Interventions that used the existing social structures of a community, such as schools or the weekly meetings of older adults, reduced barriers to implementation. Effective interventions invariably involved participants in the planning and implementation stages, such as involving the workers themselves in workplace interventions, and community leaders in community and religion-related programmes.

Executive Summary

The review also revealed gaps in knowledge. Much of the literature only reports short-term outcomes, and therefore little is known on the potential long-term effects, sustainability, and cost-effectiveness of interventions. While grey literature was used to supplement the peer-reviewed research, there is still a lack of information on interventions in low- and middle-income countries, and thus an urgent need for further research in these settings, and for upscaling the monitoring and evaluation of interventions. The framework and indicators developed by WHO to assist governments and other stakeholders to monitor the progress of their activities to promote a healthy diet and physical activity should facilitate this (for more information, see www.who.int/dietphysicalactivity/DPASindicators).

Although there is no one-size-fits-all approach for selecting interventions, the results of this review provides a summary of tried and tested diet and physical activity interventions to support and enable individuals to make healthy choices.

Background

Growing burden of disease

NCDs are by far the leading cause of death in the world today, and their impact is steadily growing. In 2005, 35 million people died from NCDs, which represents 60% of the total number of global deaths in that year. Moreover, between 2005 and 2015, deaths due to NCDs are projected to increase by 17%. This largely invisible epidemic is more serious in low- and middle-income countries, where 80% of all NCD deaths occur.

The main causes of NCDs are known. A small set of common risk factors is responsible for most of the major NCDs: unhealthy diet, physical inactivity and tobacco use. Elimination of these modifiable risk factors would prevent 80% of premature heart disease, 80% of premature stroke, 80% of type 2 diabetes and 40% of cancer.

In 2005, WHO set a global goal to reduce chronic NCD death rates by 2% per year over the following 10 years. Meeting this goal would result in 36 million deaths averted by 2015 *(2)*. The goal can be achieved by using existing scientific knowledge on sustainable and effective interventions to tackle the main causes of chronic NCDs.

Mandate

In response to the growing burden of chronic NCDs and in order to reduce the impact of major risk factors such as unhealthy diet and physical inactivity, the World Health Assembly adopted the *Global Strategy on Diet, Physical Activity and Health* in May 2004. Paragraph 27 of DPAS states:

> *Strategies need to be based on the best available scientific research and evidence; comprehensive, incorporating both policies and action and addressing all major causes of noncommunicable diseases together; multisectoral, taking a long-term perspective and involving all sectors of society; and multidisciplinary and participatory, consistent with the principles contained in the Ottawa Charter for Health Promotion and confirmed in subsequent conferences on health promotion, and recognizing the complex interactions between personal choices, social norms and economic and environmental factors.*

Paragraph 51 of DPAS states that WHO will focus on:

> *identifying and disseminating information on evidence-based interventions, policies and structures that are effective in promoting healthy diets and optimizing the level of physical activity in countries and communities.*

Background

Rationale and purpose

This document addresses the responsibility described above by providing policy-makers and other stakeholders with a summary of tried and tested diet and physical activity interventions that aim to reduce the risk of chronic NCDs.

It builds on previous evidence on dietary interventions *(3)*, broadening this knowledge to include physical activity. Emphasis in this new review is also placed on evidence from disadvantaged communities and from low- and middle-income countries where the burden of chronic NCDs is growing rapidly. Consequently, the evidence from grey literature is included to supplement peer-reviewed studies in an effort to capture as much available knowledge as possible.

Methods

Introduction

"Interventions on diet and physical activity: what works." is presented as three complementary documents (one summary report and two background documents):

- *The Summary Report* provides relevant stakeholders with a summary of the systematic review of evidence evaluating the effectiveness of diet and physical activity interventions to prevent chronic NCD.
- The background paper titled *Methodology*, provides researchers and other interested parties with detailed information on the five stages of the methodology used for the review.
- The background paper titled *Evidence tables*, provides researchers and other interested parties the detailed results of the review of the evidence evaluating the effectiveness of intervention studies included in the systematic review.

The methodology used for What Works was designed to evaluate the existing evidence on the effectiveness of diet and physical activity interventions that aim to prevent chronic NCD at group, community and population levels, with a focus on disadvantaged communities and low- and middle-income countries.

The complete results of this review and an extensive description of the methodology can both be found online in the background documents Evidence Tables and Methods respectively (www.who.int/dietphysicalactivity/whatworks).

This chapter provides a brief overview of the methodology used for: the systematic review and the preparation of the *Summary Report*.

Development of the summary report

The Surveillance and Population-based Prevention Unit at WHO Headquarters developed the document "Summary Report" according to the process described below:

- **Phase 1** - A systematic review of evidence evaluating the effectiveness of diet and physical activity interventions to prevent chronic NCD was undertaken by the Medical Research Council of South Africa and the Faculty of Health Sciences, University of Cape Town (see acknowledgements section).
- **Phase 2** - preparation of a draft Summary Report document to be used in subsequent consultation phases
- **Phase 3** - submission of the Draft Summary Report for consultation to: relevant Units within the departments of Chronic Diseases and Health Promotion, Nutrition for Health and Development and Health Systems Financing in WHO headquarters; DPAS and NCD focal points in all WHO Regional Offices.
- **Phase 4** - Finalization of the Summary Report.

Methods

Search strategy

The search strategy was restricted to studies on diet and/or physical activity that included human participants and were published in English between January 1995 and June 2006. The interventions described in the studies, however, could have taken place before 1995.

The following databases were searched: Cochrane Library, EMBASE and PubMed. The search strategy focused on four constructs for diet and physical activity: behaviour, intervention, objectives, and outcome.

The final yield of this process, after duplicates were removed, was 937 diet studies and 776 physical activity studies.

Inclusion criteria

The review included studies on interventions:

- aimed at reducing risk for NCDs
- aimed primarily at "apparently healthy" adults and children
- targeting groups or communities
- with a sample size greater than fifty
- that were clearly described
- cited in primary references only.

Interventions had to meet all the above criteria. All study designs were accepted, ranging from quasi-experimental and community-controlled trials to randomized controlled trials, to process or programme evaluations. A total of 395 peer-reviewed publications met the inclusion criteria, describing 261 different interventions. Of these 261 interventions, 64 focused on disadvantaged communities and 13 took place in low- and middle-income countries. The 395 peer-reviewed publications were grouped into categories by setting or life-course stage (Table 1). This categorization is intended to assist the reader to find interventions of relevance and facilitate an initial analysis.

Methods

Inclusion criteria

Table 1. Overview of studies and interventions by category

Category	Total number of peer-reviewed studies	Total number of interventions	Interventions focusing on disadvantaged communities	Interventions in low - or middle - income countries
Policy and environment	30	23	3	2
Mass media	36	24	2	3
School settings	107	55	14	1
The workplace	49	38	5	1
The community	75	65	22	3
Primary health care	67	29	5	0
Older adults	18	17	3	3
Religious settings	13	10	10	0
Total	**395**	**261**	**64**	**13**

Qualitative assessment

The general quality of the included studies was subsequently analysed using a quality assessment instrument. The purpose of the quality assessment was to judge how far any firm recommendations could be made based on the evidence. Each study was assessed based on the criteria used to select participants, the study design, data collection methods, intervention integrity, and withdrawals and drop-outs. Table 2 provides the quality scores per category.

Table 2. Quality scores by category

Category	No score (e.g. process evaluations)	Quality			Mean	Median
		Low	Medium	High		
Policy and environment	2	7	13	8	2.0	2.0
Mass media	1	7	20	8	2.0	2.0
School settings	1	18	46	42	1.8	2.0
The workplace	2	9	25	13	1.9	2.0
The community	3	19	32	21	2.0	2.0
Primary health care	0	11	37	19	1.9	2.0
Older adults	0	3	10	5	1.9	2.0
Religious settings	1	0	7	5	1.6	2.0
Total	**10**	**74**	**190**	**121**		

Methods

Inclusion of grey literature

The grey literature selected for inclusion comprised primarily web-based sources. Some personal communications and workshop proceedings were also included. This literature was useful in filling gaps in the evidence-base, primarily in low- and middle-income countries. In addition, it was used to elaborate on specific intervention programmes evaluated in the peer-reviewed literature. The grey literature used is included in the reference list.

Evidence tables

The 395 peer-reviewed publications that met the inclusion criteria and the included grey literature were summarized and rated in evidence tables. Information was extracted on the components of the interventions, each of which was then rated on the following three primary outcome measures:

i) **psychosocial changes**, including knowledge and attitudes related to diet and physical activity, self-efficacy, and stage of change;
ii) **behavioural changes**, including behaviour towards diet, physical activity, and sedentary lifestyles;
iii) **physical and clinical changes**, including blood pressure, body mass index, cholesterol and weight.

Each intervention was assigned a quality ranking, according to the outcome measures. The quality rankings are described below.

- *Effective*: These interventions were based on a formative assessment, with a generally robust experimental design or sufficient sample size, and with significant effects on specified outcome variables. They generally met all or most of the planned objectives and would probably be applicable in other settings (disadvantaged communities and low- and middle-income countries), and demonstrated feasibility and sustainability in their current category. These interventions were most often considered the "example intervention" for the category and specific outcome.

Moderately effective: These interventions lacked one or more of the critical components listed above, but were sufficiently robust to warrant consideration for application in specific settings or groups and met some, if not all of the planned objectives.

- *Promising/Insufficient evidence:* These interventions demonstrated an important trend or a significant effect, but may not have been sufficiently robust in terms of experimental design or sample size, and may therefore benefit from further testing and research.

- *Minimally effective:* Interventions in this ranking had significant, but perhaps not clinically relevant effects in at least one of the outcome areas. The study designs were sufficiently robust and therefore unlikely to yield different or better results through additional testing or in other settings.

Methods

Evidence tables

- *Insufficient evidence/not shown to be effective:* Here, the study design of the interventions was not robust, and the results sufficiently unremarkable or negative that no further testing or research application are warranted.
- *Not reported/not measured:* The outcomes of these interventions were either not measured, or measured but not reported.

Finally, observations were made on the process and policy implications of each intervention, as well as its intervention fidelity, sustainability, feasibility and cost-effectiveness, where data were available or evaluated. Attention was particularly drawn to programmes that could be effective in a broader context, or specifically in under-resourced settings.

The information that resulted from this review is presented in the background document *Evidence Tables* that can be accessed at: www.who.int/dietphysicalactivity/whatworks.

Limitations of the review design

The restrictions in the search strategy noted earlier mean that potentially valuable information may be missing from the results. Examples include interventions published before 1995, those published in languages other than English, and interventions that had not yet been analysed in the scientific literature at the time of this review (for example legislation to reduce trans fatty acids).

While grey literature was used to supplement the peer-reviewed research, there is still a lack of information on effective interventions, especially from low- and middle-income countries.

Quality scores for the studies included were generally modest. Therefore, even where evidence was available, the quality of the study was not always high enough to be able to make firm recommendations.

Finally, an assumed bias towards only publishing intervention strategies that are effective may explain the relative paucity of entries in the "not shown to be effective" category.

Considering the above-mentioned limitations and the fact that additional evidence has been published since June 2006, the content of this document may need to be revised within the next five years.

Interventions

Introduction

The summary of the evidence collected in the systematic review is presented in this chapter under the following intervention categories:

- policy and environment
- mass media
- school settings
- the workplace
- the community
- primary health care
- older adults
- religious settings.

Although this categorization was chosen to facilitate an analysis by the reader, it should be underlined that interventions are only truly effective when national policies are aligned, coherent and supportive (portfolio approach).

Each category starts with extracts from DPAS, followed by an overview describing the scope of the category, and a summary of the evidence condensed into the following groups:

- ***Effective interventions:*** These interventions were based on a formative assessment, with a generally robust experimental design or sufficient sample size, and with significant effects on specified outcome variables. They generally met all or most of the planned objectives and would probably be applicable in other settings (disadvantaged communities and low- and middle-income countries), and demonstrated feasibility and sustainability in their current category. These interventions were most often considered the "example intervention" for the category and specific outcome.

- ***Moderately effective interventions:*** These interventions lacked one or more of the critical components listed above, but were sufficiently robust to warrant consideration for application in specific settings or groups and met some, if not all of the planned objectives.

One or two example interventions are then presented. An example intervention is one that serves as an archetype or model for a particular setting; a typical example of good practice that has been shown to be effective with respect to at least one outcome. Example interventions have preferably taken place in disadvantaged communities or in low- or middle income countries, and may be described as feasible or sustainable.

Each category ends with a synopsis of the psychosocial, behavioural, and physical and clinical outcomes and, finally, a summary statement.

Interventions

Policy and environment

OVERVIEW

"National food and agricultural policies should be consistent with the protection and promotion of public health. Where needed, governments should consider policies that facilitate the adoption of healthy diet."

"Multisectoral policies are needed to promote physical activity."

"National and local governments should frame policies and provide incentives to ensure that walking, cycling and other forms of physical activity are accessible and safe; transport policies include nonmotorized modes of transportation; ... and sport and recreation facilities embody the concept of sport for all."

Policies and interventions that modify the physical environment are crucial to making changes to the diet and physical activity patterns of the population. A total of 23 interventions were summarized, with three targeting disadvantaged communities and two in low- or middle-income countries (4–30).

Included in this category are policies that change the composition of staple foods and that have a direct influence on the nutrient intake of the population. Environmental changes have also been demonstrated in the way stores and restaurants have used point-of-purchase prompts and messaging to encourage shoppers to select healthier food. Further, vending machines have been used to sell healthier snacks and beverages. From a physical activity perspective, environmental policies that impact on people's mode of transport or that increase public space for recreational activities, can also provide health benefits.

Summary of the evidence from the systematic review	
Effective interventions	• Government regulatory policies to support a healthier composition of staple foods (e.g. replacing palm with soya oil reduces the saturated fatty acid content of the oil) *(28)*. • Environmental interventions targeting the built environment, policies that reduce barriers to physical activity, transport policies and policies to increase space for recreational activity *(4, 6, 15, 19, 20, 24, 27)*. • Point-of-decision prompts to encourage using the stairs (e.g. information on the benefits of physical activity beside elevators and stairs) *(4, 8, 12, 18, 22)*.
Moderately effective interventions	• Pricing strategies (fiscal policies) and point-of-purchase prompts in grocery stores, vending machines, cafeterias and restaurants to support healthier choices *(7, 13, 14, 16, 17, 25, 26)*. • Multi-targeted approaches to encourage walking and cycling to school, healthier commuting and leisure activities *(5, 6, 15, 20, 24, 29, 30)*.

Interventions

EXAMPLE INTERVENTIONS	
	In 1987, the Ministry of Health of Mauritius introduced a regulatory policy to change the composition of general cooking oil, limiting the content of palm oil and replacing it with soya bean oil. Five years after the intervention, total cholesterol concentrations had fallen significantly in men and women. Consumption of saturated fatty acids had decreased by an estimated 3.5% of energy intake. This activity was part of the national NCD intervention programme and a demonstration project within WHO's "Interhealth" initiative *(10, 28)*.
	Ciclovia is an environmental intervention targeting the built environment and a multi-targeted approach to encourage healthier commuting. In 1995, the city of Bogota in Colombia initiated a vast transformation of the physical urban environment, providing accessible pathways for nonmotorized transport and an improved public transport system. A total of 260 km and 16 routes for bicycles have now been constructed. Ciclovia happens every Sunday when 120 km of roadways are closed to motorized vehicles. Results show that woman who usually participate in Ciclovia are seven times more likely to be physically active. Another result of the cycle routes is an improvement in public transport, and the prevalence of persons travelling by car has dropped from 17% to 12% during peak times *(15, 29, 30)*.

Outcomes

The majority of dietary studies reported positive behavioural and psychosocial outcomes. Sales of healthier options generally increased in interventions where these options were available and/or were reduced in price *(7, 13, 14, 16)*. Physical and clinical outcomes were rarely reported as many of these interventions target large populations. Only one study reported a clinical change, namely a significant decrease in cholesterol levels in adults *(28)*.

Fourteen of the 23 interventions focused on physical activity alone. The frequency of stair use increased in all interventions that encouraged it *(4, 8, 12, 18, 22)*. All the structural interventions reviewed demonstrated some increase in awareness of the importance of physical activity, intention to become physically active or knowledge regarding physical activity and health *(4–6, 8, 12, 15, 18, 20, 22, 24, 27, 29, 30)*. All except for one physical activity intervention *(18)* were moderately effective in terms of changes in physical activity behaviour in the target groups.

Summary statement

Relatively few policy and environmental interventions have been evaluated in peer-reviewed studies. More research is urgently required. The current review showed that policy and environmental interventions create a healthy environment and support individuals to make healthy choices. These interventions can reach large populations. The evidence showed that regulatory policies to support a healthier composition of foods also work. Policies targeting the built environment or a reduction in barriers to physical activity showed positive results. Finally, point-of-decision prompts encouraging the use of stairs proved to be simple but effective policies.

Interventions

Mass media

OVERVIEW

"Consistent, coherent, simple and clear messages ... should be communicated through many channels and in forms appropriate to local culture, age and gender."

"Simple, direct messages need to be communicated on the quantity and quality of physical activity sufficient to provide sustainable health benefits."

Mass media campaigns use paid and non-paid forms of media to increase knowledge and change attitudes and behaviours towards diet and physical activity. These interventions commonly employ television and radio, as well as print media, and are often associated with community-based activities that run in parallel. Twenty-four interventions were summarized, including two targeting disadvantaged communities and three in low- or middle-income countries *(31–64)*.

Summary of the evidence from the systematic review	
Effective interventions	• Mass media campaigns promoting physical activity *(31–33, 36, 37, 40, 41, 44–49, 52, 53, 55–58, 62)*: - with community-based, supportive activities such as programmes in schools and local communities; or - associated with policies to address local environmental barriers to participation.
Moderately effective interventions	• Intensive mass media campaigns using one simple message, e.g. increasing consumption of low-fat milk, or fruit and vegetables *(38, 41, 54)*. • National "health brand" or logos to assist consumers to make healthy food choices *(43, 63)*. • Long-term, intensive mass media campaigns promoting healthy diets *(38, 59–61)*.

Interventions

EXAMPLE INTERVENTIONS	
	Agita São Paulo is a mass media campaign in Brazil with the primary goal of increasing population levels of physical activity. Agita involves over 300 institutions collaborating with multiple stakeholders. Agita's message is to do 30 minutes of physical activity on at least five days a week. The programme aims to empower existing initiatives by coordinating and promoting activities and interventions in schools, the workplace and for seniors, with an emphasis on fun. In Sao Paulo province, the number of active or very active individuals increased by 10.2%. Agita São Paulo is well-known, with more than half of the local population aware of the campaign *(44–46)*.
	The *1% or Less Campaign* is an intensive mass media campaign using one simple message to promote the use of low-fat milk. The campaign was undertaken over a period of six weeks in Wheeling, USA, after which 34% of milk drinkers indicated having changed to low-fat milk compared with 3.6% in the control community. This was corroborated by the finding that low-fat milk sales increased from 29% to 46% in the intervention group. The media approach alone was enough for a significant proportion of people to alter the dietary habit targeted by the intervention *(54)*.

Outcomes

Fifteen of the 24 interventions reported psychosocial improvements, mostly in awareness of the campaign *(31, 32, 36–47, 52, 53, 55, 57, 62, 63)*.

Half of the interventions reported positive changes in behaviour *(32, 33, 36–39, 41–47, 50, 52–55, 57, 62, 63)*.

Four of the five interventions that reported on physical and clinical changes showed improvements *(33, 40, 47, 48, 62)*.

Outcomes were often related to exposure, such that increased exposure to the campaign translated into greater positive changes *(36, 46)*.

Positive changes were reported in high, low- and middle-income countries.

Summary statement

Since there have been few evaluations of mass media campaigns against chronic NCDs, more evidence is required on their effectiveness in a variety of settings and life cycle phases. Further research is needed to determine whether changes made as a result of such campaigns are sustained post-intervention. The limited knowledge base and data available make comparative analyses and cost-effectiveness research difficult. However, there is sufficient evidence to recommend multi-component mass media campaigns on a population basis in the settings which have been tested.

Characteristics of mass media campaigns for physical activity that have been successful in changing awareness and behaviour include the use of a simple message with frequent exposure. Those that are most likely to be successful are accompanied by appropriate "upstream" policy support and "downstream" community-based activities, and usually involve a community participation approach.

Interventions

School settings

OVERVIEW

"Of particular concern are unhealthy diets, inadequate physical activity and energy imbalances in children and adolescents."

"School policies and programmes should support the adoption of healthy diets and physical activity. Schools influence the lives of most children in all countries."

The largest number of studies evaluated was on school-based interventions. One hundred and seven peer-reviewed articles provided information on 55 interventions, mostly from North America *(65, 108)*. Minimal research came from low- or middle-income countries, although 14 interventions targeted disadvantaged communities within high-income countries. Common among the reviewed studies were comprehensive, multi-component programmes with interventions targeting the school environment and its food services and classroom curriculum. Many interventions combined diet and physical activity, and encouraged parental involvement

Summary of the evidence from the systematic review	
Effective interventions	• High-intensity school-based interventions that focus on diet and/or physical activity, are comprehensive, multi-component and include: - curriculum on diet and/or physical activity taught by trained teachers *(65, 66, 68, 69, 71, 72, 77, 78, 81, 82, 84, 85, 87, 88, 97- 99, 100-106, 109, 110, 112, 113, 115--126, 129 - 131, 134, 136, 138, 141, 142, 145-147, 154 -162, 165, 166, 169, 170)*; - supportive school environment/policies *(70, 92, 109, 119, 134,137)*; - a physical activity programme *(121,127, 128, 154, 155)*; - a parental/family component *(65, 66, 72, 77, 78, 81, 82, 84, 85, 97, 100, 106, 110, 113, 115-118, 120-123, 125, 126, 129-131, 136, 138, 141, 142, 145-148, 154, 155, 158-162, 166, 169, 170)*; - healthy food options available through school food services: cafeteria, vending machines, etc. *(77, 78, 81-84, 92, 93, 98, 99, 100, 104-107, 110, 115-118, 125, 126, 129-131, 133, 136-139, 141-144, 146-148, 156- 159, 166)*.
Moderately effective interventions	• A focused approach, for example programmes aimed at reducing sedentary behaviour and increasing participation in physical activity, accompanied by supportive activities within the curriculum *(127, 128, 149, 150)*. • A formative assessment that addresses the needs of the school and cultural contexts *(73, 78, 142, 147, 156, 157, 159)*.

Interventions

EXAMPLE INTERVENTIONS	
	CATCH, a three-year programme from grade 3 through to grade 5 in the United States of America *(83, 84, 106, 107, 111, 115, 118, 124- 126, 133, , 138, 166)*, Pathways, a three-year intervention targeting 8 to 11-year-old indigenous American children *(78, 81, 98, 99, 156-158)*, and Know Your Body, a six-year programme targeting pupils in grades 1 to 6 in Crete *(120-123)* are all example interventions that are comprehensive, multi-component, school-based, and focus on diet and physical activity. All were grounded on constructs from social learning theory with Pathways placing a strong emphasis on cultural identity. The programmes included curricula offered by trained teachers, a physical activity component and healthier meals offered in the school canteen (CATCH and Pathways). There was also a strong parental focus. The fact that teachers implemented the intervention made it sustainable and cost-effective. Of the family-based components, events at school were the most successful. These programmes demonstrated significant improvements in knowledge and food choices. Children in the Know Your Body programme demonstrated substantive reductions in intake of dietary fat, particularly saturated fat, and four- to five-fold increases in self-reported leisure-time activity. Pathways' process evaluation found that the intervention was successfully implemented with good reach, and high coverage and intervention fidelity. These programmes demonstrated the importance of community-based participatory research, and that a careful process of formative assessment is key to effectiveness and long-term success.

Outcomes

Nearly all the school-based studies showed positive psychosocial and behavioural outcomes. However, only a few measured clinical outcomes.

Positive psychosocial changes were reported for 28 interventions *(65, 66, 68, 71, 72, 78, 81-84, 87, 88, 91, 92, 98-104, 106-108, 110, 111, 113, 115, 118, 120, 122, 123, 124-129, 133, 138, 139, 141, 145-147, 150, 153, 160, 154-158,164, 166,168)*.

Behaviour was positively improved in 49 of the interventions, ranging from an increase in fruit and vegetable consumption to the number of minutes of physical activity *(65-67, 70, 71, 77, 79, 80, 82, 85-88, 91-93, 95-97, 100-105, 108, 109, 118, 117, 120, 122, 123, 126- 129, 134, 136-139, 141, 149, 150, 153-155, 158, 167, 170, 171)*.

15 interventions reported positive phisical and clinical changes *(71, 85, 88, 90, 100-103, 109,110, 120, 122, 123, 127, 128, 134, 149, 166, 170, 171)* and 6 reported no changes *(98, 108, 144, 146, 147, 151, 152, 165, 172)*.

Summary statement

School-based interventions show consistent improvements in knowledge and attitudes, behaviour and, when tested, physical and clinical outcomes. There is strong evidence to show that schools should include a diet and physical activity component in the curriculum taught by trained teachers; ensure parental involvement; provide a supportive environment; include a food service with healthy choices; and offer a physical activity programme. However there is lack of cost-effectiveness research in this area.

Interventions

The workplace

OVERVIEW

"National and local governments should frame policies and provide incentives to ensure that ... labour and workplace policies encourage physical activity."

The 38 workplace interventions reviewed included five that targeted disadvantaged communities (172-221). The majority of these interventions took place within North America, with a few based in Europe, and only one in a low- or middle-income country. Interventions were primarily multi-component and activities included environmental changes, food service changes, information campaigns, physical activity programmes and the adoption of healthy policies.

Summary of the evidence from the systematic review	
Effective interventions	• Multi-component programmes *(177, 182, 189, 190, 197-199, 202, 205, 206, 210, 213-215, 217, 222, 225)* promoting healthy dietary habits and/or physical activity, that: - provide healthy food and beverages at the workplace facilities, e.g. in the cafeteria or vending machines *(174-178, 180, 181, 185, 196, 202, 205, 206, 213, 218)*; - provide space for fitness or signs to encourage the use of stairs *(18, 206)*; - involve workers in programme planning and implementation *(175-177, 185, 197, 198, 205, 213, 217)*; - involve the family in interventions through self-learn programmes, newsletters, festivals, etc. *(197, 198, 215, 217)*; or - provide individual behaviour change strategies and self-monitoring *(184, 193, 200, 204, 211)*.

EXAMPLE INTERVENTIONS	
	The *Treatwell 5-a-day* is a multi-component programme promoting healthy dietary habits. The programme includes exposure to the national 5-a-day media campaigns, promotion of the Cancer Information Service hotline, and a one-hour diet presentation. Two intervention conditions were tested. The first was limited to the workplace, while the second tested a workplace-plus-family arm. The workplace component included worker participation in planning and implementation; programmes aimed at individual behaviour change; and changes in the workplace environment. The family component included self-learning, a family newsletter and an annual festival. Workplaces that included the family component were the most successful and recorded a 19% increase in fruit and vegetable consumption in the intervention group, compared to 7% in the workplace-only group *(197, 198, 215, 217)*.

Interventions

Outcomes

Nineteen interventions had positive psychosocial changes in the areas of knowledge, attitudes and/or self-efficacy *(120, 122, 123, 172, 178-180, 183-185, 190, 196, 199, 200, 206, 208, 210, 212, 220)*.

Positive behavioural changes were reported in 25 studies *(172, 173, 176, 178, 180, 183-185, 187-189, 197-199, 202, 204, 206, 208, 210, 211, 212, 214, 216, 217, 219)*.

Physical and clinical changes were largely not evaluated, although 15 interventions demonstrated at least moderate improvements in BMI, blood pressure, and/or serum cholesterol *(172, 178, 182, 184, 185, 188, 194, 195, 204-207, 209-211, 219)*.

Summary statement

The workplace is an ideal venue to offer employees structured and planned activities to improve their health. Since many workplaces provide meals, snacks and/or beverages, these can be optimized by providing healthy options at lowest prices in vending machines or in the available food service facilities. Additionally, physical activity programmes that are accessible and sustainable can be introduced at low cost to the organization to provide maximum health benefits for employees. Evidence consistently indicates that including workers in programme planning and implementation brings positive outcomes.

Interventions

The community

OVERVIEW

"Strategies should be geared to changing social norms and improving community understanding and acceptance of the need to integrate physical activity into everyday life."

Community-level interventions target communities, neighbourhoods, families, parents, couples and disadvantaged populations. Sixty-five interventions were reviewed with more then 20 focusing on disadvantaged communities and three from low- or middle-income countries *(222-282)*. Many of the interventions were adult classes with curriculum on diet and physical activity focusing on knowledge, attitude and behaviour change. These classes sometimes targeted chronic NCD high-risk groups, such as those predisposed to type 2 diabetes or cardiovascular diseases. There were also a number of computer- or web-based programmes focused on weight loss or walking. Additionally, some interventions offered individual counselling followed by group sessions and/or telephone counselling with information distributed through the mail.

Summary of the evidence from the systematic review	
Effective interventions	• Diet education programmes *(222, 223, 226, 231, 232, 233, 236, 242, 252-257, 281, 284, 285, 263, 288, 289, 294)* that: - target high-risk groups (e.g. menopausal, pre-diabetic women) *(226, 284, 285)*; - are multi-component *(222, 226, 228, 232, 236, 238, 263, 266, 267, 281, 284, 285,)*; • Community development campaigns with intersectoral cooperation and/or focused on a common goal (e.g. reduction in cardiovascular disease risk) *(283, 287, 292)*. • Group-based physical activity programmes or classes for a homogenous group of individuals *(284, 292)*.
Moderately effective interventions	• Interventions that use an existing phone-in service to provide dietary advice *(241, 266, 267)*. • Community-wide interventions conducted as part of a national or global campaign (e.g. healthy lifestyles strategy or "Healthy Village") in a homogenous community *(261, 273, 278, 283, 287)*. • Programmes that target low-income/low literacy populations and include diet education in the standard programme *(223, 233, 255, 256, 257)*. • Computer/web-based interventions with interactive personalized feedback, targeting high-risk groups *(229, 241, 264, 274, 270, 276, 280, 290, 294, 297)*. • Supermarket tours and on-site educational programmes to support the purchase of healthier foods *(59-61)*. • Walking school bus *(271)*.

Interventions

EXAMPLE INTERVENTIONS	Pasos Adelante, or "Steps Forward", is a community-participation campaign for chronic NCD prevention targeting border counties between the United States of America and Mexico. Community health workers were trained as promotores or group leaders and were involved in both the formative assessment and the cultural adaptation of the 12-week prevention programme. Individuals received culturally appropriate educational classes and participated in a walking club. The programme has an 87% completion rate, with a 120-minute median increase in physical activity, and a four serving increase in fruit and vegetables per person per week *(287)*.

Outcomes

Seventeen interventions reported positive psychosocial changes, including knowledge, attitudes, and self-efficacy to change behaviour *(222, 223, 226, 228, 232, 234,235, 237, 241, 246, 257, 259, 280, 283, 295)*.

Positive behaviour changes were observed in one or more areas in 41 interventions, including decreased consumption of total and saturated fats, increased consumption of fruits and vegetables and increased number of minutes of physical activity *(222-228, 230, 231, 233-236, 238, 240, 241, 249, 250, 255, 257, 259, 260, 262, 264, 266, 274, 276, 278, 281, 283, 286-289, 294, 296,)*. Seven interventions reported no improvements in behaviour *(229, 242, 248, 254, 272, 273, 292)*.

Summary statement

As with school-based interventions, the most successful community interventions generally comprised many different activities and usually included both diet and physical activity components. The majority had a strong educational component, were theory-based and focused on facilitating changes in behaviour. To date, however, few interventions have been evaluated in terms of cost-effectiveness and sustainability. The Internet and electronic communication provide the potential to create and sustain “virtual” communities of persons with common interests, challenges and needs.

Interventions

Primary health care

OVERVIEW

"Prevention is a critical element of health services. Routine contacts with health-service staff should include practical advice to patients and families on the benefits of healthy diets and increased levels of physical activity, combined with support to help patients initiate and maintain healthy behaviours."

"Routine enquiries as to key dietary habits and physical activity, combined with simple information and skill-building to change behaviour, taking a life-course approach, can reach a large part of the population and be a cost-effective intervention."

Sixty-seven manuscripts on 29 primary health care interventions were reviewed, all of which were from high-income countries *(298-367)*. Five interventions focused on disadvantaged communities. The intensity of interventions ranged from minimal, where printed materials were made available, to intense, where participants lived at a facility and had a regulated activity schedule.

Summary of the evidence from the systematic review	
Effective interventions	• Interventions targeting chronic NCD risk groups that: - include persons who are inactive, consume less than five servings of fruits and vegetables daily, consume a lot of dietary fat, are overweight, or have a family history of obesity, heart disease, cancer and/or type 2 diabetes *(298, 299, 302, 307, 309, 312-315, 318, 319, 320, 327, 329-333, 335, 339-341, 344, 350, 351, 353, 355-357, 360-362, 364, 367)*; and - include at least one session (health risk appraisal) with a health-care profes sional, with brief negotiation or discussion to decide on reasonable, attainable goals, and a follow-up consultation with trained personnel *(302, 304, 314, 315, 317, 324, 331-333, 337, 339, 365)*; - are supported by targeted information *(298-301, 304, 305, 307, 309, 312-315, 320, 323, 325, 327-336, 339-341, 344, 347-349, 350-359, 361, 362, 364, 366, 367)*; - are linked and/or coordinated with other stakeholders such as community sports organizations or ongoing mass media physical activity campaigns *(312, 313, 335, 361, 364)*.
Moderately effective interventions	• Cholesterol screening programmes that provide clients with their results and follow-up education, ideally in person *(321, 345)*. • Weight loss programmes (342, 343) using health professionals with: - personal or telephone/Internet consultations over a period of at least four weeks, and - a self-help programme that includes self-monitoring.

Interventions

EXAMPLE INTERVENTIONS

The *Green Prescription* in New Zealand targets physically inactive people seeking primary health care. A brief consultation with a primary care professional involves a discussion on the benefits of increased physical activity and joint agreement on goals. The agreed goal is then "prescribed" to the patient on green paper and faxed to the local sports foundation. Exercise specialists follow up with at least three telephone calls and the participant receives quarterly newsletters outlining opportunities for activity with the foundation. Results have shown an increase of 975 kcal/week in total energy expenditure among those in the intervention group and an increase in leisure energy expenditure of 247 kcal/week. Leisure time minutes of physical activity have also increased by 33.6 minutes per week, and those in the intervention group report an increased feeling of well-being. Green Prescription has been shown to be effective in changing physical activity behaviour and self-reported quality of life, and is cost-effective. The success of the programme is corroborated by the fact that, since it was first piloted in 1995, it now operates nationwide in New Zealand *(312, 313, 335, 361, 364)*.

Outcomes

Significant improvements in psychosocial variables were reported in five interventions *(301, 303, 307, 312, 313, 320, 331-333, 335, 340, 341, 362, 361, 364, 366)*.

Eighteen interventions reported positive behaviour changes, i.e. eating more fruit and vegetables, eating less fat, and/or increasing physical activity *(301-304, 307, 312-315, 317, 318, 320, 321, 328-333, 335, 340, 341-343, 345, 346, 348, 353-362, 364-367,)*.

Physical and clinical changes were positive in 10 interventions *(298, 299, 302, 307, 317, 320, 321, 330-333, 337, 340-345, 350, 351, 353, 356, 362, 365-367)*.

Summary statement

Interventions in the primary health care setting vary greatly in their intensity and thus in their effectiveness. Minimal contact interventions, such as health checks, single visit counselling or information distribution have typically not been effective. However, individual responses may vary depending on stage of “readiness”. In conclusion, this setting is effective at modifying risk factors with moderately intense interventions that provide chronic NCD consultations with follow-up by trained personnel and targeted information. The potential of this setting in low- or middle-income countries is largely unknown.

Interventions

Older adults

OVERVIEW

"... maintaining the health and functional capacity of the increasing elderly population will be a crucial factor in reducing the demand for, and cost of, health services."

"A life-course perspective is essential for the prevention and control of noncommunicable diseases. This approach ... encourages a healthy diet and regular physical activity from youth into old age."

Seventeen interventions specifically targeted older adults, with three focusing on those in disadvantaged communities and three from low- or middle-income countries *(308-381)*. The majority of interventions focused on physical activity. They ranged from health promotion classes, to home- and community-based physical activity classes, distribution of health information and increased exposure to fresh fruit and vegetables.

Summary of the evidence from the systematic review	
Moderately effective interventions	• Physical activity interventions in a group setting using an existing social structure or meeting place (371, 375, 379, 382, 383). • Home-based interventions in which older adults have increased access to fruit and vegetables using existing infrastructure (370, 381).

Interventions

EXAMPLE INTERVENTIONS	
	The *Seattle Senior Farmers' Market Nutrition Program* targeted home-bound older adults and aimed to increase their exposure to fresh produce by delivering baskets of fruit and vegetables every two weeks. After five months, programme participants had increased their daily consumption of fruit and vegetables by 1.04 servings. Furthermore, the number of persons receiving the recommended five daily servings of fruit and vegetables increased from 22% to 39% at follow-up compared to the baseline. This programme used an existing infrastructure, i.e. Meals on Wheels, to deliver the baskets *(370, 381)*.
	The *Community Health Intervention Programme (CHIPs)* for older adults began twice a week, peer-led physical activity classes in disadvantaged communities in rural South Africa. Classes took place following existing meetings of community seniors over a 20-week period. Significant improvements were seen in dynamic balance, lower body strength, and systolic blood pressure. This programme has been running, using a community development model through peer-leadership, for over seven years *(371)*.

Outcomes

Of the four interventions that measured psychosocial changes, two home-based programmes saw no improvement, one group programme saw an increase in quality of life and one Internet-based programme saw a decrease in perceived barriers *(306, 368, 369, 375, 379, 383)*.

Nine interventions saw favourable increases in physical activity behaviour, and both diet-related interventions saw improvements *(370, 382, 383)*.

Eight interventions reported physical and clinical changes, including improvements in blood pressure and fitness *(306, 368, 369, 371-374, 376, 378, 381-383)*.

Summary statement

Maintaining and/or improving diet and physical activity among older adults can significantly improve overall health and quality of life in a globally aging population. Group physical activity programmes reported improvements in psychosocial outcomes. Interventions were effective across contexts. More long-term research is necessary to see changes in rates of chronic NCD morbidity and mortality. Programmes for older adults must reduce barriers by addressing accessibility, for example through home delivery of fruit and vegetables, or by conducting physical activity programmes at venues where older adults regularly meet.

Interventions

Religious settings

OVERVIEW

"Consistent, coherent, simple and clear messages should be prepared and conveyed ... through several channels and in forms appropriate to local culture, age and gender. Behaviour can be influenced especially in ... religious institutions."

Of the 10 interventions in the religious category, all but one were based in the United States of America *(384-389)*. The majority of programmes were based in African-American congregations in disadvantaged communities. Programmes ranged from focusing on a healthy lifestyle, to increasing consumption of fruit and vegetables, weight loss, type 2 diabetes and cancer prevention.

Summary of the evidence from the systematic review	
Effective interventions	• Culturally appropriate and multi-component diet interventions that: - are planned and implemented in collaboration with religious leaders and congregational members using pastoral support and spiritual strategies *(384-388, 390-392, 395, 396)*; and - include group education sessions and self-help strategies *(384-387, 390, 396)*.
Moderately effective interventions	• Culturally appropriate interventions targeting weight loss, healthy dietary habits and increased physical activity *(388, 391, 395)*.

Interventions

EXAMPLE INTERVENTIONS	
	The *Black Churches for Better Health* is a multi-component intervention that recruited 50 churches from 10 counties in disadvantaged communities with at least 30% of participants from a minority population. The primary goal was to increase fruit and vegetable consumption. Information from focus groups was used to make the intervention culturally appropriate. Interventions at the individual and community level were based on social theories of behaviour change. Each pastor selected a coordinator as well as three to seven members to form the Nutrition Action Team. After two years, there was an increase of 0.85 daily servings of fruit and vegetables per participant and an increase from 23% to 33% of the sample population consuming five or more servings a day *(384, 386, 387)*.
	Project Joy is a culturally appropriate and multi-component intervention that targeted African-American women of 40 years or older. The intervention, which took place over one year, aimed at fostering a healthy lifestyle through group diet education, physical activity sessions and spiritual strategies. The control group used self-help strategies based on materials from the American Heart Association. The programme built on the social learning theory and sessions were designed to improve participants' self-efficacy. At the follow-up stage, there was a significant mean weight loss (–1.1 lbs), waist circumference (–0.66 cm), systolic blood pressure (–1.6 mmHg), energy intake (–117 kcal), total fat (–8 g), and sodium (–145 mg) in the intervention group. Further, women in the top deciles for weight loss at one year had even larger (–19.8 lbs), clinically meaningful changes in risk outcomes *(396)*.

Outcomes

Five interventions reported favourable increases in knowledge, stage of change and/or self-efficacy *(387, 389, 390, 393-395)*.

Seven interventions reported significant positive behaviour changes in physical activity or consumption of fruit and vegetables (384, 396, 390, 385, 391, 392, 394).

Positive physical and clinical changes were reported in one intervention *(396)*.

Summary statement

While the number of interventions in religious settings is small, there is consistent evidence of positive psychosocial, behavioural and physical changes. Using the existing social structure of a religious community appears to facilitate adoption of changes towards a healthy lifestyle, especially in disadvantaged communities. There are also great advantages in terms of cost of this type of study since the spiritual members themselves may take responsibility for the intervention within the ambit of the religious environment.

Conclusion

Shared characteristics of effective interventions

The evidence reviewed and presented in this report, as well as in the online background *Evidence Tables to What Works*, shows that many effective interventions exist that policy-makers can implement to improve the dietary habits and physical activity levels of populations.

Across categories, interventions that are multi-component and adapted to the local context are the most successful. Those that are culturally and environmentally appropriate are also far more likely to be implemented and sustained. Furthermore, interventions that use the existing social structures of a community, such as schools or the weekly meetings of older adults, reduce barriers to implementation.

Implicit in all successful interventions is the participation of the stakeholders throughout the process, e.g. the involvement of workers in the planning and implementation of workplace interventions, and community leaders in the community and religious categories. Listening and learning from these target populations ensures that the interventions address their needs.

Gaps in knowledge

Current data on effective diet and physical activity interventions are generally the result of short-term studies. Psychosocial outcomes may well be perceptible within a short time frame. However, behavioural, physical and clinical outcomes often take much longer to manifest and thus the full impact of the intervention may not be measured within the study follow-up time.

Moreover, little is known on the sustainability of interventions over time, nor on the cost-effectiveness of diet and physical activity interventions.

Finally, in the literature reviewed, only minimal information was available on the unintended impact of interventions.

Implications for low-and middle-income countries

There are still large unfilled gaps in the evidence base for effective interventions in low- and middle-income countries. More evidence is needed to make conclusive recommendations. To this end, WHO has developed a framework and indicators to assist governments and relevant groups in these countries to monitor the progress of their diet and physical activities (see www.who.int/dietphysicalactivity/DPASindicators).

What is known is that interventions in low- and middle-income countries should be sufficiently adapted to the cultural context and involve community members – both in the formative assessment, intervention design and implementation – for the intervention to work.

Abbreviations and glossary

Behavioural changes	Changes to dietary and/or physical activity behaviour including changes to sedentary behaviour.
Clinical changes	Changes in measurements that are used as surveillance of chronic NCD risk factors. Examples include blood glucose and cholesterol. In this report, changes in clinical and physical measurements are presented together.
BMI	Body mass index. A simple index of weight-for-height that is commonly used in classifying overweight and obesity in adult populations and individuals. It is calculated as the weight in kilograms divided by the square of the height in metres (kg/m2).
Built environment	Elements of the physical environment that are man-made, in contrast to the natural environment. The built environment includes everything from metropolitan land-use patterns to urban transportation systems to individual buildings and the spaces around them.
DPAS	WHO Global Strategy on Diet, Physical Activity and Health.
Example intervention	An intervention which serves as an archetype or model for a particular setting; a typical example of good practice, which has been shown to be effective with respect to at least one outcome, that has preferably taken place in a disadvantaged community or in a low- or middle-income country, and that may be described as feasible or sustainable.
Grey literature	Documentary material which is not commercially published or publicly available, such as technical reports or internal business documents.
NCD	Noncommunicable disease.
Physical changes	Changes in measurements that are used as surveillance of chronic NCD risk factors. Examples include BMI, waist circumference, blood pressure, pulse rate and hip circumference. In this report, changes in physical and clinical measurements are presented together.
Psychosocial changes	Changes in knowledge, attitudes, self-efficacy, and stage of change on diet and physical activity.
Self-efficacy	Beliefs that individuals hold about their capability to carry out action in a way that will influence the events that affect their lives.
Serving (of fruit or vegetables)	For vegetables this refers to one cup of raw, leafy green vegetables (spinach, salad, etc.); half a cup of another vegetable – cooked or chopped raw (tomatoes, beans, etc.); or half a cup of vegetable juice. For fruit, this refers to one medium sized piece of fruit (banana, apple, kiwi, etc.); half a cup of chopped, cooked or canned fruit; or half a cup of juice from a fruit (not artificially flavoured).

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INTERVENTION ON DIET AND PHYSICAL ACTIVITY: WHAT WORKS

SUMMARY REPORT

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