

Effective Population Health Interventions for the Primary Prevention of Musculoskeletal Conditions

Lynne Parkinson & Melissa Harris
Research Centre for Gender Health and Ageing
The University of Newcastle

An **Evidence Check** review brokered by the Sax Institute
For the Victorian Department of Health

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This report was prepared by:
Lynne Parkinson and Melissa Harris, Research Centre for Gender Health and Ageing,
The University of Newcastle

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Enquiries regarding this report may be directed to:

Prevention and Population Health Branch
Department of Health
50 Lonsdale Street, Melbourne 3000
Phone (03) 9096 0395
Email: prevention@health.vic.gov.au

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Contents

Tables.....	iii
Glossary of Terms	iv
Key Abbreviations.....	v
Main Messages.....	1
Executive Summary	3
Main Review	9
Background.....	9
Introduction.....	9
<i>Method and search strategy</i>	14
<i>Overall quality of the research</i>	17
<i>Summary of the evidence</i>	19
Older people (aged 65 years and over).....	19
Socioeconomically disadvantaged people	23
Aboriginal or Torres Strait Islander People	27
People at higher risk of vitamin D deficiency due to ethnicity or culture.....	32
Children and young people (and healthy bones).....	33
References	38
Appendices	46
<i>Appendix 1: Brief for Rapid Review</i>	46
Purpose and audience	46
Review question	46
Scope of the question.....	46
Scope of the review	47
<i>Appendix 2: Search term strategy</i>	49
<i>Appendix 3: Overview of database search results</i>	51
<i>Appendix 4: Evidence summaries</i>	56
Older people (aged 65 years and over).....	56
Socioeconomically disadvantaged people	72
Aboriginal or Torres Strait Islander people.....	80
People at higher risk of vitamin D deficiency due to ethnicity or culture.....	86
Children and young people (and healthy bones).....	87

Tables

Table 1: Summary of success factors for strategies/programs for primary prevention of OA and OP and risk factors for OA and OP by target group	6
Table 2: Risk factors and determinants of health associated with osteoarthritis.....	10
Table 3: Risk factors and determinants of health associated with osteoporosis.....	12
Table 4: NHMRC levels of evidence criteria [72]	17
Table 5: Success factors for strategies/programs for primary prevention of OA and OP and risk factors for OA and OP in older people.....	23
Table 6: Success factors for strategies/programs for primary prevention of OA and OP and risk factors for OA and OP in socioeconomically disadvantaged people.....	27
Table 7: Success factors for strategies/programs for primary prevention of OA and OP and risk factors for OA and OP in Aboriginal or Torres Strait Islander people.....	31
Table 8: Recommended daily calcium intake for children and young people	35
Table 9: Success factors for strategies/programs for primary prevention of OA and OP and risk factors for OA and OP in children and young people.....	37

Glossary of Terms

Systematic review

A systematic literature review is a method for systematically locating, appraising and synthesising evidence from scientific studies in order to obtain a reliable overview to answer a specifically stated research question [1]. Systematic reviews can include all study types and represent all levels of evidence, as described below. A systematic review should include: a defined review protocol that clearly sets out the research question/s and proposed methods; a defined search strategy to identify as much relevant literature as possible; specific detail of the search strategy to allow assessment of its rigour and completeness; explicit inclusion and exclusion criteria for primary studies; and, details of information extracted from each primary study including quality criteria to evaluate primary studies. The quality of evidence from a systematic review depends upon the methodological quality of the studies captured.

Meta-analysis

Meta-analysis is a statistical technique where results from studies identified by a systematic review are combined and summarised quantitatively. In a meta-analysis, more weight is given to results of studies with more events, and sometimes to studies of higher quality (although the latter is not recommended by the National Health and Medical Research Council [NHMRC])[1]. Meta-analysis is different from pooling raw data.

Strong evidence

Relates to NHMRC evidence Level 1. In the context of this rapid review, this assessment is obtained from a systematic review of multiple well-designed randomised controlled trials.

Good evidence

Relates to NHMRC evidence Level 2. In the context of this rapid review, this assessment is obtained from at least one properly designed randomised controlled trial of appropriate size, within the context of a systematic review.

Moderate evidence

Relates to NHMRC evidence Level 3. In the context of this rapid review, this assessment is obtained from well-designed trials such as pseudo-randomised or non-randomised trials, cohort studies, time series or matched case-control studies, within the context of a systematic review.

Weak evidence

Relates to NHMRC evidence Level 4. In the context of this rapid review, this assessment is obtained from well-designed non-experimental studies from more than one centre or research group or from case reports, within the context of a systematic review.

Very weak evidence

Relates to NHMRC evidence Level 5. In the context of this rapid review, this assessment is obtained from opinions of respected authorities, based on clinical evidence, descriptive studies or reports of expert committees, within the context of a systematic review.

Key Abbreviations

Bone Mass Density	BMD
Body Mass Index	BMI
Bone Mineral Content	BMC
Cochrane Central Register of Controlled Trials	CENTRAL
Confidence Interval	CI
Energy consumed from total fat	ETF
Environmental tobacco smoke	ETS
National Arthritis and Musculoskeletal Advisory Group	NAMSCAG
National Health and Medical Research Council	NHMRC
Nicotine replacement therapy	NRT
Osteoarthritis	OA
Osteoporosis	OP
Randomised controlled trial	RCT
Relative Risk	RR
Socioeconomic status	SES
Standard Deviation	SD
Standardised Mean Difference	SMD
Weighted Mean Difference	WMD

Main Messages

- The findings and recommendations in this review reinforce the importance of continuing to build on good evidence-informed prevention policies and programs across the risk factors of physical activity, healthy weight, tobacco, alcohol and injury prevention, as well as embedding some more specific messages about calcium and vitamin D into healthy eating programs and policies.
- Although the ageing process and female gender are at the core of osteoarthritis (OA) and osteoporosis (OP) susceptibility, a number of potentially modifiable risk factors have been identified:
 - Interventions aimed at promoting a 'healthy lifestyle' that includes regular weight bearing physical activity (and minimises repetitive load-bearing activities and joint trauma for OA), maintenance of healthy weight, adequate calcium intake, sufficient sun exposure, vitamin D supplementation where necessary, moderate alcohol consumption and no tobacco use should provide the basis for prevention of these chronic diseases.
- Overall, the quantity and quality of evidence to support programs for primary prevention of OA and OP and risk factors for OA and OP in many at-risk groups is limited. However, paucity of evidence should not be considered evidence of ineffectiveness, or create a barrier to development of health promotion programs around these important conditions. More high quality research is needed to:
 - Develop effective interventions that promote a 'healthy older lifestyle';
 - Explore culturally and demographically appropriate prevention programs;
 - Examine calcium and/or vitamin D intakes of people in at-risk groups; and
 - Develop and test programs that impact on weight in children and young people.
- *Evidence from 21 systematic reviews, 10 meta-analyses, and two systematic reviews of systematic reviews suggest that the types of health promotion and prevention programs for primary prevention of musculoskeletal conditions that are **most** likely to be effective (i.e., Levels 1 and 2 evidence) in preventing OA and OP in at-risk groups include:*
 - Adequate vitamin D and/or calcium levels for children and young people and for adults over 45 years of age;
 - Aerobics, weight bearing and resistance exercises for older people with professional guidance and continued support;
 - Tailored approaches (e.g., face-to-face education or counselling, telephone contacts or computer-tailored information) for dietary intervention programs for older people;
 - Strategies which facilitate goal setting for 'healthy lifestyle' change efforts in socioeconomically disadvantaged populations;
 - Clear messages about the benefits of healthy foods, multiple strategies (e.g., personal counselling or education) to deliver messages, and multiple delivery of messages to families, to increase healthy food consumption in low socioeconomic status young women;
 - Peer educators and a range of communication materials (e.g., media and personal communication) for delivering dietary intervention to low-income families;
 - Focus on one aim (e.g., increasing dairy consumption) for interventions to improve dietary calcium in children and young people.

- *The types of health promotion and prevention programs for primary prevention of musculoskeletal conditions that **may** be effective (i.e., Levels 3 and 4 evidence) in preventing OA and OP in at-risk groups conditions include:*
 - Mass media interventions (e.g., through television, radio, newspapers, billboards, posters, leaflets or booklets), to reduce smoking in adults, when part of a multi-channel intervention (e.g., involving telephone counselling, support groups, primary care interventions, cessation classes, health fairs, and public events, legislative changes for increased cigarette prices and clean indoor air laws);
 - A small set of strategies, and information about the risks of unhealthy behaviours and benefits of behaviour change for individual targeted 'healthy lifestyle' change efforts in socioeconomically disadvantaged populations;
 - Arguably, increasing the price of tobacco is a population-level intervention for reducing smoking-related inequalities in health;
 - Culturally appropriate face-to-face counselling or quit support (e.g., from Aboriginal Health Workers) in conjunction with (free) nicotine replacement therapy for Aboriginal tobacco cessation;
 - Culturally appropriate, locally staffed, locally lead and sustainably funded prevention programs for Aboriginal Australians; and
 - A focus on reducing unhealthy behaviours rather than increasing healthy behaviours for health promotion programs in children and young people.

Executive Summary

The Prevention and Population Health Branch of the Victorian Department of Health commissioned a rapid review of the evidence for health promotion and prevention programs for primary prevention of musculoskeletal conditions, specifically osteoarthritis (OA) and osteoporosis (OP). Five at-risk target groups were specified by the brief: older people (aged 65 years and over); socioeconomically disadvantaged people; Aboriginal or Torres Strait Islander people; people at higher risk of vitamin D deficiency (for ethnicity or cultural reasons); and children and young people (particularly with low calcium/vitamin D intakes). The brief requested that the main emphasis of the review be on interventions to: promote healthy eating; promote regular physical activity; maintain a healthy weight; avoid tobacco use; and avoid high-risk use of alcohol, as appropriate to primary prevention of musculoskeletal conditions in each of the target groups. The role of this rapid review was to provide evidence specific to prevention of OA/OP in the specified target groups. The general population literature on prevention of lifestyle risk factors is both vast and outside the scope and time frame of the rapid review. The findings from this rapid review will be used to help identify priorities for action in planning health promotion and prevention programs.

The prevention of musculoskeletal diseases presents an ongoing public health challenge. Estimates suggest that over 3 million Australians have arthritis and/or OP [2]. Although the ageing process and to a lesser extent female gender are at the core of musculoskeletal disease susceptibility, a number of potentially modifiable behavioural, biological and environmental risk factors have been identified [3]. Interventions aimed at promoting a 'healthy lifestyle' that includes regular physical activity (and minimising repetitive load-bearing activities to avoid joint trauma in the case of OA), maintenance of healthy weight, healthy eating and having adequate intake of calcium and vitamin D (including sun exposure), and reducing alcohol and tobacco consumption may provide the basis for prevention of these chronic diseases at both a population and individual level, particularly when targeted to specific groups at greater risk. The purpose of this rapid review is to identify effective health promotion programs for the primary prevention of OA and OP in five at-risk population groups. It poses the question:

What types of health promotion and prevention programs for primary prevention of musculoskeletal conditions are most likely to be effective in preventing OA and OP in at-risk groups, leading to a reduction in the associated burden of disease from these conditions?

Systematic reviews and meta-analyses (see Glossary of Terms) were identified through a series of systematic literature searches using databases relevant to health and medicine, reference lists of identified articles, and key web-based sources of information regarding the primary prevention of musculoskeletal conditions. The review searched for higher level evidence where available (NHMRC Levels 1, 2 or 3). In the cases where no existing higher quality systematic reviews were available, systematic reviews at lower quality levels (NHMRC Levels 4 or 5) were retained.

Overall quality of the research:

A wide and inclusive search was conducted. In all, 21 systematic reviews, 10 meta-analyses, and two systematic reviews of systematic reviews deemed relevant to the rapid

review brief were included. Structured summaries of all included reviews can be found at Appendix 4.

The quality of the research identified depended upon the target group and risk factor of interest. The evidence around health promotion and prevention programs for the primary prevention of OA and OP and risk factors for OA and OP in older people varied from Level 1 to Level 4. The evidence around programs in socioeconomically disadvantaged people is both limited and generally of lower quality (mostly Levels 3 and 4) but did include some higher level evidence about diet interventions (Level 2). The evidence around programs for Aboriginal or Torres Strait Islander people is also both limited and generally of lower quality (mostly Levels 4 and 5). The evidence around programs for people at higher risk of vitamin D deficiency is extremely limited and of very poor quality (Level 5). The available evidence around health promotion and prevention programs for the primary prevention of OA and OP and risk factors for OA and OP in children and young people is generally of good quality (Level 1 to Level 3).

Overall, the quantity and quality of evidence to support programs for primary prevention of OA and OP and risk factors for OA and OP in many at-risk groups is limited (except for children and young people) and there are methodological limitations for a high proportion of available studies. There is a clear lack of any studies which directly focus on the prevention of OA. However, paucity of evidence should not be considered evidence of ineffectiveness, or create a barrier to development of health promotion programs around these important conditions [3].

The following recommendations are made from a synthesis of the available systematic reviews:

Recommendations for older people (aged 65 years and over):

- Supplementation with calcium along with supplementation with vitamin D, should be encouraged for all older Australians including those over 45 years of age for primary prevention of OP. For best therapeutic effect, minimum daily doses of 1200 mg of calcium and 800 IU (20µg) of vitamin D (for combined calcium plus vitamin D supplementation) are recommended. In healthy adults, 30 minutes of sun exposure to the arms and face without sunscreen should provide daily vitamin D needs [4].
- Mass media interventions involving communication through television, radio, newspapers, billboards, posters, leaflets or booklets, with the intention of encouraging smokers to stop, and of maintaining abstinence in non-smokers, are likely to contribute to a reduction in smoking when used as one component in a multi-channel set of interventions (e.g., involving telephone counselling, support groups, primary care interventions, cessation classes, health fairs, and public events, legislative changes for increased cigarette prices and clean indoor air laws).
- Dietary intervention programs for older people should include tailored approaches which may include face-to-face education or counselling, telephone contacts or computer-tailored information.
- Physical activity programs for primary prevention of OP and OA in older people should include aerobics, weight bearing and resistance exercises. Professional advice and guidance with continued support should be used to encourage adults to be more physically active.

Recommendations for socioeconomically disadvantaged groups:

- Individual targeted healthy behaviour change efforts in socioeconomically disadvantaged populations would preferably include a small set of strategies.
- Healthy behaviour change efforts in socioeconomically disadvantaged populations could include information about the risks of unhealthy behaviours and the benefits of behaviour change.
- Arguably, increasing the price of tobacco is a population-level intervention for reducing smoking-related inequalities in health.
- Smoking cessation media campaigns for low socioeconomic status (SES) smokers should be implemented within larger community wide tobacco control programs (including e.g., telephone counselling, support groups, primary care interventions, cessation classes, health fairs, and public events, legislative changes for increased cigarette prices and clean indoor air laws).
- Healthy behaviour change efforts in socioeconomically disadvantaged populations should include strategies which facilitate goal setting for change.
- Effective interventions to increase healthy food consumption in low SES young women should use clear messages about the benefits of healthy foods, involve multiple strategies to enforce the messages including personal counselling or education, and deliver the message to families over a longer period than just one or two contacts.
- Peer educators may be useful for delivering dietary intervention to low-income families.
- A range of communication materials (such as media and personal communication) should be used in dietary interventions.

Recommendations for Aboriginal and Torres Strait Islander people:

- Tobacco cessation efforts with Aboriginal Australians should include culturally appropriate face-to-face counselling or quit support in conjunction with nicotine replacement therapy (NRT).
- Aboriginal Health Workers should be trained to provide brief smoking cessation interventions for Aboriginal people.
- Mainstream strategies for smoking cessation which should be considered for Aboriginal people include: mass media campaigns, school based tobacco prevention and cessation programs for Aboriginal students, group-based interventions run in culturally appropriate spaces, quit support and brief advice for pregnant women, and multi-component community interventions (e.g., including sponsorship of events, quit support groups, smoke free community locations, local media campaigns).
- Community-based nutrition programs for children may include education/counselling which has been well integrated into primary health care systems, and multifaceted interventions involving carers, community health workers and community representatives.
- All strategies for behaviour change among Aboriginal Australians should be tailored to ensure cultural appropriateness.
- Prevention programs for Aboriginal Australians should be based on locally trained personnel, local leadership and stable funding.

Recommendations for people at higher risk of vitamin D deficiency due to ethnicity or culture:

- Vitamin D supplementation in the later part of pregnancy should be considered in vulnerable groups, particularly recent immigrants (25–50 µg /day (1000–2000 IU/day)).

Recommendations for children and young people (and healthy bones):

- Evidence-based interventions to improve dietary calcium and/or vitamin D levels in children and young people should be a focus of prevention programs. Children (5 to 11 years) should have two to three serves of calcium rich foods each day (600-1000 mg daily) and young people (11 to 18 years) should have at least three serves each day (800-1000 mg daily). In Australia, the main source of vitamin D is sunlight. An adequate vitamin D dose for children and young people can be obtained from exposure of hands, face and arms (or equivalent area of skin) to sunlight for about ten to 15 minutes four to six times per week [5].
- Interventions to improve dietary calcium and/or vitamin D levels in children and young people should focus on one aim (e.g., increasing dairy consumption).
- Prevention programs for children and young people should focus on reducing unhealthy behaviours rather than increasing healthy behaviours.
- Physical activity programs should focus on weight bearing exercise.

Gaps in research:

- More high quality research is needed to develop effective interventions that promote a 'healthy lifestyle' for OA and OP prevention in older people.
- Research exploring culturally and demographically appropriate preventive interventions for OA and OP is needed, particularly for weight bearing physical activity interventions.
- There is an urgent need to fund evaluated culturally appropriate interventions to increase healthy behaviours and reduce unhealthy behaviours in Aboriginal Australians.
- Research examining the calcium and/or vitamin D intakes of people at higher risk of vitamin D deficiency within Australia is urgently needed.

Success factors:

Table 1 below details success factors for strategies/programs identified.

Table 1: Summary of success factors for strategies/programs for primary prevention of OA and OP and risk factors for OA and OP by target group

Older people (aged 65 years and over)	
Vitamin D and/or calcium supplementation	Low baseline levels of vitamin D and/or calcium [6]; and Higher doses (800 IU [20 µg] vitamin D, 1200 mg calcium daily) [7].
Smoking	<i>Mass media quit smoking campaigns:</i> Part of a multi-component community wide campaign (e.g., telephone counselling, support groups, primary care interventions, cessation classes, health fairs, and public events, legislative changes for increased cigarette prices and clean indoor air laws) [8]; and <i>Quit smoking self-help:</i> Tailored materials to provide individualised support [9].
Nutrition	Individual or group counselling [10, 11]; Motivated participants (e.g., those with pre-existing disease) [11, 12]; Set high goals for high effect [11]; and Tailored intervention [12].
Physical activity	Walking may be the easiest physical activity to implement and maintain [13, 14]; Individually tailored, intense, high impact exercise programs to prevent bone loss (e.g., two supervised group sessions of 60–70 minutes and two non-supervised individual home training sessions of 25 minutes per week

	(warm-up, endurance, jumping, strength and flexibility training) [14]; and Professional advice and guidance with continued support (of at least 6 weeks duration) [15].
Socioeconomically disadvantaged people	
Behaviour change (e.g., smoking cessation, increased healthy eating, physical activity)	Smaller set of strategies rather than larger set [16]; Information about consequences of behaviour and about others' views towards behaviour [16]; and Prompt people to form intentions to change behaviour and to set goals for change [16].
Smoking	<i>Mass media smoking campaigns:</i> Provide free NRT [17]; Part of multi-component campaign (e.g., telephone counselling, support groups, primary care interventions, cessation classes, health fairs, and public events, legislative changes for increased cigarette prices and clean indoor air laws) [17]; and <i>Population-level tobacco control campaigns:</i> Increasing the price of tobacco products may be more effective in reducing the prevalence of smoking in lower-income adults and those in manual occupations [18].
Nutrition	<i>Low SES women of childbearing age:</i> Educational component involving explanation of health risks associated with targeted behaviour and benefits of change [19]; Provide continued support after initial intervention (months not weeks) [19]; Social support from peers or lay health workers [19]; Use clear messages about benefits of healthy foods [19]; Multiple strategies to enforce messages, delivered to families over a longer period than just one or two contacts [19]; Personal counselling or education for increasing healthy food consumption [19]; Behavioural strategies such as goal setting and self-monitoring [19]; Personal contact with those delivering the intervention [19]; and Use of a range of communication materials (such as media and personal communication) [19].
Aboriginal or Torres Strait Islander people	
Smoking	Culturally appropriate face-to-face counselling or quit support [20]; Couple face-to-face counselling or quit support with NRT [20]; Free NRT [20]; Aboriginal Health Workers as intervention agents [20]; Consider cultural barrier of normalisation of smoking [20]; and Conduct group interventions in culturally appropriate spaces [20].
Nutrition	<i>Growth faltering in Aboriginal children up to five years old:</i> Community-based nutrition education/counselling integrated into primary health care system [21, 22]; Multifaceted interventions involving carers, community health workers and community representatives [21, 22]; and Consider underlying causes of growth faltering (e.g., vitamin A supplementation in populations with moderate to severe vitamin A deficiency; or de-worming treatment in populations with high infestation rates) [21, 22].
Alcohol	Adequate funding [23]; Staff intervention expertise [23]; Adequate support for intervention staff [23]; and Adequate educational resources [23].
Physical Activity	Locally trained personnel [24]; Local leadership [24]; and Stable funding [24].

People at higher risk of Vitamin D deficiency due to ethnicity or culture	
Vitamin D supplementation	25–50 µg /day (1000–2000 IU/day) [25]
Children and young people (and healthy bones)	
Vitamin D and/or calcium supplementation	<p>Low baseline intake [26];</p> <p>Two to three serves of calcium rich foods each day (600-1000 mg daily) for children (5 to 11 years) [5];</p> <p>At least three serves of calcium rich foods each day (800-1000 mg daily) for young people (11 to 18 years) [5]; and</p> <p>Exposure of hands, face and arms (or equivalent area of skin) to sunlight for about 10 to 15 minutes four to six times per week for vitamin D [5].</p>
Nutrition	<p>Target interventions at parents with risk factors for cardiovascular disease [27];</p> <p>Focus on one message only [27];</p> <p>Encourage children to accept or like the taste of the food, rather than highlighting the health benefits [27];</p> <p>Do not emphasise the benefits for future health [27];</p> <p>Treat different foods (e.g., fruit vs. vegetables) differently [27]; and</p> <p>Multi component interventions, rather than single component [27].</p>
Obesity	<p>Focus on reducing unhealthy behaviours rather than promoting positive behaviours [28];</p> <p>Longer interventions (more than 6 months) [28];</p> <p>Post-intervention outcomes (vs. in-treatment outcomes) [28];</p> <p>Global approach – including a variety of components and settings rather than a more limited one [29];</p> <p>Relatively intensive: over 40 hours of intervention time [30]; and</p> <p>Do not conceptualise as obesity prevention program (sell as general health education, cardiovascular disease prevention, physical activity, eating disorder prevention programs) [30].</p>

Main Review

Background and introduction

Background

The Prevention and Population Health Branch of the Victorian Department of Health commissioned a review of the evidence for health promotion programs for primary prevention of musculoskeletal conditions. The Prevention and Population Health Branch of the Victorian Department of Health has lead responsibility for primary prevention policies and programs in the areas of nutrition, physical activity, obesity prevention, reducing tobacco use, high risk use of alcohol, and falls prevention, with the overarching objective of preventing or minimising chronic disease burden. A copy of the brief can be found in Appendix 1.

The findings from this rapid review will be used to help identify priorities for action in planning health promotion and prevention programs. This will include integration of musculoskeletal health promotion into existing relevant prevention programs delivered by community-based health services and other community-based health promotion organisations.

Introduction

The prevention of musculoskeletal disease presents an ongoing public health challenge. Characterised by long-term pain and disability, diseases such as osteoarthritis (OA) and osteoporosis (OP) contribute significantly to disease burden in terms of functional impairment, mobility limitation, deformity, reduced quality of life and increased health care expenditure [2]. Arthritis and musculoskeletal conditions was identified as the fourth largest contributor of direct healthcare expenditure (\$4 billion) in Australia in the period 2004-2005 [31] with approximately 40% of this figure attributed to OA and OP. Similar trends have been found elsewhere [32]. Based on self-report figures, current estimates indicate that more than 6 million Australians have some form of musculoskeletal condition with more than half attributed to arthritis and/or OP [2]. Given the global burden of these diseases, the period 2000-2010 was declared 'the Bone and Joint Decade' in order to address the worldwide burden associated with musculoskeletal conditions. In particular, prevention and health promotion were highlighted by the United Nations, World Health Organization, and more than 60 countries around the world [33]. Within Australia, the prevention and treatment of OA and OP have received particular attention as a National Health Priority Area (arthritis and musculoskeletal conditions) [34].

Osteoarthritis

OA is a progressive disease which erodes cartilage (the connective tissue found in the joints between bones). It is the most prevalent musculoskeletal disease [35]. OA typically affects the weight-bearing joints of the hips, knees and ankles, although the spine and hands may also be affected [36]. Within the Australian context, around 8% of the population (1.6 million people) self-report having OA, with almost 75% of those reporting OA being over the age of 55 years [36]. As such, OA has traditionally been regarded as an 'ageing disease'. Although it is difficult to determine the exact incidence of OA in Australia, with estimates dependent upon the diagnostic criteria used for assessment (i.e., radiological or clinical), findings from the Australian Burden of Disease Study [37] have

conservatively suggested that around 42,000 new cases of OA are diagnosed each year. Moreover, although the incidence of OA is known to increase with age for both genders, OA has been shown to affect women earlier in life, with peak incidence rates occurring for women aged between 65 and 74 years, and for men after the age of 75 years.

Age is a significant factor in the development of OA, and, while the causes of this condition are not fully known, it is generally thought to be a complex interaction of genetic, environmental and lifestyle factors [2, 38, 39]. Table 2 summarises the main risk factors for OA [38]. Postmenopausal women are particularly at-risk for OA development, suggesting that hormonal changes may play an intermediary role in the breakdown of cartilage. Additionally, having a family history of arthritis (i.e., a genetic predisposition) has been shown to increase the risk of developing the disease, so that having parents who developed OA at an early age or who have multiple joints involved increases susceptibility to developing OA. The main modifiable risk factor for developing OA is exposure to joint trauma including dislocation, fracture or ligament injury or repetitive joint-bearing tasks such as kneeling or heavy lifting [2]. Up to 30% of OA development has been attributed to occupational activity involving repetitive joint-bearing tasks. A number of studies have found that key lifestyle factors may also contribute either directly or indirectly to the development of OA, such as being overweight or obese. Epidemiological studies have shown that for every two unit increase in Body Mass Index (BMI) score or around 5kg of additional weight, the risk of developing OA increases by over 30% [40]. Being morbidly obese (i.e., having a BMI of 30 or more) increases the risk of developing OA of the knee by 20-fold [40]. Research has also shown that decreases in weight can reduce the risk of OA development (in some cases by as much as 50%). In light of this evidence, modifiable factors relating to physical inactivity and poor nutrition have been indirectly implicated in the development of OA through obesity pathways [41]. However, there is an important caveat in regard to obesity interventions for older people. In the ageing population, the issue of malnutrition and underweight is generally of far more concern than overweight [42-44]. Older people are at high risk of malnutrition due to age-related decreases in digestive function, reduced taste sensation, use of multiple medications, reduced mobility and ability for self-care, and depleted social and economic resources and the presence of chronic diseases [42-45]. Lipski [46] estimated that up to 30% of people aged 60 years and over living independently in the community may suffer some degree of malnutrition. So, obesity interventions for adults should ideally be focussed on those younger than 60 years, who are not a focus of this review.

Table 2: Risk factors and determinants of health associated with osteoarthritis

Risk Factors	Potentially Modifiable	Non Modifiable
Behavioural	Joint trauma (occupational, sport, recreational)	
Psychosocial	Depression	
Biological	Overweight and obesity Co-morbid conditions	Age Female gender Family history Congenital joint anomalies High bone mineral density
Environmental	Exposure to repetitive tasks involving joint loading	Socioeconomic status

Source: Adapted from the National Arthritis and Musculoskeletal Advisory Group (NAMSCAG) [38]

The NAMSCAG [38] identified the main at-risk groups for OA as:

- Older people (over 50 years of age);
- Women;
- People with a family history of osteoarthritis;
- Overweight and obese people;
- People with a history of joint trauma;
- People who perform repetitive load-bearing tasks;
- People with abnormal joint anatomy or alignment; and
- Disadvantaged groups.

The NAMSCAG also identified the following areas as opportunities to improve the prevention of OA:

- Raising awareness about OA prevention;
- Promoting awareness of the need for weight control and joint injury prevention (from sport, recreational, occupational activities); and
- Reducing the prevalence of modifiable risk factors such as obesity and joint injury [38].

Osteoporosis

OP meaning 'porous bones', is a condition characterised by a decline in bone density and strength that increases the risk of fracture [38]. OP increases susceptibility to bone fractures, particularly of the hip, spine and wrist [2]. Presentation to health services as a result of a fracture is often the first clinical sign of OP development, although by this time, OP is well established. Unlike OA, OP is preventable and treatable, however, without optimal prevention and management of OP, the current high incidence of OP and minimal trauma fractures will continue and increase due to the ageing of the population [38].

OP commonly affects postmenopausal women, although it is increasingly being recognised as a problem for men also. Global estimates suggest that lifetime risk for this 'silent disease' ranges from 30-50% for women and 15-30% for men [47]. Australian estimates suggest that around 3% of the population has doctor-diagnosed OP [48] while one in two women and one in three men over 60 years of age will experience osteoporotic fractures [49]. This figure is increasing exponentially and by the year 2021, it is projected that Australians will be hospitalised every 3-4 minutes for osteoporotic fractures [49].

Table 3 summarises the main risk factors for OP [38]. Women are over-represented for OP due to overall lower bone mass, and accelerated age-related changes in oestrogen during menopause [38, 50]. Estimates of bone loss for women following menopause range between 1% and 5% per year [51]. Other non-modifiable (i.e., fixed) risk factors for the development of OP include having a family history of OP (i.e., similar bone remodelling characteristics), having a physical disability, and consuming medicines which accelerate bone loss (e.g., anti-inflammatory agents). Increasing age is also a key risk factor for OP development. In an Australian national health survey, 12% of people aged between 65 and 74 years of age self-reported being diagnosed with OP by a doctor [48]. This figure increased to 17% for those aged over 75 years.

Table 3: Risk factors and determinants of health associated with osteoporosis

Risk Factors	Potentially Modifiable	Non Modifiable
Behavioural	Calcium and vitamin D levels Physical activity Smoking Excessive alcohol intake	
Biological	Low bone mineral density Low body mass index Long-term systemic corticosteroid use Co-morbid conditions	Age Family history Female gender Early menopause

Source: Adapted from NAMSCAG [38]

As noted above, OP is preventable, as many of the risk factors associated with the development of OP are modifiable, and include the prominent lifestyle factors implicated in the development of a range of chronic diseases, (see [52] for review) including physical inactivity, tobacco consumption and excessive alcohol consumption. In particular, it has been suggested that exercise is important for maximising and maintaining peak bone mass from early childhood and that it helps to slow bone loss across the lifespan [48]. A report by the Australian Institute of Health and Welfare [48] suggests that more than 5 million Australians over the age of 15 years are at an increased risk of OP due to sedentary lifestyle patterns. With peak bone mass (i.e., maximum strength and density) occurring between the ages of 20 and 30 years, childhood and adolescence have been identified as critical periods in maximising peak bone mass. Studies [53, 54] have found that increasing peak bone mass by as little as 10% could have long-term impacts on delaying OP development. Preventive strategies for OP should include health promotion strategies aimed at reducing overweight and obesity in young people. In older populations however, increased risk of OP development has been linked to low body weight. Having a low BMI score (<18.5) has been consistently associated with bone loss [55-59]. This may be in part due to the associations between low weight and low oestrogen levels. Therefore, effective interventions to prevent OP in older populations will be different to those aimed at other populations.

Smoking tobacco and excessively consuming alcohol have also been found to have negative effects on bone mass density (BMD). While poorly understood, it has been suggested that smoking may impact BMD through interactions with hormones that affect bone strength or by reducing body weight [2]. Research has shown that by the age 80, BMD is 6% lower in smokers than in non-smokers [60]. Excessive alcohol consumption is thought to lower BMD by hindering bone forming processes and metabolism of calcium. Two Australian national surveys suggest that over seven million Australian adults are either current or ex-smokers, while two million Australians engage in risky or high-level drinking practices (according to NHMRC guidelines) thus placing them at increased risk for OP [48, 61].

Dietary factors associated with OP development are adequate consumption of essential micronutrients such as calcium and vitamin D. The processes associated with bone formation and alternatively, bone loss, have been found to be intricately linked to calcium absorption and vitamin D metabolism (which is essential in aiding calcium absorption). Low consumption of calcium-rich foods (such as dairy products) have been associated with significant bone loss and increased fracture risk as have vitamin D deficiency through inadequate access to sunlight (the prime source of vitamin D) [62-65]. There are specific

groups who are at increased risk of vitamin D deficiency due to inadequate vitamin D intake through sun exposure: older people, due to changes in vitamin D synthesis with age [66]; people who are institutionalised, housebound, non-ambulatory, or habitually covered for cultural/religious reasons; and people with darker skin (e.g., of African heritage) [67].

It may be argued that good bone health begins in infancy and that OP development may begin as early as childhood or adolescence [68]. In conjunction with a balanced healthy diet, adequate calcium intake and vitamin D metabolism are particularly important for the accrual of bone mass during the pubertal phase [69]. Current research suggests that young girls in particular fail to consume more than half the recommended daily intake of calcium each day [63] placing them at increased risk of developing OP. Moreover, the effects of reduced calcium consumption (e.g., dairy products) may be exacerbated by increased carbonated beverage (soft drink) consumption. The results from a large scale longitudinal study of men and women aged between 30 and 87 years (the Framingham Osteoporosis Study [70]) suggest that women who consume carbonated cola beverages (containing phosphoric acid which inhibits calcium absorption) have lower BMD, particularly in the hip area. Thus, nutritional/supplementation interventions for children and young people may prove effective in reducing the long-term risk of OP development.

A vitamin D and calcium forum [63] initiated by Osteoporosis Australia and held in partnership with the Australian and New Zealand Bone and Mineral Society acknowledged the emergence of calcium and vitamin D deficiency as a public health concern in Australia. This forum highlighted the need for interventions aimed at increasing the daily intake of calcium to maintain musculoskeletal health (particularly in young women) in conjunction with lifestyle changes to ensure adequate sun exposure for at-risk individuals, supported by evidence that vitamin D and/or calcium supplementation in adults over the age of 50 years may reduce the risk of osteoporotic fractures by up to 40% [71].

The NAMSCAG [38] identified the main at-risk groups for OP as:

- Older people;
- Postmenopausal women;
- People with a family history of minimal trauma fracture;
- People with inadequate calcium and vitamin D levels;
- People with low exposure to sunlight;
- People with a low BMI;
- People who require long-term systemic corticosteroid therapy;
- People who are immobile or not physically active;
- People who smoke;
- People with an excessive intake of alcohol;
- People with co-morbid conditions predisposing them to OP, such as rheumatoid arthritis or malabsorption syndromes; and
- Disadvantaged groups.

The NAMSCAG also identified the following areas as opportunities to improve the prevention of OP:

- Raise awareness about OP prevention;
- Meet the recommended daily intake of calcium;
- Avoid vitamin D deficiency;

- Avoid corticosteroid induced-OP;
- Maintain a physically active lifestyle over the life course;
- Develop awareness of the risks of smoking; and
- Develop awareness of the risks of excessive alcohol intake [38].

Summary and purpose of review

Although the ageing process and to a lesser extent female gender are at the core of musculoskeletal disease susceptibility, a number of potentially modifiable behavioural, biological and environmental risk factors have been identified [38]. Interventions aimed at promoting a 'healthy lifestyle' that includes regular weight bearing physical activity (and minimising repetitive load-bearing activities to avoid joint trauma in the case of OA), maintenance of healthy weight, healthy eating and having adequate intake of calcium and vitamin D (including sun exposure), and reducing alcohol and tobacco consumption, may provide the basis for prevention of these chronic diseases at both a population and individual level, particularly when targeted to specific groups at greater risk.

The purpose of this rapid review is to identify effective health promotion programs for the primary prevention of OA and OP in at-risk population groups specified in the Prevention and Population Health Branch of the Victorian Department of Health brief (see Appendix 1): older people (65 years or older), socioeconomically disadvantaged people, Aboriginal or Torres Strait Islander people, people at-risk of vitamin D deficiency due to ethnicity or cultural reasons, and children and young people with poor calcium/vitamin D intakes.

The role of this review must be to provide evidence specific to prevention of OA/OP. It is not possible to review the gamut of general population 'health promotion/primary prevention' literature on risk factor interventions within the time frame appropriate to a rapid review. There are existing reviews on some of these issues, and a critical mass of expert opinion within the Victorian Department of Health. The general population literature on prevention of lifestyle risk factors is both vast and outside the scope of the review. The rapid review question is:

What types of health promotion and prevention programs for primary prevention of musculoskeletal conditions are most likely to be effective in preventing OA and OP in at-risk groups, leading to a reduction in the associated burden of disease from these conditions?

Method and search strategy

Systematic reviews and meta-analyses were identified through a series of systematic literature searches of the peer reviewed and grey literature. A 'systematic review' systematically locates, appraises and synthesises evidence from scientific studies to obtain a reliable overview for a specific research question, while a 'meta-analysis' is a statistical technique which summarises the results from studies identified by a systematic review [1]. The quality of evidence from a systematic review or meta-analysis depends upon the methodological quality of the studies captured.

This review aimed to locate systematic reviews of interventions to prevent OA and OP in population groups at higher risk of developing OA or OP:

- Older people (aged 65 years and over);
- Socioeconomically disadvantaged people;
- Aboriginal or Torres Strait Islander people;
- People at higher risk of vitamin D deficiency due to ethnicity or culture; and
- Children and young people (and healthy bones).

A primary focus of the review was systematic reviews of population health interventions with the target aims of: promoting healthy eating; promoting regular physical activity; maintaining a healthy weight; avoiding tobacco use; and, avoiding high-risk use of alcohol, related to OA and OP prevention.

The review included literature defined by several search 'key word' levels:

- Target 'at-risk' populations (older people [65 years or older], socioeconomically disadvantaged people, Aboriginal or Torres Strait Islander people, people at-risk of vitamin D deficiency due to ethnicity or culture, and children and young people [and healthy bones]);
- Primary prevention of OA and OP;
- Intervention and prevention;
- Risk factors associated with OA and OP (such as, promoting healthy eating; promoting regular physical activity, avoiding tobacco use; avoiding high-risk use of alcohol); and
- Intervention impact measures (such as, attitudes and knowledge).

In each case, identified medical subject heading (MeSH) terms were exploded to provide greater scope within each search. The final extensive list of key words can be found in Appendix 2.

Key word combinations were searched in the title, original title and abstract and mapped to subject headings, based upon the following search strategies:

- *Search strategy 1*: specific target 'at-risk' groups and primary prevention of OA/OP (i.e., A subgroup in combination with B and C);
- *Search strategy 2*: specific target groups and primary prevention of relevant OA/OP risk factors (i.e., A subgroups in combination with C and D); and
- *Search strategy 3*: specific target groups and intervention impact measures (i.e., A subgroups in combination with E).

Initially, literature databases relevant to health and medicine were searched, including: MEDLINE, PsycInfo, CINAHL, the Cochrane Library and Web of Science. Then, the reference lists of all identified articles were hand searched for other relevant systematic reviews and meta-analyses.

Additionally, key web-based sources of information regarding the primary prevention of musculoskeletal conditions were searched. These included Australian government websites such as the Department of Health and Ageing, including National Health Priorities publications (such as the 'National Service Improvement Framework for Osteoarthritis, Rheumatoid Arthritis, and Osteoporosis'); The Australian Institute of Health and Welfare (AIHW); and the Department of Families, Housing, Community Services and Indigenous Affairs (FaHCSIA): as well as state health department websites (e.g., NSW Department of Health, VIC Health, Government of WA Department of Health and QLD Health).

Searches were also made of web-based literature from peak bodies within Australia such as the Australian Association of Gerontology; Arthritis Australia; The Federation of Ethnic Communities Councils of Australia (FECCA); The National Aboriginal Community Controlled Health Organisation (NACCHO), Osteoporosis Australia, and a number of international sources including:

- World Health Organization (WHO);
- British Association for Parenteral and Enteral Nutrition (BAPEN);
- National Institute of Health and Clinical Excellence (NICE);
- Health Evidence, Canada;
- Centers for Disease Control and Prevention (CDC);
- National Institute of Health Centre for Reviews and Dissemination;
- National Osteoporosis Foundation;
- HealthierUS.gov; and
- The Society of Obstetricians and Gynaecologists of Canada.

Database and grey literature searches were conducted during late July 2010 and early August 2010. Database searches included only studies that were: Reviews; Human; English language; published 2000-2010; and from Australia. In the absence of high quality studies from Australia, studies from other countries (USA, UK [Great Britain, Ireland, Scotland, Wales], Canada, New Zealand, Scandinavia [Denmark, Sweden, Norway]) were sought. Returned citations, from all searches, were downloaded and combined into a single database using Endnote version X2. A summary of the search results is located in Appendix 3.

Abstracts were initially manually screened by MH, to ensure relevance to the main search question:

What types of health promotion and prevention programs for primary prevention of musculoskeletal conditions are most likely to be effective in preventing OA and OP in at-risk groups, leading to a reduction in the associated burden of disease from these conditions?

Additionally, manual screening included only systematic reviews that considered population health intervention types (such as group-based interventions, health education and skill development, social marketing and health information, community action, settings and supportive environments, and capacity building), and interventions where evidence of change was evaluated. Interventions that focussed only on back pain; and workplace-based interventions were excluded.

The full report was obtained for all potentially relevant systematic reviews, and LP screened these for direct relevance and for quality using the simplified NHMRC level of evidence criteria in Table 4.

Table 4: NHMRC levels of evidence criteria [72]

I.	Strong evidence from at least one systematic review of multiple well-designed randomised controlled trials (RCTs)
II.	Strong evidence from at least one properly designed RCT of appropriate size
III.	Evidence from well-designed trials such as pseudo-randomised or non-randomised trials, cohort studies, time series or matched case-control studies
IV.	Evidence from well-designed non-experimental studies from more than one centre or research group or from case reports
V.	Opinions of respected authorities, based on clinical evidence, descriptive studies or reports of expert committees

Source: Adapted from NHMRC [72]

The review included only higher level evidence where possible (NHMRC Levels 1, 2 or 3). In the cases where no existing higher quality systematic reviews were available, systematic reviews at lower quality levels (NHMRC Levels 4 or 5) were retained. Levels of evidence were designated from strong to very weak, according to NHMRC level of evidence criteria [72]: *Strong evidence* means NHMRC evidence Level 1; a systematic review of multiple well-designed RCTs. *Good evidence* means NHMRC evidence Level 2; a systematic review containing at least one properly designed RCT of appropriate size. *Moderate evidence* means NHMRC evidence Level 3; a systematic review of well-designed trials such as pseudo-randomised or non-randomised trials, cohort studies, time series or matched case-control studies. *Weak evidence* means NHMRC evidence Level 4; a systematic review of well-designed non-experimental studies from more than one centre or research group or from case reports. *Very weak evidence* means NHMRC evidence Level 5; a systematic review of opinions of respected authorities, based on clinical evidence, descriptive studies or reports of expert committees. In cases where evidence from different systematic reviews was conflicting, either the higher level of evidence was adhered to, or a level of evidence judged between the various evidence levels, depending upon the expert opinion of the reviewer (LP).

LP extracted data from each directly relevant report using the following headings: Study findings; Level of evidence; Quality of evidence; Summary of evidence; and Recommendations or implications arising from the evidence. The results of this data extraction are included at Appendix 4.

Overall quality of the research

A wide and inclusive search was conducted. Preliminary searches and screening for duplicates generated a database of approximately 450 Australian reviews, and several thousand from international sources (NZ/Canada/USA/UK/Scandinavia). However, the vast majority of these reviews were rejected once inclusion and quality criteria were applied. Reference list checks provided a large proportion of the included studies.

The search strategy recognised the need to retrieve studies which focussed on prevention, and had the potential to provide success factors of interventions and programs. In all, 21 systematic reviews, 10 meta-analyses and two systematic reviews of systematic reviews deemed relevant to the rapid review brief were included. Structured summaries of all included articles can be found at Appendix 4.

The quality of the research identified depended upon the target group of interest. The evidence around health promotion and prevention programs for the primary prevention of OA and OP and risk factors in older people was of varying quality (from Level 1 to Level 4), depending upon the focus of the systematic review. A significant problem was the lack of reviews that specifically focussed on older people, and primary prevention of OA and OP. Reviews based on the general adult population have been included where either the issues for older people are considered, or some studies include older people. However, the usefulness of findings for a general population sample in regard to interventions for older people remains tentative, particularly given the higher risk for adverse events for older people. While higher level evidence is mostly preferred, in some situations, such as community wide interventions, it is neither practical nor desired to expect higher than Level 3 evidence.

The evidence around programs in socioeconomically disadvantaged people is both limited and generally of lower quality (mostly Levels 3 and 4) but did include some higher level evidence about diet interventions (Level 2). Similar to the case for older people, it may sometimes not be appropriate to expect higher level evidence for special groups, and lower level designs (and evidence) for community wide interventions may be sufficient.

The evidence around programs for Aboriginal or Torres Strait Islander people is also both limited and generally of lower quality (mostly Levels 4 and 5). A significant caveat on research with Aboriginal and Torres Strait Islander people is that although they are diverse in languages and cultures, and live across the range of metropolitan, regional, and remote areas, commonly the available studies do not reflect this diversity [73]. Additionally, it is well accepted that the most rigorous scientific designs such as RCTs are not appropriate for this population, due to cultural sensitivities [74]. Therefore, lower quality studies provide the majority, and best quality, of evidence available for Aboriginal or Torres Strait Islander people.

The evidence around programs for people at higher risk of vitamin D deficiency is extremely limited and of very poor quality (Level 5).

Programs promoting healthy bones were the focus for children and young people, so primary prevention through supplementation, and nutrition and physical activity interventions which specifically consider bone health only were included. Selected meta-analyses on prevention of obesity for general child/young persons' populations are also included, given the importance of preventing obesity for reducing the risk of OA. A thorough synthesis of the vast literature on promoting physical activity, improving nutrition and reducing obesity in younger people is beyond the scope of a rapid review, so the studies included here are not exhaustive. The most relevant, highest evidence level and most recent systematic reviews only have been included. The available evidence around health promotion and prevention programs for the primary prevention of OA and OP and risk factors for children and young people is generally of good quality (Level 1 to Level 3).

Overall, the quantity and quality of evidence to support programs for primary prevention of OA and OP in many at-risk groups is limited and there are methodological limitations to the majority of available studies. There is a clear lack of any studies which directly focus on the prevention of OA. However, paucity of evidence should not be considered evidence

of ineffectiveness, or create a barrier to development of health promotion programs around these important conditions [38].

Summary of the evidence

Older people (aged 65 years and over)

Overall quality of the evidence

The evidence around health promotion and prevention programs for the primary prevention of OA and OP and risk factors in older people was of varying quality (from Level 1 to Level 4), depending upon the focus of the systematic review. Although this review focussed only on systematic reviews, the quality of evidence from these reviews depends upon the quality of the included available studies, and a conservative view of levels of evidence has been taken. Where review findings conflicted, the higher quality review is included (for example Liu vs. Ma [75, 76]), or a level of evidence is judged between the various evidence levels, depending upon the expert opinion of the reviewer. A significant problem was the lack of reviews that specifically focussed on older people, and primary prevention of OA and OP. Reviews based on the general adult population have been included where either the issues for older people are considered, or some studies include older people. However, the usefulness of findings for a general population sample in regard to interventions for older people remains tentative, particularly given the higher risk for adverse events for older people. While higher level evidence is mostly preferred, in some situations, such as community wide interventions, it is neither practical nor desired to expect higher than Level 3 evidence. This view is reflected in both the recommendations and rationale.

Summary of overall evidence

- Moderate (Level 3) to strong (Level 1) evidence supported supplementation with vitamin D and/or calcium in people 45 years and older for prevention of OP [6, 7, 77].
- Strong (Level 1) evidence did not support supplementation with soy isoflavones¹ for prevention of OP [76].
- There is moderate (Level 3) evidence to support the use of comprehensive tobacco control programs which include mass media campaigns to reduce smoking in adults [8]. There is strong (Level 1) evidence to support the use of tailored advice and support materials to reduce adult smoking compared to non-tailored materials or nothing, although the effect size is small [9]. There is no direct evidence for the effect of intervention on tobacco smoking in older people.
- There is good (Level 2) evidence to support the effectiveness of tailored nutrition education programs, including those that involve face-to-face education or counselling, telephone contacts or computer-tailored information, for dietary improvements that would support primary prevention of OA or OP, in adults over the long-term [12]. There is no good quality evidence to support choice of healthy eating interventions for older adults.

¹Soy isoflavones are phytoestrogens that are naturally present in the soy bean. They comprise mainly of genistein, daidzein, and glycitein, which have structures similar to that of 17 β -estradiol, a potential alternative to hormone replacement therapy.

- There is good (Level 2) evidence that aerobics, weight bearing and resistance exercises are all effective for increasing BMD of the spine in postmenopausal women [13, 14]. There is moderate (Level 3) evidence that Tai Chi may be effective for increasing BMD in postmenopausal women [78].
- There is good (Level 2) evidence that professional advice and guidance with continued support can encourage adults in the general community to be more physically active in the short to mid-term [15]. There is very limited direct evidence for interventions to increase physical activity in older people.

What types of health promotion and prevention programs for primary prevention of musculoskeletal conditions are most likely to be effective in preventing OA and OP in older people, leading to a reduction in the associated burden of disease from these conditions?

Recommendations

1. Supplementation with vitamin D along with calcium should be encouraged for older Australians including those over 45 years of age for primary prevention of OP. For best therapeutic effect, minimum daily doses of 1200 mg of calcium, and 800 IU (20 µg) of vitamin D (for combined calcium plus vitamin D supplementation) are recommended. In healthy adults, 30 minutes of sun exposure to the arms and face without sunscreen should provide daily vitamin D needs [4].
2. Mass media interventions involving communication through television, radio, newspapers, billboards, posters, leaflets or booklets, with the intention of encouraging smokers to stop, and of maintaining abstinence in non-smokers, are likely to contribute to a reduction in smoking when used as one component in a multi-channel set of interventions.
3. Dietary intervention programs for older people should include tailored approaches which may include face-to-face education or counselling, telephone contacts or computer-tailored information.
4. Physical activity programs for primary prevention of OP and OA in older people should include aerobics, weight bearing and resistance exercises. Professional advice and guidance with continued support should be used to encourage adults to be more physically active.
5. More high quality research is needed to develop effective interventions that promote a 'healthy lifestyle' for OA and OP prevention in older people.

Rationale

The main primary prevention strategies suggested for OP was supplementation [6, 7, 76, 77, 79]. Ensuring good vitamin D (800 IU [20 µg]) and calcium (1200 mg) daily intake for people from 45 years of age, including supplementation if necessary is a recommended strategy for reducing OP. There were no studies located on primary prevention strategies for OA.

It is well accepted that reducing the risk of developing OA and OP means following a 'healthy lifestyle' plan [2], so interventions to achieve 'healthy lifestyle' should achieve the aim of primary prevention of these diseases: therefore, older people should increase their level of physical activity, eat well to maintain healthy weight (including ensuring adequate intake of calcium), undertake a healthy level of exposure to sunshine for vitamin D, quit smoking, and limit alcohol consumption. While there has been some discussion and policy

consideration around these behaviours over the last decade [3], there remains scant specific evidence to support the effectiveness of interventions to achieve the aim of a 'healthy lifestyle' for older people.

All good quality reviews of tobacco cessation interventions identified were aimed at the adult general population, with little consideration of effect for older people. The two reviews included [8, 80] were the only ones that either mentioned older people or the influence of age on intervention effect. The Bala et al. [8] review found moderate (Level 3) evidence that comprehensive tobacco control programs which include mass media campaigns can be effective in changing smoking behaviour in adults, but found no consistent relationship between campaign effectiveness and age or other population features. It should be noted, however, that there is a broad consensus that comprehensive tobacco control interventions which include mass media campaigns can be effective in reducing smoking consumption and prevalence [81-83]. Mass media campaigns are rarely conducted outside the context of a multi-component community-based smoking cessation intervention, so the contribution the separate elements make to the overall impact of a comprehensive tobacco control program is difficult to ascertain. Furthermore, it is inherently difficult to evaluate mass media campaigns, as large samples are needed to detect relatively small effects on individual members of the target community. Although the impact of campaign duration and intensity is difficult to ascertain, a consistent effect was shown in a multiple cross-sectional time series study undertaken in Australia [84]. Given these considerations, Level 3 evidence to support community wide interventions is adequate to recommend their continuation. Lancaster et al. [9] found strong (Level 1) evidence that support for smoking cessation using standard written materials or other media was not very effective for reducing tobacco smoking, although this support was better than nothing. Tailoring materials to the individual increased effect in the general adult population, but the effect size remained small. While some studies included older people, this group was not specifically considered in the review findings.

The main foci of nutrition interventions were either increasing fruit and vegetable intake or reducing fat intake. There were no reviews of studies which considered dietary intervention specific to OP (e.g., increased dairy intake). However, improving diet quality can impact on micronutrient intake (such as calcium) and the lessons from other dietary interventions might be useful for interventions to increase dairy intake. The reviews of nutrition for older community-living people were all very poor quality, so only two of these have been included here. Payette et al. [85] provide an interesting but poor quality review (Level 5) of the determinants of healthy eating and effectiveness of interventions to support healthy eating in Canada. They suggest that effective dietary self-management is supported by good health and independent means, while those who are poor and unwell remain at high-risk for an unhealthy diet. Payette et al. [85] make no recommendations for programs or services to facilitate healthy eating for older community-living people, due to limited evaluation of programs. Bowen and Beresford [10] provide slightly better evidence (Level 4 to 5) about dietary evidence to prevent disease. They suggest that the most commonly implemented interventions, those based on individual or group counselling for dietary change, were generally successful in changing dietary behaviours; however, there are currently no proven methods for dietary change at the community level. Eyles et al. [12] provide the highest quality evidence in relation to nutrition; however their review includes all adults and does not specifically consider older people. They found that tailored

nutrition education can increase the fruit and vegetable intake of adults, from 15 trials of moderate to good quality (Level 2 to 3). The few studies which included low income groups reported a positive effect of tailored nutrition education compared to control. Eyles et al. [12] suggested that should automated tailored nutrition education become a widely implemented public health strategy, it is possible that adults would increase their intake of fruit and vegetables by 0.6 servings per day, and lower their intake of percentage of energy from total fat by 2.5%, which would be clinically significant improvements given current intakes and recommendations. Pomerleau et al. [11] also considered interventions to increase fruit and vegetable intake in the general population, in a review of 44 interventions of moderate (Level 3) overall quality, predominantly from developed countries. They reported consistent positive effects for interventions that included face-to-face education or counselling, telephone contacts or computer-tailored information. Computer tailored nutrition education may be a promising tool to motivate people to make healthy dietary changes, however there were no trials of this intervention type outside the USA and Europe, and this mode is unlikely to be appropriate to socioeconomically disadvantaged people or many rural communities.

There were four reviews which provided evidence about the types of physical activity that would impact on BMD for postmenopausal women. Wayne et al. [78] only found moderate (Level 3) evidence to support the effect of Tai Chi on BMD in postmenopausal women, due to the lack of quality research. Martyn-St James et al. [86] provided moderate (Level 3) evidence that high-intensity resistance training reduced bone loss at the lumbar spine but not the total hip, with inconsistent results for femoral neck. Bonaiuti et al. [13] found good (Level 2) support for the effectiveness of aerobics, weight bearing and resistance exercises for increasing BMD of the spine, and walking for the hip, in postmenopausal women. However, they concluded that walking may be the best program to propose to most people, and may be the easiest and simplest program to implement long-term. Schmitt et al. [14] presented good (Level 2) evidence that physical activity effectively slows bone loss in postmenopausal women in a dose-dependent manner. Schmitt et al. [14] suggested that while individually tailored, intense, high impact exercise programs may be most effective in preventing OP, the high cost and general low acceptability to people may limit the appropriateness of this approach, although popular and more easily applicable existing programs (such as aerobic classes, Tai Chi, and walking) were found less effective based on the studies included in the review.

While there were no reviews which specifically considered types of population health interventions to increase physical activity in older people, a review of general adult studies which considered several studies with older people was included. Foster et al. [15] reviewed the effectiveness of interventions designed to promote physical activity in sedentary community dwelling adults (over 16 years). While 19 studies considered the effect of interventions on self-reported physical activity, only three of these studies included population health interventions with older people. Of these, one small US RCT included all older women enrolled in a group-based or home-based walking intervention [87], while two small Japanese RCTs included some older people; one tested moderate physical activity after a group program [88]; and the other tested group-based endurance and resistance training the only one with a positive intervention effect [89]. The review provided good (Level 2) evidence that professional advice and guidance with continued support can encourage people to be more physically active in the short to

mid-term, but that more research is needed to establish which methods of exercise promotion work best in the long-term to encourage specific groups of people to be more physically active.

Structured summaries of the included systematic reviews are provided at Appendix 4. Table 5 details success factors for strategies/programs identified.

Table 5: Success factors for strategies/programs for primary prevention of OA and OP and risk factors for OA and OP in older people

Vitamin D and calcium supplementation	Low baseline levels of vitamin D and/or calcium [6]; Higher doses (800 IU [20 µg] vitamin D, 1200 mg calcium daily) [7]
Smoking	<i>Mass media quit smoking campaigns:</i> Part of a multi-component community wide campaign (e.g., telephone counselling, support groups, primary care interventions, cessation classes, health fairs, and public events, legislative changes for increased cigarette prices and clean indoor air laws) [8]; and <i>Quit smoking self-help:</i> Tailored materials to provide individualised support [9].
Nutrition	Individual or group counselling [10, 11]; Motivated participants (e.g., those with pre-existing disease) [11, 12]; Set high goals for high effect [11]; and Tailored intervention [12].
Physical activity	Walking may be the easiest physical activity to implement and maintain [13, 14]; Individually tailored, intense, high impact exercise programs to prevent bone loss (for example, two supervised group sessions of 60–70 minutes and two non-supervised individual home training sessions of 25 minutes per week (warm-up, endurance, jumping, strength and flexibility training) [14]; and Professional advice and guidance with continued support (of at least six weeks duration) [15].

Socioeconomically disadvantaged people

Overall quality of the evidence

The evidence around health promotion and prevention programs for the primary prevention of OA and OP and risk factors in socioeconomically disadvantaged people is both limited and generally of lower quality (mostly Levels 3 and 4) but did include some higher level evidence about diet interventions (Level 2). Given the paucity of good quality evidence for some target behaviours, several lower level systematic reviews have been included. Similar to the case for older people, it may sometimes not be appropriate to expect higher level evidence for special groups, and lower level designs (and evidence) for cross community interventions may be sufficient. This view is reflected in both the recommendations and rationale.

Summary of overall evidence

- There is moderate (Level 3) evidence that behaviour change interventions that would support primary prevention of OA or OP risk factors (including smoking cessation, healthy eating, increased physical activity) which focus on a small set of strategies

may be more effective than interventions which include a large number of strategies [16].

- There is moderate (Level 3) to good (Level 2) evidence that providing information and education, and facilitating goal-setting for behaviour change may be effective for low-income groups [16, 19].
- There is weak (Level 4) evidence that media campaigns may be most effective for low socioeconomic status (SES) smokers when implemented within larger community wide tobacco control programs [17].
- There is weak (Level 4) evidence that increasing the price of tobacco is more effective in reducing smoking in lower-income adults and those in manual occupations [18].
- There is good (Level 2) evidence that an educational component involving explanation of the health risks associated with the targeted behaviour and the benefits of change can be effective in changing dietary behaviours in low SES young women of childbearing age [19].
- There is good (Level 2) evidence that effective interventions to increase fruit and vegetable consumption in low SES young women of childbearing age use clear messages about the benefits of fruit and vegetables, multiple strategies to enforce the messages, and deliver the message to families over a longer period than just one or two contacts [19].
- There is good (Level 2) evidence that personal counselling or education is effective in increasing fruit and vegetable consumption in low-income women [19].
- There is good (Level 2) evidence that peer educators may be an effective means of delivering dietary intervention to low-income families [19].
- There is good (Level 2) evidence that dietary interventions employing behavioural strategies such as goal setting and self-monitoring and involving personal contact with those delivering the intervention were effective in low-income women of childbearing age [19].
- There is good (Level 2) evidence that the use of a range of communication materials (such as media and personal communication), are effective for improving diet in disease-free lower SES populations as part of disease-prevention programs [19].

What types of health promotion and prevention programs for primary prevention of musculoskeletal conditions are most likely to be effective in preventing OA and OP in socioeconomically disadvantaged people, leading to a reduction in the associated burden of disease from these conditions?

Recommendations

1. Individual targeted healthy behaviour change efforts in socioeconomically disadvantaged populations would preferably include a small set of strategies.
2. Healthy behaviour change efforts in socioeconomically disadvantaged populations could include information about the risks of unhealthy behaviours and the benefits of behaviour change.
3. Arguably, increasing the price of tobacco is a population-level intervention for reducing smoking-related inequalities in health.
4. Smoking cessation media campaigns for low SES smokers should be implemented within larger community wide tobacco control programs (including e.g., telephone counselling, support groups, primary care interventions, cessation classes, health fairs, and public events, legislative changes for increased cigarette prices and clean indoor air laws).

5. Healthy behaviour change efforts in socioeconomically disadvantaged populations should include strategies which facilitate goal setting for change.
6. Effective interventions to increase healthy food consumption in low SES young women should use clear messages about the benefits of healthy foods, involve multiple strategies to enforce the messages including personal counselling or education, and deliver the message to families over a longer period than just one or two contacts.
7. Peer educators may be useful for delivering dietary intervention to low-income families.
8. A range of communication materials (such as media and personal communication) should be used in dietary interventions.
9. Research exploring culturally and demographically appropriate preventive interventions is needed, particularly for physical activity interventions.

Rationale

Only six relevant systematic reviews for socioeconomically disadvantaged people were located for the period 2000 to 2010. None considered primary prevention of OA or OP. SES is variously defined (e.g., low income, minority groups, lower education), and is often bound up with ethnicity in the available studies, so it may be difficult to separate out the cultural issues from those specific to SES. Only one of the reviews included here was undertaken by Australian researchers [90]. There are two studies which review SES inequalities in general population interventions [18, 90].

One systematic review looked at behaviour change across several healthy behaviours in low-income groups [16]. This review found moderate (Level 3) evidence from a small number of studies that behaviour change interventions for healthy behaviours (smoking cessation, healthy eating, and increased physical activity) can be effective in low-income groups. From 17 intervention evaluations, nine were successful, seven were not statistically different, and one suggested adverse effects. The interventions incorporated between four and 19 techniques: the most commonly utilised were: providing general information; providing information about the consequences of a particular behaviour; helping to form an intention to change a behaviour; setting specific goals; identifying barriers to changing behaviour; and planning social support or social change and providing rewards contingent on performing the behaviour. There was moderate (Level 3) evidence that interventions which included fewer strategies may be more effective than those which combined a large number of different strategies. The most common techniques, providing information and facilitating goal-setting, may be effective in low-income groups [16].

Two reviews considered tobacco control in lower SES populations. A systematic review of 18 evaluated programs [17] found weak (Level 4) evidence that media campaigns to promote smoking cessation are less effective among socioeconomically disadvantaged populations relative to more advantaged populations in developed European descent countries. Despite the lack of rigour in evaluation design, Niederdeppe et al. [17] suggested it was unlikely that nine from 17 interventions would be effective by chance, and noted that the most effective mass media campaigns for low SES smokers are those implemented within larger tobacco control programs that include community mobilisation, free nicotine replacement therapy (NRT), telephone counselling, social support, or policy changes to the social and structural context of tobacco use (e.g., clean indoor laws). Niederdeppe et al. [17] concluded that disparities in the effectiveness of media campaigns between SES groups could involve differences in meaningful exposure, differences in motivational response, or differences in opportunity to sustain long-term

cessation, and could have the unintended effect of increasing or maintaining existing disparities in smoking rates by SES. Conversely, Thomas et al. [18], in a review of the effects of population-level tobacco control interventions in individuals or groups with different demographic or socioeconomic characteristics, found weak (Level 4) evidence that population-level tobacco control interventions have the potential to benefit more disadvantaged groups and thereby contribute to reducing health inequalities. They defined population-level tobacco control interventions as those applied to populations, groups, areas, jurisdictions or institutions with the aim of changing the social, physical, economic or legislative environments to make them less conducive to smoking. These interventions might include: measures to reduce illicit cross-border shopping; restricting advertising of tobacco products; (enforcing) restrictions on selling tobacco products to minors; mandatory health warning labels on tobacco products; increasing the price of tobacco products; restricting access to cigarette vending machines; and restricting smoking in public places. These approaches might be included within wider, multifaceted interventions in schools or communities. Strategies aimed at individuals, including interventions applied to whole groups or populations (e.g., mass media health education campaigns) were not included. Although the evidence from both these systematic reviews was only weak (Level 4), the features of the most effective interventions identified can guide health promotion practice in smoking cessation interventions for lower SES groups.

Two systematic reviews looked at nutrition interventions in lower SES groups. A review of systematic reviews by Baird et al. [19] provided good (Level 2) evidence about effective interventions for diet behaviour change in low SES women of child-bearing age. Although evidence was relatively limited (only six reviews were located on improving diet), four aspects of intervention design were identified that were effective at changing one or more healthy behaviours: use of an educational component; provision of continued support after the initial intervention; family involvement; and social support from peers or lay health workers. Oldroyd et al. [90] found moderate (Level 3) evidence that nutrition interventions have differential effects by SES, but only limited evidence that nutrition interventions widen dietary inequalities, although they did not exclude this possibility, given the small number of available studies. They did not provide useful details of the successful interventions.

There was one review which considered physical activity interventions in socioeconomically disadvantaged people. Banks-Wallace and Conn [91] provided weak (Level 4) evidence that low SES (African American) women can increase their physical activity in response to interventions. Diverse interventions, settings, and measures were found. Common methodological weaknesses included lack of randomisation of subjects, single-group design, instruments without documented validity and reliability, significant attrition, and questionable timing of outcome variable measurement. The diversity of the interventions and effects meant that overall conclusions were limited, and the authors did not provide an analysis of the features of successful intervention.

Structured summaries of the included systematic reviews are provided at Appendix 4. Table 6 below details success factors for strategies/programs identified.

Table 6: Success factors for strategies/programs for primary prevention of OA and OP and risk factors for OA and OP in socioeconomically disadvantaged people

Behaviour change (e.g., smoking cessation, increased healthy eating, physical activity)	Smaller set of strategies rather than larger set [16]; Information about consequences of behaviour and about others' views towards behaviour [16]; and Prompt people to form intentions to change behaviour and to set goals for change [16].
Smoking	<i>Mass media smoking campaigns:</i> Provide free NRT [17]; Part of multi-component campaign (e.g., telephone counselling, support groups, primary care interventions, cessation classes, health fairs, and public events, legislative changes for increased cigarette prices and clean indoor air laws) [17]; and <i>Population-level tobacco control campaigns:</i> Increasing price of tobacco products may be more effective in reducing the prevalence of smoking in lower-income adults and those in manual occupations [18].
Nutrition	<i>Low SES women of child-bearing age:</i> Educational component involving explanation of health risks associated with targeted behaviour and benefits of change [19]; Provide continued support after initial intervention (months not weeks) [19]; Social support from peers or lay health workers [19]; Use clear messages about benefits of healthy foods [19]; Multiple strategies to enforce messages, delivered to families over a longer period than just one or two contacts [19]; Personal counselling or education for increasing healthy food consumption [19]; Behavioural strategies such as goal setting and self-monitoring [19]; Personal contact with those delivering the intervention [19]; and Use of a range of communication materials (such as media and personal communication) [19].

Aboriginal or Torres Strait Islander People

Overall quality of the evidence

The evidence around health promotion and prevention programs for the primary prevention of OA and OP and risk factors in Aboriginal or Torres Strait Islander people is both limited and generally of lower quality (mostly Levels 4 and 5). A significant caveat on research with Aboriginal and Torres Strait Islander people is that although they are diverse in languages and cultures, and live across the range of metropolitan, regional, and remote areas (so that factors relating to health are also very diverse), commonly the available studies do not reflect this diversity [73]. Most Aboriginal and Torres Strait Islander people live in capital cities and regional areas, with an estimated 32% living in major cities, 43% in regional areas and 25% in remote areas in 2006 [92]. The majority of Aboriginal and Torres Strait Islander people live in New South Wales (29%), Queensland (27%), Western Australia (14%) and the Northern Territory (12%) [92]. Only 6% of Aboriginal and Torres Strait Islander people live in Victoria [92]. Where possible, area of residence has been considered when assessing reviews. Additionally, it is well accepted that the most rigorous scientific designs such as RCTs are not appropriate for this population, due to cultural sensitivities [74]. Therefore, lower quality studies provide the majority, and best quality, of evidence available. This view is reflected in both the recommendations and rationale.

Summary of overall evidence

- There is weak (Level 4) evidence that face-to-face counselling or quit support in conjunction with NRT is likely to increase quit rates among Aboriginal people.
- There is weak (Level 4) evidence that training Aboriginal Health Workers to provide brief smoking intervention may contribute to increased smoking quit rates for Aboriginal people.
- There is very weak (Level 5) evidence that community-based nutrition/counselling interventions that focus on nutrition behaviour change that are well integrated into primary health care systems may be effective in preventing growth faltering in Aboriginal or Torres Strait Islander children under five years of age.
- There is very weak (Level 5) evidence that multifaceted interventions involving carers, community health workers and community representatives may be effective in preventing growth faltering in Aboriginal or Torres Strait Islander children under five years of age.
- There is very weak (Level 5) evidence that restrictions on the supply of alcohol may reduce excessive consumption of alcohol, and related harm, among Australia's Aboriginal population.
- There is weak (Level 4) evidence that sustainability of physical activity interventions for non-Australian Aboriginal people is more likely where programs include locally trained personnel, local leadership and stable funding.

What types of health promotion and prevention programs for primary prevention of musculoskeletal conditions are most likely to be effective in preventing OA and OP in Aboriginal or Torres Strait Islander people, leading to a reduction in the associated burden of disease from these conditions?

Recommendations

1. Tobacco cessation efforts with Aboriginal Australians should include culturally appropriate face-to-face counselling or quit support in conjunction with NRT.
2. Aboriginal Health Workers should be trained to provide brief smoking cessation interventions for Aboriginal people.
3. Mainstream strategies for smoking cessation which should be considered for Aboriginal people include: mass media campaigns, school based tobacco prevention and cessation programs for Aboriginal students, group based interventions run in culturally appropriate spaces, quit support and brief advice for pregnant women, and multi-component community interventions (e.g., including sponsorship of events, quit support groups, smoke free community locations, local media campaigns).
4. Community-based nutrition programs for children may include education/counselling which has been well integrated into primary health care systems, and multifaceted interventions involving carers, community health workers and community representatives.
5. All strategies for behaviour change among Aboriginal Australians should be tailored to ensure cultural appropriateness.
6. Prevention programs for Aboriginal Australians should be based on locally trained personnel, local leadership and stable funding.
7. There is an urgent need to fund evaluated culturally appropriate interventions to increase healthy behaviours and reduce unhealthy behaviours in Aboriginal Australians.

Rationale

Very few reviews of any quality were located for Aboriginal or Torres Strait Islander populations, so the five reviews included here are generally of lower quality (Levels 4 and 5) than those for non-Aboriginal groups. However, it has been argued that scientific designs such as RCTs are not appropriate for this population [20]. No studies considered primary prevention of OA or OP. Two of the five included reviews only consider studies on Native Americans [24, 93], so it is not certain how relevant these will be to an Australian Aboriginal group, however, some suggestions for what facilitates a successful intervention in Aboriginal populations may be relevant. Although it is well accepted that the relative socioeconomic disadvantage experienced by Aboriginal and Torres Strait Islander people compared with non-Aboriginal people increases their exposure to health risk factors [92], Australian Aboriginal health promotion research is still particularly lacking, with a surprising proportion of research still at the stage of considering how to be culturally appropriate at the most basic levels, with few concrete evaluations of interventions. However, a similar story is emerging from this very sparse work, that there can be no health gains without some cultural control, which has been reflected in other literature (see the Sydney Consensus) [74].

Musculoskeletal conditions were reported by 22% of Aboriginal or Torres Strait Islander people in 2004–2005 (13% back pain/disc disorders; 9% arthritis) [92]. Reporting of musculoskeletal conditions was higher in older age groups, with prevalence of these conditions for Aboriginal people 25 to 54 years higher than for non-Aboriginal Australians. Arthritis was the most common cause of hospitalisation for musculoskeletal diseases for Aboriginal Australians [92]. However, no systematic reviews were located which focussed directly on primary prevention of OA or OP for Aboriginal Australians.

In 2004–2005, 50% of Aboriginal adults smoked which was twice the rate of non-Aboriginal adults. Similar proportions of Aboriginal men (51%) and women (49%) were current daily smokers, but men in remote areas were more likely to be daily smokers than those in non-remote areas (58% vs. 49%) [92]. One high quality review of poor quality tobacco interventions for Aboriginal Australians by Power et al. [20] provided weak (Level 4) evidence that face-to-face counselling or quit support in conjunction with NRT is likely to increase quit rates among Aboriginal people, and weak (Level 4) evidence that training Aboriginal Health Workers to provide brief smoking cessation interventions may enhance quit rates for Aboriginal people. The potential of these interventions was supported by their effectiveness in mainstream communities and direct evidence from Aboriginal communities. Strategies which may work but for which there was very limited evidence (i.e., successful in mainstream but no evidence in Aboriginal populations) were mass media campaigns, school-based tobacco prevention and cessation programs for Aboriginal students, group-based interventions run in culturally appropriate spaces, quit support and brief advice for pregnant women, and multi-component community interventions (e.g., including sponsorship of events, quit support groups, smoke free community locations, local media campaigns). A major challenge was the lack of evidence for strategies to overcome the cultural barrier of normalisation of smoking within Aboriginal communities. The majority of studies reviewed appeared to be based in rural or remote communities.

The one systematic review located on nutrition focussed on growth faltering in Aboriginal children up to five years old, in remote Australian Aboriginal communities [22]. Growth

faltering may be relevant to healthy bone formation (essential to prevention of OP), depending upon the underlying reason, for example, poor nutrition would often involve poor calcium intake. The methodological rigour of the 44 identified studies, of which only four actually focussed on Australian Aboriginal children, was highly variable, with a diversity of study design, intervention type, reflecting the difficulties associated with carrying out studies in the contexts of poverty. The overall conclusion was that there was very weak (Level 5) evidence that growth faltering may be prevented by community-based nutrition education/counselling which has been well integrated into primary health care systems and interventions with multiple strategies to involve carers, community health workers and community representatives to integrate the program into local primary health care systems. Interventions for which there is some evidence of benefit in specific populations include: vitamin A supplementation in populations with moderate to severe vitamin A deficiency, and de-worming treatment in populations with high infestation rates. The authors recommended that programs should be designed according to best-practice, and should address the underlying causes of growth faltering.

After adjusting for population age differences, the rates of chronic risky/high risk drinking Aboriginal and non-Aboriginal Australians in 2004–2005 were similar, but Aboriginal people were twice as likely as non-Aboriginal people to be binge drinkers (i.e., episodes of short-term risky drinking) [92]. In a review of the effectiveness of alcohol interventions among Australia's Aboriginal population Gray et al. [23] found very weak (Level 5) evidence that the impact of most interventions (including health promotion education, acute interventions and supply reduction) appeared to be limited. However, this finding should be viewed with caution, as the authors suggested this null finding may be somewhat a function of inadequate resourcing and program support. While a broad range of intervention strategies has been employed, few systematic evaluations have been undertaken and the methodologies employed have been generally insufficient to allow robust generalisation. Evaluations of health promotion programs highlighted the need for greater staff support and more educational resources. While 'sobering-up shelters' have been shown to be acceptable to both community members and police, there is no quantitative evidence of their impact on indicators of alcohol-related harm. The few available studies suggest that, similar to other populations, there is no simple solution to the problem of excessive alcohol consumption among Aboriginal people.

In 2004–2005, 75% of Aboriginal adults (15 years and over) living in non-remote areas reported being sedentary or exercising at low levels in the two weeks prior to interview [92], Aboriginal women were more likely than Aboriginal men to be sedentary or have low levels of exercise (82% vs. 67%), which is a differential similar to non-Aboriginal populations. Aboriginal Australians were more likely than non-Aboriginal Australians to be sedentary or to exercise at low levels, after adjusting for population differences in age. While no systematic reviews were located which focussed on increasing physical activity in Aboriginal Australians, two reviews have been included which both considered physical activity within Native American populations [24, 93]. The review by Coble et al. [93], found very weak (Level 5) evidence that age, gender, and social support are important factors associated with physical activity for Native American populations: As Native Americans age, physical activity levels tend to decrease, and overall physical activity levels of Native Americans tend to be lower than in non-minorities; Native American men are more active than Native American women; and social environment appeared to be an integral part of the physical activity behaviour of Native Americans. Intervention details were not

described by Coble et al. and given the poor methodology of included studies, and the unknown relevance to Australian Aboriginal populations, the three included intervention studies were not sourced. In a review of physical activity interventions for Native Americans, mostly in Southwest USA, Teufel-Shone et al. [24] found very weak (Level 5) evidence that program sustainability was more likely where locally trained personnel, local leadership and stable funding were features of the program. They reported that effective physical activity interventions generally demonstrated an impact on individual health and community resources.

The Health and Welfare of Australia's Aboriginal and Torres Strait Islander Peoples 2008 reports that in 2004–2005, 38% of Aboriginal people aged 15 years and over (who reported their height and weight) were a healthy weight, 28% were overweight and 29% were obese [92]. Overall, more than half (57%) of Aboriginal people aged 15 years and over were overweight or obese. Aboriginal people in older age groups had higher rates of overweight/obesity, ranging from 37% for people 15 to 24 years to 74% for people 55 years and over. Overall, the rates of overweight/obesity were similar for both Aboriginal males (58%) and females (55%). The rates of overweight/obesity were similar for both Aboriginal and non-Aboriginal adults, after adjusting for age differences, although Aboriginal women were one-and-a-half times as likely to be overweight/obese as non-Aboriginal women. No systematic reviews were located which focussed on obesity prevention for Aboriginal Australians.

Structured summaries of the included systematic reviews are provided at Appendix 4. Table 7 below details success factors for strategies/programs identified.

Table 7: Success factors for strategies/programs for primary prevention of OA and OP and risk factors for OA and OP in Aboriginal or Torres Strait Islander people

Smoking	Culturally appropriate face-to-face counselling or quit support [20]; Couple face-to-face counselling or quit support with NRT [20]; Free NRT [20]; Aboriginal Health Workers as intervention agents [20]; Consider cultural barrier of normalisation of smoking [20]; and Conduct group interventions in culturally appropriate spaces [20].
Nutrition	<i>Growth faltering in Aboriginal children up to five years old:</i> Community-based nutrition education/counselling integrated into primary health care system [21, 22]; Multifaceted interventions involving carers, community health workers and community representatives [21, 22]; and Consider underlying causes of growth faltering (e.g., vitamin A supplementation in populations with moderate to severe vitamin A deficiency; or de-worming treatment in populations with high infestation rates) [21, 22].
Alcohol	Adequate funding [23]; Staff intervention expertise [23]; Adequate support for intervention staff [23]; and Adequate educational resources [23].
Physical Activity	Locally trained personnel [24]; Local leadership [24]; and Stable funding [24].

People at higher risk of vitamin D deficiency due to ethnicity or culture

Overall quality of the evidence

- The evidence around health promotion and prevention programs for the primary prevention of OA and OP in people at higher risk of vitamin D deficiency due to ethnicity or culture is extremely limited and of very poor quality.

Summary of overall evidence

- There is very weak (Level 5) evidence to support vitamin D supplementation during pregnancy as an intervention for primary prevention of OP in mothers and babies at higher risk of vitamin D deficiency due to ethnicity or culture.

What types of health promotion and prevention programs for primary prevention of musculoskeletal conditions are most likely to be effective in preventing OA and OP in people at higher risk of vitamin D deficiency, leading to a reduction in the associated burden of disease from these conditions?

Recommendations

1. Vitamin D supplementation in the later part of pregnancy should be considered in vulnerable groups, particularly recent immigrants (25–50 µg/day (1000–2000 IU/day)).
2. Research examining the calcium and/or vitamin D intakes of people at higher risk of vitamin D deficiency within Australia is urgently needed.

Rationale

Only one systematic review which considered health promotion and prevention programs for primary prevention of musculoskeletal conditions in people at higher risk of vitamin D deficiency was located. Although this review was not specifically focussed on people at-risk of vitamin D deficiency due to ethnicity or culture, this perspective was explored in the review. Mahomed and Gülmezoglu [94] examined the effect of vitamin D supplementation in pregnancy on birth outcomes. The review concluded that there is not enough evidence to evaluate the effects of vitamin D supplementation during pregnancy. From two available trials, in one, supplemented mothers had higher mean daily weight gain and a lower number of low birth weight infants while in the other, the supplemented group had lower birth weights. The recommendation was that vitamin D supplementation in the later part of pregnancy should be considered in vulnerable groups, such as Asian women living in Northern Europe, and possibly others in climates with long winters, which would also extend to immigrants to Australia from those regions.

A non-systematic review of the maternal and neonatal outcomes of vitamin D deficiency or supplementation during pregnancy [95] found that most identified studies included women with low vitamin D and calcium intake, lack of sun exposure or heavily pigmented skin. Specker [95] found that the evidence about vitamin D supplementation in these populations and benefits for foetal growth and bone development were inconclusive. They found no evidence that supplementation during pregnancy above amounts routinely required to prevent vitamin D deficiency in adults was of any benefit. However, these conclusions must be circumspect given the very poor quality of this non-systematic review. Although this review was not included in this rapid review, there is general consensus that vitamin D deficiency should be avoided in pregnancy [94, 96, 97].

Vitamin D intakes needed to achieve adequate serum blood level targets vary according individual characteristics, but intakes of 25–50 µg/day (1000–2000 IU/day) have been suggested as desirable [98, 99]. Food is a poor source of vitamin D, with the main sources (fatty fish and fortified foods such as milk) needing to be consumed in unrealistic quantities to provide intakes of at least 25 µg/day. To ensure vitamin D adequacy, most people need vitamin D supplements and/or increased sun exposure. While there has been some concern about vitamin D toxicity [25], oral vitamin D doses well above 25–50 µg/day have been shown to be safe for regular consumption by most people [25]. In healthy adults, 30 minutes of sun exposure to the arms and face without sunscreen should provide daily vitamin D needs [4]. Increasing sun exposure is the preferred mode of increasing vitamin D levels where this is possible.

Structured summaries of the included systematic reviews are provided at Appendix 4. While no programs were identified, successful supplementation would be at the level of 25–50 µg/day (1000–2000 IU/day) [25].

Children and young people (and healthy bones)

Overall quality of the evidence

This section focuses solely on promoting healthy bones in children and young people, so considers primary prevention through supplementation, and nutrition and physical activity interventions which specifically consider bone health only. Selected meta-analyses on prevention of obesity for general child/young persons' populations are also included, given the importance of preventing obesity for reducing the risk of OA. A thorough synthesis of the vast literature on promoting physical activity, improving nutrition and reducing obesity in younger people is beyond the scope of a rapid review, so the studies included here are not exhaustive. The most relevant, highest evidence level, and most recent systematic reviews only have been included. The available evidence around health promotion and prevention programs for the primary prevention of OA and OP and risk factors in children and young people is generally of good quality (Level 1 to Level 3).

Summary of overall evidence

- There is strong (Level 1) evidence that increased dietary calcium/dairy product intake, with and without vitamin D, significantly increases total body and lumbar spine bone mineral content (BMC) in children and young people with low base-line intakes [26].
- There is good (Level 2) evidence that interventions for the promotion of increased fruit and vegetable consumption by children aged four to 10 years can have a small, but significant positive effect [27].
- There is good (Level 2) evidence that targeted interventions for the promotion of increased fruit and vegetable consumption for parents with risk factors for cardiovascular disease have a larger effect size [27].
- There is good (Level 2) evidence that targeted interventions for the promotion of increased fruit and vegetable consumption which focus on one message have a larger effect size [27].
- There is moderate (Level 3) evidence that obesity prevention programs for children and young people can have a small impact on target behaviours [28].

- There is moderate (Level 3) evidence that obesity prevention strategies for children and young people attempting to reduce unhealthy behaviours may be more effective than those promoting positive behaviours [28].
- There is good (Level 2) evidence that childhood obesity prevention programs do not have an impact on weight status (using anthropometric measures) of children and young people [29].

What types of health promotion and prevention programs for primary prevention of musculoskeletal conditions are most likely to be effective in preventing OA and OP in children and young people, leading to a reduction in the associated burden of disease from these conditions?

Recommendations

1. Interventions to improve dietary calcium and/or vitamin D levels in children and young people should be a focus of prevention programs. Children (5 to 11 years) should have two to three serves of calcium rich foods each day (600-1000 mg daily) and young people (11 to 18 years) should have at least three serves each day (800-1000 mg daily; see Table 8). In Australia, the main source of vitamin D is sunlight. An adequate vitamin D dose can be obtained from exposure of hands, face and arms (or equivalent area of skin) to sunlight for about ten to 15 minutes four to six times per week [5].
2. Interventions to improve dietary calcium and/or vitamin D levels in children and young people should focus on one aim (e.g., increasing dairy consumption).
3. Prevention programs in children and young people should focus on reducing unhealthy behaviours rather than increasing healthy behaviours.
4. Physical activity programs should focus on weight bearing exercise.

Rationale

This section focuses solely on promoting healthy bones in children and young people, so includes only systematic reviews which comprise interventions which specifically consider bone health.

There were two reviews which considered low calcium and vitamin D intakes for healthy bones in children and young people. Huncharek et al. [26] provided strong (Level 1) evidence that increased intake of dietary calcium/dairy products, with and without vitamin D, significantly increases total body and lumbar spine BMC in children and young people with low baseline intakes. The authors suggest that further work is needed in order to confirm whether calcium/dairy intake translates into decreased fracture risk and decreased risk of osteoporosis in later life. Lerch and Meissner [100] found very few studies on the prevention of nutritional rickets in term born children. The four studies identified used vitamin D and/or calcium supplementation as an intervention for various aged children and young people. However, given the negative effects of rickets on bone health and the favourable risk-benefit ratio of supplementation, the authors suggested that it is reasonable to offer preventive measures (vitamin D and/or calcium) to all children up to two years of age, especially in high risk groups of children, such as those living in Africa, Asia or the Middle East and immigrants from these regions. Neither of these reviews detailed what type of health promotion intervention would be most useful in promoting increased calcium and vitamin D intake.

The recommended daily intake of calcium for children and young people is detailed in Table 8 below [101]. Common sources of dietary calcium include milk and other dairy products, white bread, some green vegetables, soft-boned fish and some nuts [102]. About two cups of regular milk equate to 500 mg of calcium. Dietary sources of Vitamin D are limited, and mainly arise from foods fortified with Vitamin D such as milk, soy drinks, margarine and cereals, although it is also found naturally in liver, fatty fish (tuna, salmon, sardines, herring and mackerel) and egg yolk [67]. The body's main source of Vitamin D is commonly from its manufacture in the skin on exposure to sunlight, and only 10 to 15 minutes of exposure to outdoor sun is necessary for the production of Vitamin D in children. For Australian children, exposure to sunlight might generally be sufficient. When supplementation of calcium or Vitamin D is needed, primary health care would seem to be the most logical setting for providing this advice.

Table 8: Recommended daily calcium intake for children and young people

Category	Age (years)	Calcium (mg)
Children	1-3	500
	4-8	700
Girls	9-11	1000
	12-18	1300
Boys	9-11	1000
	12-18	1300

Source: Adapted from NHMRC recommendations [101]

There were no systematic reviews identified that focussed on increasing dietary intake of foods for bone health (e.g., dairy products, fatty fish). One review on nutrition intervention in children was included here which considers the promotion of fruit and vegetables [27]. Although some vegetables can provide calcium (e.g., some green vegetables), none provide vitamin D, so this review was chosen as a comprehensive and good quality systematic review of diet related interventions for children, expecting that the findings for this dietary intervention type may generalise to other dietary interventions. However, this assumption would need to be tested for specific dietary interventions related to bone health (e.g. increasing dairy and fatty fish intake). Thomas, et al. [27] found good (Level 2) evidence from 19 interventions that promotion of fruit and vegetables to children aged four to 10 years can have a small significant positive effect, increasing children's fruit intake by one-fifth of a portion per day and their vegetable intake by nearly one-fifth of a portion per day [27]. The majority of the interventions were school-based, targeted and/or involved parents, and combined education on the health benefits of fruit and vegetables with experiential components such as food preparation and taste-testing. Targeted interventions for parents with risk factors for cardiovascular disease and interventions which focussed on one message (e.g. increasing fruit intake) demonstrated larger intervention effects. Single component interventions, such as classroom lessons alone or providing fruit only tuck shops, were not effective. A cross study synthesis, which compared a quantitative meta-analysis with a descriptive synthesis of children's own views on the barriers to healthy eating, suggested that interventions which brand fruit and vegetables as being tasty rather than healthy, which do not emphasise the benefits for future health, and which treat different foods (e.g., fruit vs. vegetables) differently, are more effective.

There were no systematic reviews identified that specifically detailed interventions to increase physical activity in younger people for bone health. One review, by French et al. [103], which looked at the evidence for weight bearing exercise and calcium intake for

healthy bone mass growth in children and young people was considered but not included, as it was not a systematic review, and provided no intervention details, although it concluded that weight bearing physical activity or calcium intake have positive effects on bone mass gain in children and young people. French et al. [103] also contended that there appeared to be no differential impact of weight bearing exercise and calcium intake according to gender, and they found no research that explored the interactions between pubertal development and weight bearing physical activity or calcium intake on bone mass outcomes [103]. There were many systematic reviews which were focussed on generally understanding how to increase physical activity in younger people, across varying age groups, and in various settings [104-107], however a thorough review of this extensive literature would need to be the subject of another review. An example review has not been included here, as there is no basis on which to assume that the lessons from interventions to increase general physical activity would apply to specific physical activity interventions to increase bone health, that is, weight bearing physical activity.

Five systematic reviews of interventions to prevent obesity in general child and young person populations were identified [28-30, 108, 109]. The three most recent, highest evidence level systematic reviews have been included here. Kamath et al. [28] found moderate (Level 3) evidence that obesity prevention programs can have a small impact on target behaviours but do not significantly impact BMI. In a systematic review and meta-analyses of mostly poor quality studies, they considered interventions delivered across many settings (home, school, clinic, or community setting) by healthcare professionals, community members, or health authorities, aimed at changing lifestyle behaviours (i.e., increased physical activity, decreased sedentary activity, increased healthy dietary habits, decreased unhealthy dietary habits) to prevent obesity in children and young people (aged two to 18 years). Strategies attempting to reduce unhealthy behaviours (i.e., decreasing sedentary behaviours and dietary fat) seem to be more effective than those promoting positive behaviours (i.e., increasing physical activity and consumption of fruits and vegetables) however, the meta-analyses were underpowered to recommend specific intervention components. Similarly, in a review of five systematic reviews, Poobalan et al. [29] found good (Level 2) evidence that childhood obesity prevention programs do not have an impact on the weight status of children and young people. Again they considered a wide range of interventions and delivery modes. Behavioural interventions did result in positive behaviour changes but this was not reflected as a positive effect on weight. Poobalan, et al. [29] concluded that the available evidence suggests that obesity is a product of social, economic, lifestyle and cultural changes which require comprehensive, co-ordinated, multi-component approaches to diet and physical activity over many years [29]. Stice et al. [30] provided moderate (Level 3) evidence for similar findings in a meta-analysis of primary studies. From 64 obesity prevention programs, only 21% produced significant effects that were typically very short-term. Larger effects were found for programs targeting children and young people compared to preadolescents and females, programs that were relatively brief, programs solely targeting weight control versus those targeting obesity in combination with other health behaviours such as smoking, programs evaluated in pilot trials, and programs where participants were self-selected into the intervention. Factors such as including mandated improvements in diet and exercise, sedentary behaviour reduction, delivery by trained interventionists, and parental involvement, were not associated with significantly larger effects.

Structured summaries of the included systematic reviews are provided at Appendix 4. Table 9 below details success factors for strategies/programs identified.

Table 9 : Success factors for strategies/programs for primary prevention of OA and OP and risk factors for OA and OP in children and young people

Vitamin D and/or calcium supplementation	Low baseline intake [26]; Two to three serves of calcium rich foods each day (600-1000 mg daily) for children (5 to 11 years) [5]; At least three serves of calcium rich foods each day (800-1000 mg daily) for young people (11 to 18 years) [5]; and Exposure of hands, face and arms (or equivalent area of skin) to sunlight for about five to 15 minutes four to six times per week for vitamin D [5].
Nutrition	Target interventions at parents with risk factors for cardiovascular disease [27]; Focus on one message only [27]; Encourage children to accept or like the taste of the food, rather than highlighting the health benefits [27]; Do not emphasise the benefits for future health [27]; Treat different foods (e.g., fruit and vegetables) differently [27]; and Multi-component interventions, rather than single component [27].
Obesity	Focus on reducing unhealthy behaviours rather than promoting positive behaviours [28]; Longer interventions (more than 6 months) [28]; Post-intervention outcomes (vs. in-treatment outcomes) [28]; Global approach – including a variety of components and settings rather than a more limited one [29]; Relatively intensive: over 40 hours of intervention time [30]; and Do not conceptualise as obesity prevention program (sell as general health education, cardiovascular disease prevention, physical activity, eating disorder prevention programs) [30].

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Appendices

Appendix 1: Brief for Rapid Review

Purpose and audience

The purpose of this rapid review is to identify effective health promotion programs for the primary prevention of specific musculoskeletal conditions in at-risk population groups.

The Prevention and Population Health Branch of the Victorian Department of Health has lead responsibility for primary prevention policies and programs in the areas of nutrition, physical activity, obesity prevention, reducing tobacco use, high risk use of alcohol, and falls prevention, with the overarching objective of preventing or minimising chronic disease burden.

The findings from this rapid review will be used to help identify priorities for action in planning musculoskeletal health promotion and prevention programs. This will include integration of musculoskeletal health promotion into existing relevant prevention programs delivered by community-based health services and other community-based health promotion organisations.

Review question

The review will address the following question:

What types of health promotion and prevention programs for primary prevention of musculoskeletal conditions are most likely to be effective in preventing osteoarthritis and osteoporosis in at-risk groups, leading to a reduction in the associated burden of disease from these conditions?

Scope of the question

The review should focus on interventions to prevent osteoarthritis (OA) and osteoporosis (OP) in population groups at higher risk of developing OA or OP:

- older people (aged 65 and over), including gender-specific interventions;
- socio-economically disadvantaged people;
- Aboriginal or Torres Strait Islander people;
- people at higher risk of Vitamin D deficiency (for example, those with dark skin or who are habitually covered for cultural reasons); and
- children (particularly with low calcium and vitamin D intakes for healthy bones).

Interventions in the following areas are excluded from this review:

- interventions that focus only on back pain; and
- workplace-based interventions.

The review should focus on interventions with the following target aims:

- promoting healthy eating;
- promoting regular physical activity;
- maintaining a healthy weight;
- avoiding tobacco use; and
- avoiding high-risk use of alcohol.

Interventions ranging from those that are targeted to at-risk groups (as above) (e.g., community-based muscle strengthening group exercise programs) to those that have a broader intervention target to the general population but would be applicable to the specified at-risk groups (e.g., mass media campaigns about bone health) are to be covered by the review.

The types of intervention methodologies of interest for this review are broadly defined to include: group-based interventions, health education and skill development, social marketing and health information, community action, settings and supportive environments, and capacity building.

The review should only include interventions where evidence of change is evaluated (descriptive before-and -after studies or controlled comparison studies).

The principal outcome of interest is the prevention of OA or OP. However, due to the long lead-time in developing these musculoskeletal conditions and the multi-factorial causes that contribute to them, other outcome measures are of interest:

- intermediate outcomes: these can include changes in attitudes, knowledge, health behaviours or risk factors related to OA or OP (e.g., increased regular physical activity which is likely to promote musculoskeletal health by reducing joint loading from excessive weight, or by maintaining bone density); improved health-related quality of life in the specified at-risk groups;
- where available, information on the cost-effectiveness of programs should be included; and
- where available, information on process measures (e.g., uptake or reach of programs) should be included.

The review is to focus on high level evidence where possible, i.e., existing systematic reviews. Where no existing reviews are available, the researcher can include key studies along with a clear rationale as to why the particular study was selected. While Australian studies are preferred, studies from other countries similar to Australia may be included with reference to the Australian context.

Scope of the review

The review should:

- provide a brief summary of existing reviews of the evidence and key research papers;
- identify areas where there is strong evidence in relation to the review question; where there is equivocal or conflicting evidence; and where there are gaps in the evidence;
- add expert opinion about the quality of the findings;
- provide a comprehensive coverage of research in the peer review literature including academic databases (e.g., Cochrane, Medline, PsycholInfo);
- provide a comprehensive review of the grey literature including government reports and agency reports. In addition other reports may be provided by the Victorian Department of Health;
- focus on literature published between 2000 and 2010; and
- comment on
 - critical factors that resulted in the success of the interventions (these might include elements of the intervention or of the implementation strategies used);

- the potential for interventions to lead to a reduction in health inequalities in musculoskeletal health; and
- applicability of interventions to socioeconomically disadvantaged groups.

Appendix 2: Search term strategy

A: TARGET GROUP TERMS

Older people (aged 65 years and over), including gender-specific interventions:

aged.mp. or exp 'Aged, 80 and over' / or exp Aged/ OR elderly.mp. OR senior citizen.mp. OR exp Aging/ or older adult.mp.

Socioeconomically disadvantaged people:

exp Socioeconomic Factors/ or exp Social Class/ or disadvantage.mp. OR socio?economic status.mp. OR exp Social Isolation/ or exp Psychosocial Deprivation/ or social deprivation.mp. or exp Poverty/ OR ired.mp OR index of socio?economic disadvantage.mp. OR seifa.mp. OR socio?economic indexes for areas.mp.

Aboriginal or Torres Strait Islander people:

exp Oceanic Ancestry Group/ or Australian Aboriginal.mp. OR Australian Aborigine.mp. OR indigenous Australian.mp. OR Aboriginal and Torres Strait Islander OR indigenous Australian.mp. OR Aboriginal and Torres Strait Islander OR Aboriginal.mp. OR aborigine.mp. OR indigenous.mp.

People at higher risk of vitamin D deficiency due to ethnicity or culture:

vitamin d deficiency.mp. or exp Vitamin D Deficiency/ NOT exp Hip Fractures/ or exp Accidental Falls/ or exp Fractures, Bone/ or falls.mp. OR exp Intestinal Absorption/ or exp Vitamin D/ or vitamin d absorption.mp. NOT exp Hip Fractures/ or exp Accidental Falls/ or ex p Fractures, Bone/ or falls.mp. OR exp Sunscreening Agents/ or exp Sunlight/ or sun exposure.mp. or exp Skin/ OR ultra violet rays.mp. or exp Ultraviolet Rays/ OR sunscreen.mp. OR sun?block.mp. or exp Zinc Oxide/ OR melanin.mp. or exp Melanins/ OR seasonal.mp. or exp Seasons/ OR exp Risk Factors/ or absorption risk.mp. OR malabsorption.mp. OR exp Culture/ or culture.mp. OR exp 'Religion and Medicine'/ or exp Religion/ or religion.mp. OR muslim.mp. or exp Islam/ OR exp Arabs/ or exp Israel/ or arab*.mp. OR exp Calcium/ or exp Calcium, Dietary/ or calcium intake.mp. OR exp African Continental Ancestry Group/ or exp African Americans/ or african.mp. OR exp Pacific Islands/ or pacific islander.mp. OR calcium deficiency.mp. OR exp Clothing/ or hijab.mp. OR head scarf.mp. OR exp Ethiopia/ or abaya.mp. OR chador.mp. OR niqab.mp.

Children (particularly with low calcium and vitamin D intakes for healthy bones):

child*.mp. or exp Child Development/ or exp Child/ AND [(vitamin d deficiency.mp. or exp Vitamin D Deficiency/ NOT exp Hip Fractures/ or exp Accidental Falls/ or exp Fractures, Bone/ or falls.mp.) OR (exp Intestinal Absorption/ or exp Vitamin D/ or vitamin d absorption.mp. NOT exp Hip Fractures/ or exp Accidental Falls/ or ex p Fractures, Bone/ or falls.mp.) OR exp Risk Factors/ or absorption risk.mp. OR exp Calcium/ or exp Calcium, Dietary/ or calcium intake.mp. OR calcium deficiency.mp. OR vitamin deficiency.mp. or exp Avitaminosis/ OR exp Bone Diseases/ or bone health risk.mp.] OR exp Adolescent/ or adolescen*.mp. or exp Minors/ AND [(vitamin d deficiency.mp. or exp Vitamin D Deficiency/ NOT exp Hip Fractures/ or exp Accidental Falls/ or exp Fractures, Bone/ or falls.mp.) OR (exp Intestinal Absorption/ or exp Vitamin D/ or vitamin d absorption.mp. NOT exp Hip Fractures/ or exp Accidental Falls/ or ex p Fractures, Bone/ or falls.mp.) OR exp Risk Factors/ or absorption risk.mp. OR exp Calcium/ or exp Calcium, Dietary/ or calcium intake.mp. OR calcium deficiency.mp. OR vitamin deficiency.mp. or exp Avitaminosis/ OR exp Bone Diseases/ or bone health risk.mp.] OR teenage.mp. AND [(vitamin d deficiency.mp. or exp Vitamin D Deficiency/ NOT exp Hip Fractures/ or exp Accidental Falls/ or exp Fractures, Bone/ or falls.mp.) OR (exp Intestinal Absorption/ or exp Vitamin D/ or vitamin d absorption.mp. NOT exp Hip Fractures/ or exp Accidental Falls/ or ex p Fractures, Bone/ or falls.mp.) OR exp Risk Factors/ or absorption risk.mp. OR exp Calcium/ or exp Calcium, Dietary/ or calcium intake.mp. OR calcium deficiency.mp. OR vitamin deficiency.mp. or exp Avitaminosis/ OR exp Bone Diseases/ or bone health risk.mp.] OR young adult.mp. or exp Young Adult/ AND [(vitamin d deficiency.mp. or exp Vitamin D Deficiency/ NOT exp Hip Fractures/ or exp Accidental Falls/ or exp Fractures, Bone/ or falls.mp.) OR (exp Intestinal Absorption/ or exp Vitamin D/ or vitamin d absorption.mp. NOT exp Hip Fractures/ or exp Accidental Falls/ or ex p Fractures, Bone/ or falls.mp.) OR exp Risk Factors/ or absorption risk.mp. OR exp

Calcium/ or exp Calcium, Dietary/ or calcium intake.mp. OR calcium deficiency.mp. OR vitamin deficiency.mp. or exp Avitaminosis/ OR exp Bone Diseases/ or bone health risk.mp.] OR youth.mp. AND [(vitamin d deficiency.mp. or exp Vitamin D Deficiency/ NOT exp Hip Fractures/ or exp Accidental Falls/ or exp Fractures, Bone/ or falls.mp.) OR (exp Intestinal Absorption/ or exp Vitamin D/ or vitamin d absorption.mp. NOT exp Hip Fractures/ or exp Accidental Falls/ or ex p Fractures, Bone/ or falls.mp.) OR exp Risk Factors/ or absorption risk.mp. OR exp Calcium/ or exp Calcium, Dietary/ or calcium intake.mp. OR calcium deficiency.mp. OR vitamin deficiency.mp. or exp Avitaminosis/ OR exp Bone Diseases/ or bone health risk.mp.] OR juvenile.mp. AND [(vitamin d deficiency.mp. or exp Vitamin D Deficiency/ NOT exp Hip Fractures/ or exp Accidental Falls/ or exp Fractures, Bone/ or falls.mp.) OR (exp Intestinal Absorption/ or exp Vitamin D/ or vitamin d absorption.mp. NOT exp Hip Fractures/ or exp Accidental Falls/ or ex p Fractures, Bone/ or falls.mp.) OR exp Risk Factors/ or absorption risk.mp. OR exp Calcium/ or exp Calcium, Dietary/ or calcium intake.mp. OR calcium deficiency.mp. OR vitamin deficiency.mp. or exp Avitaminosis/ OR exp Bone Diseases/ or bone health risk.mp.]

B: MUSCULOSKELETAL CONDITION TERMS

Osteoarthritis.mp. or exp osteoarthritis, Hip/ or exp osteoarthritis/ or exp Osteoarthritis, Spine/ or exp osteoarthritis, Knee/ OR exp Osteoporosis, Postmenopausal/ or exp Osteoporosis/ or osteoporosis.mp. OR exp Arthritis/ or arthritis.mp. OR hand osteoarthritis.mp. OR exp Musculoskeletal System/ or exp Musculoskeletal Diseases/ or musculoskeletal.mp. OR bone density.mp. or exp Bone Density/ OR exp Bone Resorption/ or exp 'Bone and Bones'/ or bone loss.mp. OR wrist osteoarthritis.mp. OR foot osteoarthritis.mp. OR ankle osteoarthritis.mp.

C: INTERVENTION/PREVENTION TERMS

preventative strategies.mp. OR exp Preventive Medicine/ or preventive health.mp. OR mass screening.mp. or exp Mass Screening/ OR health promotion.mp. or exp Health Promotion/ OR primary intervention.mp. OR exp Primary Prevention/ OR primary prevention.mp. or exp Primary Prevention/

D: RISK FACTOR/OUTCOME TERMS

nutrition.mp. or exp Nutrition Disorders/ OR exp Diet/ or diet.mp. OR food intake.mp. or exp Eating/ OR eating.mp. OR nutrient.mp. or exp Food/ OR physical activity.mp. OR exp Physical Fitness/ or fitness.mp. OR exercise.mp. or exp Exercise/ or exp Exercise Therapy/ OR exp Smoking/ or smoking.mp. or exp Smoking Cessation/ OR exp 'Tobacco Use Disorder'/ or exp Tobacco/ or tobacco.mp. or exp 'Tobacco Use Cessation'/ OR alcohol consumption.mp. OR exp Drinking/ or drinking.mp. or exp Alcohol Drinking/ or exp Drinking Behavior/ OR quality of life.mp. or exp 'Quality of Life'/ OR exp Obesity/ or exp Obesity, Morbid/ or obesity.mp. OR overweight.mp. or exp Overweight/ or exp Body Weight/

E: INTERVENTION IMPACT MEASURE TERMS

attitudes to osteoarthritis.mp. OR attitudes to osteoporosis.mp. OR exp Health Education/ or exp Attitude to Health/ or attitudes to health.mp. or exp Attitude/ or exp Health Knowledge, Attitudes, Practice/ OR attitude to nutrition.mp. OR attitudes to physical activity.mp. OR health behavior?.mp. or exp Health Behavior/ OR attitude to exercise.mp. OR attitude to smoking.mp. OR attitude to alcohol.mp. OR health knowledge.mp. OR exercise knowledge.mp. or exp Patient Education as Topic/ OR smoking knowledge.mp. or exp Health Education/ OR knowledge about osteoporosis.mp. OR knowledge about osteoarthritis.mp. OR exp Behavior Therapy/ or behavior?r change.mp. AND exp Smoking/ or smoking.mp. OR exp Behavior Therapy/ or behavior?r change.mp. AND exercise.mp. or exp Exercise/ OR exp Behavior Therapy/ or behavior?r change.mp. AND alcohol.mp. OR increased awareness of osteoarthritis.mp. OR increased awareness of osteoporosis.mp. OR increased awareness of exercise.mp. OR increased awareness of smoking.mp. OR increased awareness of alcohol.mp. OR increased awareness of health behavior?.mp. OR increased awareness of nutrition.mp. OR increased awareness of physical activity.mp.

Appendix 3: Overview of database search results

Search Strategy	Medline			PsycInfo		
	Overall Results	Limited to Australia only	International limits NZ/Canada/US/UK/Scandinavia	Overall Results	Limited to Australia only	International limits NZ/Canada/US/UK/Scandinavia
Search 1: A (older people) + B + C	201	1	42	2	0	0
Search 1: A (SE Disadvantage) + B + C	16	1	4	0	0	0
Search 1: A (ATSI people) + B + C	3	2	2	0	0	0
Search 1: A (Vitamin D deficiency risk) + B + C	255	5	51	1	0	0
Search 1: A (At-risk children) + B + C	105	0	18	0	0	0
Search 2: A (older people) + C + D	752	19	201	26	0	1
Search 2: A (SE Disadvantage) + C + D	224	12	78	3	1	1
Search 2: A (ATSI people) + C + D	29	14	19	1	0	0
Search 2: A (Vitamin D deficiency risk) + C + D	1271	31	350	22	1	2

Search Strategy	Medline			PsycInfo		
	Overall Results	Limited to Australia only	International limits NZ/Canada/US/UK/Scandinavia	Overall Results	Limited to Australia only	International limits NZ/Canada/US/UK/Scandinavia
Search 2: A (At-risk children) + C + D	279	4	89	1	0	0
Search 3: A (older people) + E	2518	54	647	48	1	4
Search 3: A (SE Disadvantage) + E	1222	32	450	14	0	0
Search 3: A (ATSI people) + E	106	27	76	2	0	1
Search 3: A (Vitamin D deficiency risk) + E	4414	103	1487	69	0	0
Search 3: A (At-risk children) + E	610	17	209	5	0	0

Search Strategy	Cinahl			Web of Science		
	Overall Results	Limited to Australia only	International limits NZ/Canada/US/UK/Scandinavia	Overall Results	Limited to Australia only	International limits NZ/Canada/US/UK/Scandinavia
Search 1: A (older people) + B + C	9	0	3	84	0	11
Search 1: A (SE Disadvantage) + B + C	3	0	2	5	0	2
Search 1: A (ATSI people) + B + C	1	0	1	1	1	1
Search 1: A (Vitamin D deficiency risk) + B + C	11	0	5	179	1	14
Search 1: A (At-risk children) + B + C	2	0	0	12	0	3
Search 2: A (older people) + C + D	92	6	23	300	4	40
Search 2: A (SE Disadvantage) + C + D	33	4	12	75	3	29
Search 2: A (ATSI people) + C + D	8	1	4	14	4	6

Search Strategy	Cinahl			Web of Science		
	Overall Results	Limited to Australia only	International limits NZ/Canada/US/UK/Scandinavia	Overall Results	Limited to Australia only	International limits NZ/Canada/US/UK/Scandinavia
Search 2: A (Vitamin D deficiency risk) + C + D	84	6	35	817	9	139
Search 2: A (At-risk children) + C + D	2	0	0	19	0	2
Search 3: A (older people) + E	179	4	37	534	13	95
Search 3: A (SE Disadvantage) + E	112	2	22	343	5	101
Search 3: A (ATSI people) + E	11	1	5	59	13	27
Search 3: A (Vitamin D deficiency risk) + E	192	10	73	1878	32	353
Search 3: A (At-risk children) + E	2	0	0	37	0	4

Search Strategy	Cochrane Library		
	Overall Results	Limited to Australia only	International limits NZ/Canada/US/UK/Scandinavia
Search 1: A (older people) + B + C	5	0	1
Search 1: A (SE Disadvantage) + B + C	0	0	0
Search 1: A (ATSI people) + B + C	0	0	0
Search 1: A (Vitamin D deficiency risk) + B + C	3	0	0
Search 1: A (At-risk children) + B + C	0	0	0
Search 2: A (older people) + C + D	38	2	4
Search 2: A (SE Disadvantage) + C + D	7	0	0
Search 2: A (ATSI people) + C + D	1	0	0
Search 2: A (Vitamin D deficiency risk) + C + D	10	1	2
Search 2: A (At-risk children) + C + D	0	0	0
Search 3: A (older people) + E	85	0	8
Search 3: A (SE Disadvantage) + E	21	0	0
Search 3: A (ATSI people) + E	1	0	0
Search 3: A (Vitamin D deficiency risk) + E	36	0	1
Search 3: A (At-risk children) + E	0	0	0

Older people (aged 65 years and over)

Primary prevention of OA/OP

- I. Liu, J, Ho, SC, Su, YX, Chen, WQ, Zhang, CX, Chen, YM. Effect of long-term intervention of soy isoflavones on bone mineral density in women: A meta-analysis of randomized controlled trials. *Bone*, 2009; 44(5): 948-53. DOI: 10.1016/j.bone.2008.12.020.

Study methods

Effect of soy isoflavone supplementation of at least one year duration on BMD at the lumbar spine, total hip and femoral neck in women, who were not taking medications known to affect bone health. English language, MEDLINE, PubMed, EMBASE and Cochrane Central Register of Controlled Trials (CENTRAL); January 1990 to March 2008.

Study findings

Soy isoflavone supplementation is unlikely to have significant favourable effects on BMD at the lumbar spine and hip in women.

Level of evidence - Level 1

Quality of evidence

Meta-analysis of RCTs or parallel or crossover study design. 10 eligible RCTs (896 women). There was large between-study heterogeneity in the effects of soy isoflavone and BMD changes at the lumbar spine and femoral neck, due to different doses of soy isoflavones and poorer quality studies overstated effects.

Summary of evidence

A mean dose of 87 mg soy isoflavones for at least one year did not significantly affect BMD changes. The mean (95% Confidence Interval [CI]) differences in BMD changes (in mg/cm²/year) were 4.1 (-1.6, 9.8) (0.4%) at the lumbar spine, -1.5 (-7.2, 4.3) (-0.3%) at the femoral neck under random-effects model, and 2.5 (-0.5, 5.4) (0.2%) at the total hip by fixed-effects model, respectively. Similar results were obtained in subgroup analyses by isoflavone sources (soy protein vs. isoflavone extract), ethnic differences (Asian vs. Western). Larger dose (≥ 80 mg/d), but not lower dose (≤ 80 mg/d), of isoflavone intervention tended to have a weak beneficial effect on spine BMD (p=0.08 vs. p=0.94). Sensitivity analyses showed that the weighed mean difference tended to be lower when the analysis was limited to those with high score of study quality (≥ 4.0). It suggested that low study quality might overestimate the beneficial effect of isoflavones on BMD.

Recommendations or implications arising from the evidence

The results suggested that ingesting a mean daily dose of 87 mg of soy isoflavins for 1-2 years is unlikely to significantly improve BMD in women.

- II. Papadimitropoulos, E, Wells, G, Shea, B, Gillespie, W, Weaver, B, Zytaruk, N, Cranney, A, Adachi, J, Tugwell, P, Josse, R, Greenwood, C, Guyatt, G. Meta-analyses of therapies for postmenopausal osteoporosis. VIII: Meta-analysis of the efficacy of vitamin D treatment in preventing osteoporosis in postmenopausal women. *Endocrine Reviews*, 2002; 23(4): p. 560-9.

Study methods

Effect of vitamin D on bone density in postmenopausal women (older than 45 years with absence of menses for a minimum of 6 months), for trials which randomised women to standard or hydroxylated vitamin D with or without calcium supplementation or a control and measured bone density and fracture rates for at least 1 year. No country or language exclusions, MEDLINE and EMBASE, reference lists, proceedings of international meetings; 1966 to 1999.

Study findings

Vitamin D treatment increases BMD, decreases vertebral fractures and may decrease non-vertebral fractures. There was no evidence regarding the relative effects of standard and hydroxylated vitamin D for fractures, but bigger effects for hydroxylated vitamin D were observed for increasing BMD.

Level of evidence - Level 2

Quality of evidence

Meta-analysis of RCTs. Included 25 RCTs, (4017 patients in each of treatment and control groups). There was considerable heterogeneity between studies, due to variability in study designs, methodological weaknesses in the primary studies (including lack of blinding in many studies), paucity of data, and inconsistency of results. Two particular issues are that methods of supplementation, and the use of calcium in addition to vitamin D, vary from study to study, and baseline levels of vitamin D were typically not measured, although it would be expected that vitamin D will have a different impact in different populations. Baseline differences in baseline vitamin D status was considered the most likely explanation for heterogeneity of treatment effect across studies.

Summary of evidence

Vitamin D reduced the incidence of vertebral fractures [relative risk (RR) 0.63, 95% CI 0.45-0.88, $p < 0.01$] and showed a trend toward reduced incidence of non-vertebral fractures (RR 0.77, 95% CI 0.57-1.04, $p = 0.09$). In trials evaluating vertebral fractures most patients received hydroxylated vitamin D, but in trials evaluating non-vertebral fractures most patients received standard vitamin D. Hydroxylated vitamin D had a consistently larger impact on bone density than did standard vitamin D. Total body differences in percentage change between hydroxylated vitamin D and control were 2.06 (0.72, 3.40) and 0.40 (-0.25, 1.06) for standard vitamin D. At the lumbar spine and forearm sites, hydroxylated vitamin D doses above 50µg yield larger effects than lower doses. Vitamin D resulted in an increased risk of discontinuing medication in comparison to control as a result of either symptomatic adverse effects or abnormal laboratory results (RR 1.37, 95% CI 1.01-1.88), an effect that was similar in trials of standard and hydroxylated vitamin D.

Recommendations or implications arising from the evidence

The data from the available randomised trials of vitamin D are very limited. Vitamin D formulations increase BMD and most likely reduce vertebral fractures, but the impact on non-vertebral fractures is uncertain. There is no evidence on the relative impact of different formulations on fracture rates, and the extent to which vitamin D effects vary in different populations. Hydroxylated vitamin D with doses above 0.43 µg is recommended.

- III. Tang BM, Elick GD, Nowson C, Smith C, Bensoussan A. Use of calcium or calcium in combination with vitamin D supplementation to prevent fractures and bone loss in people aged 50 years and older: A meta-analysis. *Lancet*, 2007; 370(9588): 657-66. DOI: 10.1016/S0140-6736(07)61342-7.

Study methods

Effect of randomised trials in which calcium, or calcium in combination with vitamin D, was used to prevent osteoporotic bone loss in people aged 50 years and older. No language exclusions, MEDLINE, EMBASE, Current Content, CINAHL, DARE, CENTRAL, Cochrane Database of Systematic Reviews, National Institute of Health, National Research Register, Current Controlled Trials, Trials Central, International Osteoporosis Foundation, National Guideline Clearinghouse, American College of Physicians, Computer Retrieval of Information on Scientific Projects, reference lists, review articles, conference abstracts; January 1966 to January, 2007.

Study findings

Evidence supports the use of calcium, or calcium in combination with vitamin D supplementation to prevent osteoporosis in people aged 50 years or older.

Level of evidence - Level 1

Quality of evidence

Meta-analysis of randomised trials. 23 randomised trials (41,419 participants) were identified. Data were pooled by use of a random-effect model.

Summary of evidence

In trials that reported BMD as an outcome, the treatment was associated with a reduced rate of bone loss of 0.54% (0.35-0.73; $p < 0.0001$) at the hip and 1.19% (0.76–1.61%; $p < 0.0001$) in the spine. The treatment effect was better with calcium doses of 1200 mg or more than with doses less than 1200 mg (0.80 vs. 0.94; $p = 0.006$), and with vitamin D doses of 800 IU or more than with doses less than 800 IU (0.84 vs. 0.87; $p = 0.03$).

Recommendations or implications arising from the evidence

Evidence supports the use of calcium, or calcium in combination with vitamin D supplementation, in the preventive treatment of osteoporosis in people aged 50 years or older. For best therapeutic effect, minimum doses of 1200 mg of calcium, and 800 IU of vitamin D (for combined calcium plus vitamin D supplementation) are recommended.

- IV. Shea B, Wells G, Cranney A, Zytaruk N, Robinson V, Griffith L, Hamel C, Ortiz Z, Peterson J, Adachi J, Tugwell P, Guyatt G. Calcium supplementation on bone loss in postmenopausal women. *Cochrane Database of Systematic Reviews*, 2004; (1): CD004526. DOI: 10.1002/14651858.CD004526.pub2.

Study methods

Effects of calcium supplementation on BMD (total body, vertebral spine, hip, or forearm) in postmenopausal women (older than 45 years with absence of menses for a minimum of six months), followed for at least one year. No country or language exclusions, CENTRAL, MEDLINE and EMBASE; up to 2001.

Study findings

Calcium supplementation alone has a small positive effect on BMD in postmenopausal women.

Level of evidence - Level 3

Quality of evidence

Systematic review. Fifteen RCTs (1806 participants) were included. Limitations of the review are large loss to follow-up in most studies and unexplained heterogeneity of results across studies.

Summary of evidence

Calcium was more effective than placebo in reducing rates of bone loss after two or more years of treatment. The pooled difference in percentage change from baseline was 2.05% (95% CI 0.24-3.86) for total body bone density, 1.66% (95% CI 0.92 to 2.39) for the lumbar spine at 2 years, 1.60% (95% CI 0.78-2.41) for the hip, and 1.91% (95% CI 0.33-3.50) for the distal radius.

Recommendations or implications arising from the evidence

Ensuring adequate calcium intake may be important for a variety of reasons, including its role as part of an intervention that includes another agent such as vitamin D or bisphosphonates.

Primary prevention of OA/OP risk factors, including intervention impact measures

Smoking

1. Bala M, Strzeszynski L, Cahill K. Mass media interventions for smoking cessation in adults. *Cochrane Database of Systematic Reviews*, 2008; (1): CD004704. DOI: 10.1002/14651858.CD004704.pub2.

Study methods

Mass media approaches (i.e., channels of communication such as television, radio, newspapers, billboards, posters, leaflets or booklets intended to reach large numbers of people, and which are not dependent on person-to-person contact, primarily to encourage smokers to quit; carried out alone or in conjunction with tobacco control programs) for reducing smoking in adults (25+ years) who regularly smoke cigarettes, with primary outcome of change in smoking behaviour (i.e., changes in prevalence, changes in cigarette consumption, quit rates, odds of being a smoker). No country or language exclusions, Cochrane Tobacco Addiction Group, CENTRAL, MEDLINE, EMBASE, CINAHL, PsycInfo, Dirline, Hstat, Healthstar, Science Direct, EIFL Direct, IBZ, IDEAL, Addiction Abstracts, ASSIA, ISI, ERIC, IBSS, Sociological Abstracts, Conference Paper Index, ProQuest, Springer Link, Swetsnet, and the ASH (Action on Smoking and Health) Database, reference lists, authors of existing trials and other experts; to March 2007.

Study findings

There is evidence that comprehensive tobacco control programs which include mass media campaigns can be effective in changing smoking behaviour in adults, but the evidence comes from a heterogeneous group of studies of variable methodological

quality. There was no consistent relationship was observed between campaign effectiveness and age, education, ethnicity or gender.

Level of evidence - Level 3

Quality of evidence

Systematic review of controlled trials allocating communities, regions or states to intervention or control conditions; interrupted time series. Cochrane methods. Results were not pooled due to heterogeneity. 11 campaigns identified.

Summary of evidence

Studies differed in design, settings, duration, content and intensity of intervention, length of follow up, methods of evaluation and also in definitions and measures of smoking behaviour used. None of the included studies tested only a mass media intervention; some studies did compare mass media intervention alone compared to mass media coupled with a community intervention. From nine campaigns reporting smoking prevalence, significant decreases were observed in two state-wide tobacco control campaigns compared with the rest of the USA, and for three other studies, there were some positive effects on prevalence in the whole population or in subgroups. Three large-scale campaigns of the seven presenting results for tobacco consumption found statistically significant decreases. Among the seven studies presenting abstinence or quit rates, four showed some positive effect, although in one of them the effect was measured for quitting and cutting down combined. Among the three that did not show significant decreases, one demonstrated a significant intervention effect on smokers and ex-smokers combined. One USA state-wide tobacco control program showed positive results up to eight years after the campaign, while another USA study showed positive results only during the period of adequate funding and implementation. Six of nine studies carried out in communities or regions showed some positive effects on smoking behaviour and one Australian study showed significant change in smoking prevalence. While effectiveness may be influenced by campaign intensity and duration, length of follow up and contemporaneous secular trends and events mean this is difficult to quantify. There was no consistent relationship was observed between campaign effectiveness and age, education, ethnicity or gender.

Recommendations or implications arising from the evidence

It is likely that mass media interventions (which involve communication through television, radio, newspapers, billboards, posters, leaflets or booklets) aimed at encouraging smokers to stop, and maintaining abstinence in non-smokers, contribute to a reduction in smoking when used as part of a complex set of interventions, but it is difficult to establish their independent role and value in this process.

II. Lancaster T, Stead LF. *Self-help interventions for smoking cessation*. Cochrane Database of Systematic Reviews, 2005(3): p. CD001118.

Study methods

Effectiveness of different forms of self-help materials (i.e., structured programming for smokers trying to quit without intensive contact with a therapist), compared with no treatment and with other minimal contact strategies; the effectiveness of adjuncts to self help, such as computer-generated feedback, telephone hotlines and pharmacotherapy;

and the effectiveness of approaches tailored to the individual (i.e., those that make use of participant characteristics to provide individualised programs for a broadly defined category of smoker, for example, women with young children, older smokers, or smokers in a particular stage of change) compared with non-tailored materials, with follow up of at least six months, where at least one arm tested a self-help intervention, evaluated using either self report of cessation alone or biochemically validated cessation. Excluded pregnant and adolescent smokers. No country or language exclusions, Cochrane Tobacco Addiction Review Group which routinely searches MEDLINE and EMBASE via OVID; up to November 2008.

Study findings

Advice and behavioural counselling can help smokers to quit. Giving the same type of support via written materials or other media has not been found to be very helpful, although there is likely to be a small benefit for people given no other support. Tailoring materials to provide individualised support is more effective. Comparisons between different types of standard materials have generally failed to show differences between them.

Level of evidence - Level 1

Quality of evidence

Meta-analysis of RCTs. 68 trials identified. Included trials where allocation to treatment was by a quasi-randomised method and sensitivity analysis used to determine whether their inclusion altered the results. Conclusions about the effect of self-help materials are based on an intention to treat analysis in which all randomised participants are included whether or not they received the intended intervention.

Summary of evidence

Thirty-four trials compared self-help materials to no intervention or tested materials used in addition to advice. In 12 trials in which self help was compared to no intervention there was a pooled effect that just reached statistical significance (N=15,711; RR 1.21; 95% CI 1.05-1.39). This analysis excluded two trials with strongly positive outcomes that introduced significant heterogeneity. Five further trials in which the control group received alternative written materials did not show evidence for an effect of the smoking self-help materials. There was no evidence of benefit from adding self-help materials to face-to-face advice, or to NRT. There were 25 trials using materials tailored for the characteristics of individual smokers, where meta-analysis supported a small benefit of tailored materials (N=28,189; RR 1.31; 95% CI 1.20-1.42, I²=19%). The evidence is strongest for tailored materials compared to no intervention, but also supports tailored materials as more helpful than standard materials, but part of this effect could be due to the additional contact or assessment required to obtain individual data. A small number of other trials failed to detect benefits from using additional materials or targeted materials, or to find differences between different self-help programs. A trial of manuals tailored for older smokers was unfortunately excluded as no long-term follow up was reported [110], so no specific conclusions about older smokers are provided.

Recommendations or implications arising from the evidence

Standard self-help materials may increase quit rates compared to no intervention, but the effect is likely to be small. There was no evidence of additional benefit when used

alongside other interventions such as advice from a healthcare professional, or NRT. There is evidence that materials that are tailored for individual smokers are more effective than untailored materials, although the absolute size of effect is still small.

Nutrition

- I. Payette H, Shatenstein B. *Determinants of healthy eating in community-dwelling elderly people. Canadian Journal of Public Health, 2005; 96: p. S27-31.*

Study methods

Determinants of healthy eating in community dwelling older people (65+). Canada only, English or French, MEDLINE, Ageline, PsycInfo (and other databases not specified), web-based search tools (e.g., Google, AltaVista), grey literature; 1990 to 2003.

Study findings

Effective dietary self-management is evident for well, independent older people without financial constraints, whatever their living arrangements, but nutritional risk is high for those in poor health or lacking resources. No recommendations for programs or services to facilitate healthy eating are possible, due to the paucity of research in regard to older community-living people, particularly in Canada.

Level of evidence - Level 5

Quality of evidence

Review of descriptive studies only. Looks at determinants of healthy eating, not interventions to improve nutrition.

Summary of evidence

The individual determinants of healthy eating include: age, sex, education, physical and emotional functioning, lifestyle practices and knowledge, attitudes, beliefs and behaviours, as well as socioeconomic status and culture. For example, increasing age has associated with decreasing adequate nutrition, while higher education and income levels are frequently associated with better nutrition knowledge and healthier eating behaviours. The facilitating collective factors included: accessible food labels, appropriate shopping environment, marketing of a 'healthy eating' message, adequate social support, and effective, community-based meal delivery services.

Recommendations or implications arising from the evidence

Older people who are well, independent and without financial constraints can self-manage a healthy diet, whatever their living arrangements, while those who are in poor health and lacking resources are at high nutritional risk. There has not been enough research to recommend programs or services to facilitate healthy eating in older community-living people.

- II. Eyles HC, Mhurchu CN. *Does tailoring make a difference? A systematic review of the long-term effectiveness of tailored nutrition education for adults. Nutrition Reviews, 2009; 67(8): p. 464-480.*

Study methods

Long-term (≥ 6 months) effectiveness of tailored nutrition education (in which at least one group of participants received tailored nutrition education and one group received either generic and/or no nutrition education) for adults (male and/or female, ≥ 18 years of age of all ethnicities and any health status). Priority population groups included ethnic and low income. No country or language exclusions, MEDLINE, MEDLINE In-Process, PsycInfo, CINAHL, ERIC, EMBASE, DARE, CDSR, Digital Abstracts, Science Citation Index, and PubMed; January 1990 to December 2007.

Study findings

Tailored nutrition education was found to be a promising strategy for improving the diets of adults (including those in priority population groups) over the long-term. Overall, the quality of the studies was moderate to good.

Level of evidence - Level 2

Quality of evidence

Meta-analysis of RCT or quasi-randomised controlled trials employing a parallel design. 15 trials (20,809 participants) included. Overall, quality of the studies was moderate to good. There was some publication bias noted.

Summary of evidence

The majority of studies focussed on fruit and vegetable intake in servings/day, and percentage of energy consumed from total fat (ETF). Meta analyses results suggest that tailored nutrition education was more effective than generic nutrition education and control: Those in the tailored group were found to consume WMD (weighted mean difference) 0.35 servings of fruits and vegetables per day more and WMD -2.20% ETF less than participants receiving generic nutrition education. In addition, participants that received tailored nutrition education were found to consume WMD 0.59 servings of fruits and vegetables per day more and WMD -2.45% ETF less than participants that received no nutrition education. Few studies of tailored nutrition education included large numbers of participants from a priority (USA) ethnic ($n=4$) or low-income ($n=1$) group. However, those that did were large (range, 357 to 3,737 participants), and most reported a positive effect of tailored nutrition education compared with control. The majority of interventions were tailored according to current diet, nutrient intake, food purchases, or behaviour theories (e.g., transtheoretical model [111]). Other basis for tailoring included: nutrition knowledge; perceived adequacy of nutrient intake; dietary preferences; occupation; anthropometry; demographics; health concerns and behaviours; diabetic profile; environment and social support; religion; motivational reasons for weight loss or diet change; former weight-loss experiences; and psychosocial factors. Most of these tailored interventions were delivered by newsletters, pamphlets, magazines, or workbooks. However, e-mail and the Internet were also common, and two studies delivered education via a kiosk housed in a supermarket. The frequency of tailored feedback ranged from one to 36 occasions over intervention periods of 1 day to 18 months.

Recommendations or implications arising from the evidence

Should automated tailored nutrition education be implemented widely as a public health strategy, it is possible that adults would increase their intake of fruits and vegetables by approximately 0.6 servings per day, and lower their intake of percentage of energy from

total fat by approximately 2.5%, which are clinically significant improvements in light of current intakes and recommendations. Future studies should ensure adequate reporting of research design and methods and reduce the chances of false-positive findings by using more objective measures of diet, clearly identifying the primary study outcome, and concentrating on outcomes most relevant to nutrition-related disease.

III. Pomerleau J, Lock K, Knai C, McKee M. Interventions designed to increase adult fruit and vegetable intake can be effective: A systematic review of the literature. *Journal of Nutrition*, 2005; 135(10): 2486-95. DOI: 135/10/2486 [pii].

Study methods

Effectiveness of controlled interventions and programs promoting fruit and/or vegetable intake in free-living not acutely ill adults (16-69 years), with follow-up periods ≥ 3 mo, that measured change in intake. English, French, Spanish, Portuguese, Russian, Danish, Norwegian, Swedish, PubMed; CAB Abstracts (including nutritional abstracts and reviews); Cochrane Library (including DARE: Database of Abstracts and Reviews of Effects); Web of Knowledge (including Web of Science and ISI database); IBSS (international bibliography of the Social Sciences); PsycInfo (BIDS); EMBASE; AGRICOLA; LILACS (Latin American and Caribbean Health Science Literature Database); ID21 (Development research reporting service); ERIC (Educational Resources Information Center); SIGLE (System for Information on Grey Literature); New York Academy of Medicine (grey literature); INGENTA, expert contact; database inception to April 2004.

Study findings

Small increases in fruit and vegetable intake are possible in population subgroups, and these can be achieved by a variety of approaches, including face-to-face education or counselling, telephone contacts, computer-tailored information, and community-based multi-component interventions.

Level of evidence - Level 3

Quality of evidence

Systematic review of controlled interventions and programs. 44 studies included (most with at least 500 participants). Due to heterogeneity in study populations, settings, types of interventions, and outcome assessment measures and lack of other important information, meta-analysis was not attempted.

Summary of evidence

Studies were mainly from developed countries. Larger effects were generally observed in individuals with pre-existing health disorders. In primary prevention interventions in healthy adults, fruit and vegetable intake was increased by +0.1-1.4 serving/day, however, it is indeterminate if this reflects clinically significant change. Consistent positive effects were seen in studies involving face-to-face education or counselling, and in interventions using telephone contacts or computer-tailored information. Computer tailored nutrition education may be a promising tool to motivate people to make healthy dietary changes, however there were no trials of this intervention type outside the US and Europe, and this mode is unlikely to be appropriate to developing countries, particularly for poor and rural communities. Community-based multi-component interventions also had positive findings, although the details of these were not provided. Authors noted an Australian estimate that

national campaigns to increase fruit and vegetable intake prevent 3626 disability adjusted life years each year with corresponding cost savings of AUD\$125 million each year over the implementation costs [estimated at AUD\$2.5 million a year] [112].

Recommendations or implications arising from the evidence

More research is required to examine the effectiveness of specific components of interventions in different populations, particularly less developed countries. There is also a need for a better assessment of the effectiveness and cost-effectiveness of large community based interventions.

IV. Bowen DJ, Beresford SAA. Dietary interventions to prevent disease. Annual Review of Public Health, 2002; 23: p. 255-86.

Study methods

Effect of interventions to change key dietary habits (i.e., fat intake, fibre intake, and consumption of fruits and vegetables) considered by intervention channel (i.e., individual randomised trials, intervention studies focussed on family, providers, and community organisations, point-of-purchase interventions, community-wide) among healthy free-living adults, where weight loss was not communicated to participants as the main study goal. English language, MEDLINE; 1966 to April 2001.

Study findings

The most common type of intervention was based on individual or group counselling for dietary change, which were generally successful in changing dietary behaviours. Community settings (e.g., religious organisations, point-of-sale) and community wide interventions had mixed success. There are currently no proven methods for dietary change at the community level.

Level of evidence - Level 4

Quality of evidence

Systematic review. There were no methodological criteria for study selection. 80 studies were reviewed, but few studies were population-based or effectiveness studies of an intervention. Most were efficacy studies of a select group of individuals or other, specific subgroup channels (e.g., religious groups). The authors acknowledge that generalising estimates of efficacy from these studies to the general population is not appropriate, therefore the size of intervention effects was not compared between different studies.

Summary of evidence

The most common type of intervention was based on individual or group counselling for dietary change. While most of these studies were successful in changing dietary behaviours, many by large amounts, most were conducted in individuals with existing risk factors for cardiovascular disease. Participants in these studies were often motivated and fully resourced, and so there was no attempt to change the dietary behaviours of large segments of the public. These studies provided some support for the idea that changing dietary behaviours in free-living people is possible.

Community settings such as religious organisations and grocery stores had mixed success. The few published studies in religious organisations indicated a positive finding. Grocery

store interventions produced little evidence of efficacy. Point-of-purchase interventions may raise awareness, but the effects on behaviour in choice of healthy food items are not yet proven. Despite the influence of advertising of food products by commercial interests on food choice being consistently substantiated, public health interventions have failed to not found the appropriate mechanism for capturing the public's interest and behaviours for healthy choices in places of purchase.

Community-wide strategies had mixed success in producing changes in dietary intake. For example, the Five-a-Day campaign was first evaluated in California through a state-wide campaign implemented by the State Health department [113]. The interventions consisted of five campaign waves, released over a period of 18 months and including media releases complemented by point-of-purchase information. The program was evaluated by self-report of servings of fruits and vegetables, and awareness, knowledge, beliefs, and attitudes about cancer, using a random-digit dial survey of 1000 adult residents of California. Consumption increased by 0.3 servings for white and African Americans, but decreased by 0.7 servings for Latinos. Of the key community studies, only the North Karelia Study reported such clear effects on dietary behaviour that statistical evaluation was not necessary [114]. Many single-community studies show changes over time in consumption of target nutrients, but it is difficult to attribute this change to an intervention without a control group. For example, the North Coast Cholesterol Check Campaign implemented a coordinated cholesterol-screening and follow-up program for residents of a defined area in Australia [115]. Cross-sectional resident surveys measuring food, blood cholesterol, and awareness and attitudes found significant changes in cholesterol from baseline to three months, with smaller changes maintained at one- and three-year follow-up surveys. However, overall, there has been mixed success of community-wide initiatives to change dietary intake, and poor evaluation standards. There are currently no proven methods for dietary change at the community level. Specific evidence for older people was not discussed in this review.

Recommendations or implications arising from the evidence

Future research should test methods of intervention in smaller-scale studies before applying them to large entire sets of communities. In general, there was a positive relationship between intensity of the goal presented in the intervention and the effect size produced by the intervention. More research is needed, with innovative strategies, to enable stores and markets to be used as an effective health promotion tool.

Physical activity

1. Schmitt NM, Schmitt J, Doren M. *The role of physical activity in the prevention of osteoporosis in postmenopausal women - An update. Maturitas, 2009; 63(1): 34-38. DOI: 10.1016/j.maturitas.2009.03.002.*

Study methods

Association of physical activity and osteoporosis in postmenopausal women. No country or language exclusions, MEDLINE, reference lists; January 2000 to October 2008.

Study findings

There is convincing evidence that physical activity effectively slows bone loss in postmenopausal women in a dose-dependent manner. Based on few and not entirely

comparable studies discussed in this review moderate or high intensity physical activity appears to exert site-specific beneficial effects on BMD.

Level of evidence - Level 2-3

Quality of evidence

Systematic review of RCTs and prospective cohort studies. Seven studies included: three RCTs, one controlled not randomised clinical trial, and three prospective cohort studies.

Summary of evidence

Six studies exclusively evaluated postmenopausal women and one included both men and women, with only limited data for postmenopausal women. Two prospective cohort studies indicate the clinical relevance of this association by showing an inverse relationship between physical activity and the risk of hip fracture. There is convincing evidence that physical activity effectively slows bone loss in postmenopausal women in a dose-dependent manner. Exercise programs may increase BMD. The authors suggest that best practice is represented by an intervention which included two supervised group sessions of 60–70 minutes and two non-supervised individual home training sessions of 25 minutes per week (warm-up, endurance, jumping, strength and flexibility training) [116]. Due to lack of good-quality, long-term studies, it is still not known whether exercise intervention programs decrease the risk of hip fractures.

Recommendations or implications arising from the evidence

Individually tailored, intense, high impact exercise programs may be most effective to maximise the goals of public health to prevent osteoporosis and consecutive adverse outcomes. However, high cost, low practicability, and limited applicability in routine prevention and care may limit the appropriateness of this approach. Popular and more easily applicable existing programs (e.g., aerobic classes, Tai Chi, and walking) seem less effective in the prevention of osteoporotic fractures in postmenopausal women based on the studies included in this review.

- II. Wayne PM, Kiel DP, Krebs DE, Davis RB, Savetsky-German J, Connelly M, Buring JE. *The effects of Tai Chi on bone mineral density in postmenopausal women: A systematic review. Archives of Physical Medicine and Rehabilitation, 2007; 88: 673-80. DOI: 10.1016/j.apmr.2007.02.012.*

Study methods

Effect of Tai Chi on BMD in postmenopausal women, for studies which had Tai Chi as an intervention, and at least one outcome related to measurement of BMD. English, Chinese-language, MEDLINE, Science Citation Index, Cochrane databases, China Biological Medicine Database, reference lists, personal libraries; 1966 to April 2006.

Study findings

Confident conclusions about the effect of Tai Chi on BMD are constrained by the lack of quantity and quality of the available research. However, this limited evidence suggests Tai Chi may be effective, safe, and practical for maintaining BMD in postmenopausal women.

Level of evidence - Level 3

Quality of evidence

Systematic review of RCTs, prospective cohort studies, and cross-sectional studies. Six controlled studies were identified. There were 2 RCTs, 2 non-randomised prospective parallel cohort studies, and 2 cross-sectional studies.

Summary of evidence

The two RCTs and one of the prospective cohort studies suggested that Tai Chi-naive women who participated in Tai Chi training exhibited reduced rates of postmenopausal declines in BMD. Cross-sectional studies suggested that long-term Tai Chi practitioners had higher BMD than age-matched sedentary controls, and had slower rates of postmenopausal BMD decline. No adverse effects related to Tai Chi were reported in any trial.

Recommendations or implications arising from the evidence

Conclusions on the impact of Tai Chi on BMD are limited by the quantity and quality of research to date. This limited evidence suggests Tai Chi may be an effective, safe, and practical intervention for maintaining BMD in postmenopausal women.

III. Martyn-St James M, Carroll S. High-intensity resistance training and postmenopausal bone loss: A meta-analysis. *Osteoporosis International*, 2006; 17: 1225-40. DOI: 10.1007/s00198-006-0083-4.

Study methods

Effects of progressive, high-intensity resistance training on BMD amongst postmenopausal women. No country or language exclusions, MEDLINE, EMBASE, PubMed, Web of Science, Sports Discus and Evidence Based Medicine Reviews Multifile (EBMZ); database inception to December 2004.

Study findings

The findings for high-intensity resistance training effects at the lumbar spine were significant. A non-significant positive effect was also evident at total hip. Results for femoral neck were inconsistent.

Level of evidence - Level 3

Quality of evidence

Meta-analysis of RCTs. 15 RCTs identified; lumbar spine (227 treatment, 226 control participants), femoral neck (192 treatment, 198 control participants), total hip (159 treatment, 162 control participants). Methodological quality of all included studies was low, with a reporting bias towards studies with positive BMD outcomes.

Summary of evidence

At the lumbar spine, 14 RCT study groups were homogenous ($I^2=25.2\%$) in demonstrating a significant increase ($p=0.006$) in BMD of 0.006 g/cm^2 (fixed effect; 95% CI 0.002-0.011) following high-intensity resistance training. Marked heterogeneity ($I^2=88.2\%$) was apparent within 11 RCT study groups evaluating femoral neck. For this comparison, a random effects model showed a positive change in femoral neck BMD of 0.010 g/cm^2 (95% CI -0.002 to 0.021 ; $p=0.11$). Subgroup analyses showed more anatomical variability of BMD responses to resistance training according to participants' hormone therapy use. Treatment effects

for study groups increasing all participants' calcium intake showed significant positive BMD changes at total hip ($p=0.007$).

Recommendations or implications arising from the evidence

The low impact nature of resistance training coupled with its physiological benefits provides a practical non-pharmacological therapy for postmenopausal women.

VI. Bonaiuti D, Shea B, Iovine R, Negrini S, Robinson V, Kemper HC, Wells G, Tugwell P, Cranney A. Exercise for preventing and treating osteoporosis in postmenopausal women. *Cochrane Database of Systematic Reviews*, 2002; (3): CD000333. DOI: 10.1002/14651858.CD000333.

Study methods

Effectiveness of physical activity (e.g., walking, calisthenics, resisted strengthening) compared to standard therapy (e.g., usual activity or placebo with or without drug consumption) for preventing bone loss in healthy postmenopausal women (45-70 years). No country or language exclusions, Cochrane Musculoskeletal Group Register, CENTRAL, MEDLINE, EMBASE, HealthSTAR, Sports Discus, CINAHL and PEDro; 1966 to January 2000.

Study findings

Aerobics, weight bearing and resistance exercises are all effective in increasing BMD of the spine in postmenopausal women. Walking is also effective on the hip.

Level of evidence - Level 2

Quality of evidence

Systematic review of RCTs. 18 RCTs included, with mean methodological quality score of 2.53 (Cochrane). Quality of reporting and methodology was low in many trials, particularly for allocation concealment and blinding.

Summary of evidence

Aerobics, weight bearing and resistance exercises were all effective on the BMD of the spine. The WMD for the combined aerobics and weight bearing program on the spine was 1.79 [95%CI (0.58, 3.01)]. Walking was an effective intervention for both BMD of the spine 1.31 [95%CI (-0.03, 2.65)] and the hip 0.92 [95%CI (0.21, 1.64)]. Aerobic exercise was effective in increasing BMD of the wrist 1.22 [95%CI (0.71, 1.74)]. Exercise therapy, and particularly weight bearing exercise, appears to be effective in increasing BMD at the lumbar spine and hip in postmenopausal women. The impact of exercise on bone density in the wrist is unclear at this time. Based on the results of one study, exercise does not appear to prevent fractures in postmenopausal women during the first two years of exercise.

Recommendations or implications arising from the evidence

The results suggest that walking may be the best program to propose to most people, and may be the easiest and simplest program to implement long-term.

V. Foster C, Hillsdon M, Thorogood M. Interventions for promoting physical activity. *Cochrane Database of Systematic Reviews* 2005, Issue 1. Art. No.: CD003180. DOI:10.1002/14651858.CD003180.pub2.

Study methods

Effectiveness of interventions designed to promote physical activity in sedentary community dwelling adults aged 16 years and older, not living in an institution and free from pre-existing medical conditions or studies with no more than 10% of subjects with pre-existing medical conditions that may limit participation in physical activity. Interventions included one only or a combination of: One-to-one counselling/advice or group counselling/advice; Self-directed or prescribed physical activity; Supervised or unsupervised physical activity; Home-based or facility-based physical activity; Ongoing face-to-face support; Telephone support; Written education/motivation support material; Self monitoring. The review included only studies with a minimum of six months follow up from intervention start to final data collection, and which either used an intention-to-treat analysis or, failing that, had no more than 20% loss to follow up. Interventions on trained athletes or sports students were excluded. Included interventions conducted by one or a combination of practitioners including a physician, nurse, health educator, counsellor, exercise leader or peer. Mass media interventions and multiple risk factor interventions were excluded. The interventions were compared with a no intervention control, attention control (receiving attention matched to length of intervention, e.g. general health check) and/or minimal intervention control group. No country or language exclusions, The Cochrane Library (issue 1 2005), MEDLINE, EMBASE, CINAHL, PsycLIT, BIDS ISI, SPORTDISCUS, SIGLE, SCISEARCH, reference list search, researcher contacts; earliest dates to December 2004.

Study findings

The review concluded that professional advice and guidance with continued support can encourage people to be more physically active in the short to mid-term, but that more research is needed to establish which methods of exercise promotion work best in the long-term to encourage specific groups of people to be more physically active. The effect of interventions on self-reported physical activity was positive and moderate (pooled standardised mean difference [SMD] random effects model 0.28 95% CI 0.15 to 0.41). There was significant heterogeneity in the reported effects as well as heterogeneity in characteristics of the interventions, which was reduced in higher quality studies, when physical activity was self-directed with some professional guidance and when there was on-going professional support. This review suggests that physical activity interventions have a moderate effect on self-reported physical activity, and on achieving a predetermined level of physical activity. Due to the clinical and statistical heterogeneity of the studies, only limited conclusions can be drawn about the effectiveness of individual components of the interventions. The relevance of the overall results of this review to an older community population is unknown given the small representation of older people across studies.

Level of evidence - Level 2

Quality of evidence

Systematic review of RCTs; 29 RCTs were included. Five of these were workplace based, and 15 were primary care based, so outside the scope of the current OA/OP review. 19 studies (7598 participants) considered the effect of interventions on self-reported physical activity; the three studies which included population health interventions with older people were in this group of studies. Of these, only one small relevant RCT (n=20) included only older people (84 to 92 years), and this study included only women, with an

intervention of group-based or home-based walking, in the USA [87]. Two other small relevant RCTs included some older people, both from Japan: Inoue 2003 (86 participants aged 47-68 years) considered moderate physical activity after a group program [88]; and the Sendai Silver Center Trial (SSCT) 2000 (65 participants aged 60-81 years) tested group-based endurance and resistance training [89]. The relevance of the overall results of this review to an older community population is unknown given this meagre representation of older population.

The overall quality of the studies in the review was limited by a lack of intention-to-treat analysis and failure to examine the interaction between baseline levels of physical activity and exposure to the intervention. Only six studies (none of those including older people) achieved all of the quality criteria. The observed effects were smaller but more consistent in studies with higher quality scores. There were two relevant main weaknesses in the studies: studies failed to state their randomisation methods, and the studies did not use personnel to collect main outcome measures that were independent and blinded to group allocation.

Summary of evidence

Nineteen studies (7,598 participants) reported their main outcome as one of several continuous measures of physical activity, including the three relevant studies with older participants. The pooled effect of these 19 studies was positive but moderate (SMD 0.28, 95% CI 0.15 to 0.41) with significant heterogeneity in observed effects. Seven studies reported positive effects, including SSCT 2000 [89], one of the few studies which included people 65 years or older. For the 19 studies that reported continuous outcomes for physical activity, six were classified as high quality but none of those with participants 65 years and over. Lower quality studies also had a positive pooled effect but with significant heterogeneity in the observed effects; the standardised mean difference was 0.36 (95% CI 0.17 to 0.56).

The review was unable to determine if any type of physical activity is more likely to be adopted than any other type of physical activity, (e.g., walking, jogging or running) as the studies were not designed to examine this question and as such generally did not report exactly what type of physical activity was performed.

The behavioural components of the interventions were stratified according to a number of characteristics: degree of nature of direction (the extent to which physical activity was prescribed or self-directed) and the level of on-going professional support (frequency of follow up after week five of the study). Although there were insufficient studies to statistically test the difference in observed effects between these study characteristics, the significant heterogeneity in reported effects was reduced when physical activity was self-directed with some professional guidance and when there was on-going professional support (in studies with continuous outcome measures for self-reported physical activity). The review was unable to describe the quality of the components of the interventions. There is no evidence that such interventions will reduce physical activity or cause other harm, but only very limited evidence of the long-term effectiveness of interventions.

Recommendations or implications arising from the evidence

There is some evidence to suggest that interventions designed to increase physical activity can lead to moderate short and mid-term increases in physical activity, at least in middle

age. Due to the clinical and statistical heterogeneity of the studies, only limited conclusions can be drawn about the effectiveness of individual components of the interventions. Nevertheless interventions which provide people with professional guidance about starting an exercise program and then provide ongoing support may be more effective in encouraging the uptake of physical activity. There is no evidence that such interventions will reduce physical activity or cause other harm. There is only very limited evidence of the long-term effectiveness of interventions.

Socioeconomically disadvantaged people

Primary prevention of OA/OP risk factors, including intervention impact measures

- I. Michie S, Jochelson K, Markham WA, Bridle C. *Low-income groups and behaviour change interventions. A review of intervention content and effectiveness. 2008, King's Fund: London.*

Study methods

Effectiveness of behaviour change interventions in low-income (e.g., SES, deprivation, disadvantaged, income) non-clinical, general population adults (18 years and older) for smoking cessation, healthy eating, and physical activity, for studies with behavioural outcomes relevant to the intervention target (i.e., smoking cessation, increased healthy eating, physical activity). English language, 21 electronic databases, expert consultations; January 1995 to September 2006.

Study findings

There is some tentative evidence from a small number of studies that behaviour change interventions for healthy behaviours can be effective in low-income groups. From 17 intervention evaluations targeted at low-income groups (contained within 13 studies), nine were successful, seven were not statistically different and one suggested adverse effects.

Level of evidence - Level 3

Quality of evidence

Systematic review, studies with concurrent control, with or without random allocation. 13 studies were included. Eight studies were RCTs, five were non-randomised cohorts with concurrent control. Sample sizes ranged from 15 to more than 2,000, with most between 200 and 1,000, and an average of about 500. Effect data were extracted for the final follow-up (less than six months, between six and 12 months, 12 months or more).

Summary of evidence

Seven, six and four studies involved interventions to promote smoking cessation, healthy eating and physical activity, respectively, and three studies included more than one behaviour. No studies investigated cost-effectiveness. Interventions were very heterogeneous, incorporating between four and 19 techniques. The most common (in at least 10 of 17 interventions) were: providing general information; providing information about the consequences of a particular behaviour; helping to form an intention to change a behaviour; setting specific goals; identifying barriers to changing behaviour;

and planning social support or social change and providing rewards contingent on performing the behaviour.

Nine interventions had positive effects, seven resulted in no detectable change and one had an adverse effect. Four smoking studies reported a positive effect and three reported no effects. For healthy eating, four studies reported positive effects and two no effects. For physical activity, one study reported a positive effect, two no effects and one an adverse effect. Overall, five of the nine positive intervention effects were obtained from RCTs aimed at promoting healthy eating, physical activity and smoking cessation, three of which were conducted in the UK. Differing sample sizes did not appear to explain differences in effectiveness, since there was no difference between sample sizes for effective interventions (Mean=665, Standard deviation [SD]=812) and those having no effect (Mean=613, SD 443; $t[11]=0.12$, $p=0.91$). Effective interventions had a tendency to have fewer techniques on average than ineffective interventions (8.22 vs. 12.75; $t[15]=-1.95$, $p=0.07$; 95% CI for mean difference = -9.48, 0.43). Meta-analysis was not appropriate, due to heterogeneity in intervention content and design. However, descriptive comparison suggests that providing information about consequences of the behaviour and about others' views towards the behaviour, and prompting people to form intentions to change behaviour and to set goals for change may be associated with effective interventions.

Theories were cited in six of the 13 included studies, incorporating 10 of the 17 comparisons, four studies drawing on more than one theory. Five studies cited the stages of change/transtheoretical model, four cited social cognitive theory, while other theories were cited only once: theory of reasoned action, precaution adoption model, precede-proceed model, behaviour modification principles and organisational theory. There was also no obvious association between reported use of theory and whether or not the intervention was effective.

Recommendations or implications arising from the evidence

There is suggestive evidence that interventions focusing on a small set of strategies may be more effective than interventions combining a large number of different strategies. The most common techniques (providing information and facilitating goal-setting) may be helpful for low-income groups. However, there is limited evidence about the effectiveness and cost-effectiveness of changing health behaviours in disadvantaged groups.

Smoking

1. Niederdeppe J, Kuang X, Crock B, Skelton A. Media campaigns to promote smoking cessation among socioeconomically disadvantaged populations: What do we know, what do we need to learn, and what should we do now? *Social Science and Medicine*, 2008; 67:1343-1355.

Study methods

Effectiveness of media campaigns to promote smoking cessation among low SES adults (aged 18 and older) in the USA and countries with comparable political systems and demographic profiles such as Canada, Australia and Western European nations, English language, literature reviews of media campaigns and smoking cessation, such as Centers for Disease Control, National Cancer Institute, Task Force on Community Preventive

Services, U.S. Department of Health and Human Services, PubMed, Communication Abstracts;1990 to 2008.

Study findings

There is evidence that media campaigns to promote smoking cessation are often less effective, sometimes equally effective, and rarely more effective among socioeconomically disadvantaged populations relative to more advantaged populations. Disparities in the effectiveness of media campaigns between SES groups may occur at any of three stages: differences in meaningful exposure, differences in motivational response, or differences in opportunity to sustain long-term cessation. Media campaigns appear most effective among low SES smokers when implemented within larger tobacco control programs that include community mobilization, free NRT, telephone counselling, social support, or policy changes to change the social and structural context of cigarette use.

Level of evidence - Level 4

Quality of evidence

Systematic review, evaluated programs, not RCTs. 29 articles, summarising results from 18 studies, which made explicit statistical comparisons of media campaign effectiveness by SES, and 21 articles, summarising results from 13 studies, which assessed the effectiveness of media campaigns targeted specifically to low SES populations were included.

Summary of evidence

Of 18 general population media campaigns that tested for differences in effectiveness by SES, nine were less effective among lower SES relative to higher SES smokers. Reduced effectiveness among lower vs. higher SES populations was observed at each stage of the hypothesised causal chain, including message recall, motivational response, and long-term smoking. The six interventions that were equally effective in promoting smoking cessation among low and high SES smokers used a diverse set of approaches, but were generally large in scale, implemented in the context of other tobacco control programs or activities, and often featured graphic portrayals of the health effects of tobacco. Of the three studies which provided evidence of greater effectiveness among low SES compared to high SES smokers two were general population mass media included within the context of a multi-component campaign (one included telephone counselling, support groups, primary care interventions, cessation classes, health fairs, and public events [117], and the other was paired with increased cigarette prices, and clean indoor air laws) [118].

Of 13 media campaigns that exclusively targeted low SES populations none provided unequivocal evidence that a media campaign promoted sustained cessation among socioeconomically disadvantaged smokers.

These studies provide some evidence that media campaigns to promote smoking cessation at the overall population level are often less effective, sometimes equally effective, and rarely more effective among low SES populations relative to high SES populations. Many of these campaigns could have the unintended effect of increasing or maintaining existing disparities in smoking rates and the mortality burden of tobacco by SES. Media campaigns appear most effective among low SES smokers when they are implemented alongside larger tobacco control programs that include community

mobilization, free NRT, telephone counselling, social support, or policy changes to change the social and structural context of tobacco use.

Recommendations or implications arising from the evidence

There remains a need to conduct research that examines the effectiveness of media campaigns by SES; these studies should employ research designs that are sensitive to various ways that SES differences in smoking cessation media effects might occur.

- II. Thomas S, Fayer D, Misso K, Ogilvie D, Petticrew M, Sowden A, Whitehead M, Worthy G. *Population tobacco control interventions and their effects on social inequalities in smoking: Systematic review. Tobacco Control, 2008; 17: 230-7. DOI: 10.1136/tc.2007.023911.*

Study methods

Effects of population-level tobacco control interventions in smokers, people at-risk of taking up smoking, people at-risk of exposure to environmental tobacco smoke (ETS) or the general population in individuals or groups with different demographic or socioeconomic characteristics. No country or language exclusions, bibliographies and conference abstracts, key journals, author contacts, medical, nursing, psychological, social science and grey literature databases, database inception to January 2006.

Study findings

Smoking restrictions in schools may be more effective in girls. Restrictions on sales to minors may be more effective in girls and younger children. Increasing the price of tobacco products may be more effective in reducing smoking among lower-income adults and those in manual occupations, although there was also some evidence to suggest that adults with higher levels of education may be more price-sensitive. Young people aged under 25 are also affected by price increases, with some evidence that boys and non-white young people may be more sensitive to price.

Level of evidence - Level 4

Quality of evidence

Systematic review, narrative synthesis of studies of any design. 84 studies included. Stronger designs tended to have been used for studies of the effects of restrictions on smoking in public places and schools and restrictions on sales to minors, of which three were cluster RCTs. Studies of other types of interventions were predominantly cross-sectional or retrospective. Studies of restrictions on sales to minors were the most likely to fulfil the criteria for quality of execution, with one study meeting all six criteria and two studies meeting five. Two studies of restrictions on smoking in schools met four criteria. The remaining studies in this review met between zero and three of the criteria.

Summary of evidence

Population-level tobacco control interventions were defined as interventions applied to populations, groups, areas, jurisdictions or institutions with the aim of changing the social, physical, economic or legislative environments to make them less conducive to smoking. These interventions might include: measures to reduce illicit cross-border shopping; restricting advertising of tobacco products; (enforcing) restrictions on selling tobacco

products to minors; mandatory health warning labels on tobacco products; increasing the price of tobacco products; restricting access to cigarette vending machines; and restricting smoking in public places. These approaches might be included within wider, multifaceted interventions in schools or communities. Strategies aimed at individuals, including interventions applied to whole groups or populations (e.g., mass media health education campaigns) were not included.

There was relevant evidence for seven intervention types: restrictions on smoking in public places, restrictions on smoking in schools, restrictions on sales to minors, health warnings on tobacco products, restrictions on advertising of tobacco products, price of tobacco products and multifaceted interventions. There was no strong evidence that restrictions in public places are more effective in reducing smoking in more advantaged groups. There was evidence from single studies that smoking restrictions in schools may be more effective in girls and in younger schoolchildren. There was some better-quality evidence on the differential effects of restrictions on sales to minors: restrictions seem to be more effective in girls and in younger schoolchildren, and one study of a combined education and enforcement intervention found restrictions on sales to minors to be more effective in white than non-white groups. For health warnings on tobacco products and restrictions on tobacco advertising, the lack of robust studies makes firm conclusions difficult. The effects of health warnings do not appear to be subject to a sociodemographic gradient, but their effects have not been examined with respect to income, occupation or ethnicity and the evidence with respect to educational level, gender and age is not convincing. The effects of advertising bans also show no differential by gender or age, but the evidence is not strong. The balance of econometric evidence suggests that increasing the price of tobacco is more effective in reducing smoking in lower-income adults and those in manual occupations. The evidence with respect to differential effects by gender, ethnicity or age is not consistent. From the few studies assessing the effects of pricing in children, it appears that boys, non-white children and also older children may be more price-sensitive. There was no evidence on how effects on children varied by household income.

Recommendations or implications arising from the evidence

Population-level tobacco control interventions have the potential to benefit more disadvantaged groups and thereby contribute to reducing health inequalities. The most compelling evidence of a social gradient in effectiveness which favours the least well off is for the price of tobacco products. Increasing the price of tobacco is therefore the population-level intervention for which there was the strongest evidence as a measure for reducing smoking-related inequalities in health.

Nutrition

- i. Baird J, Cooper C, Margetts BM, Barker M, Inskip HM. Changing health behaviour of young women from disadvantaged backgrounds: Evidence from systematic reviews. *Proceedings of the Nutrition Society*, 2009; 68(2): 195-204. DOI: 10.1017/S0029665109001050.

Study methods

Systematic collation of evidence from systematic reviews of interventions directed at changing health behaviours including diet, breast-feeding, physical activity and smoking in young women of childbearing age, and with children where interventions required

change in health behaviour by family groups including the mothers. Developed countries, Cochrane Database of Systematic Reviews, DARE), Health Technology Assessment Database, MEDLINE; 1966 to January 2008.

Study findings

The evidence relating to interventions that might bring about behaviour change in women of childbearing age is relatively limited, particularly for interventions to improve diet and nutrition. Four aspects of intervention design were identified that were effective at changing one or more of the health behaviours considered: use of an educational component; provision of continued support after the initial intervention; family involvement; social support from peers or lay health workers.

Level of evidence - Level 2

Quality of evidence

Review of systematic reviews. 14 systematic reviews included (six related to diet). The majority of systematic reviews had rigorous methods and were of high quality; many of them were Cochrane reviews.

Summary of evidence

Six reviews related to diet, all of which were of good (Level 2) quality. There were several key findings: interventions with an educational component and those that aimed to support and empower women can improve nutrition knowledge and behaviour in both the general population and low-income groups of women; the most effective interventions to increase fruit and vegetable consumption used clear messages about the benefits of fruit and vegetables and multiple strategies to enforce the messages and were delivered to families over a longer period than just one or two contacts; peer educators may be an effective means of delivering intervention to low-income families; interventions on children in a school setting were most effective when family was involved; personal counselling or education are effective in increasing fruit and vegetable consumption in low-income and other adult population groups; interventions employing behavioural strategies such as goal setting and self-monitoring and involving personal contact with those delivering the intervention were effective; patient education and counselling were effective in changing health behaviours; behavioural techniques, particularly self-monitoring and the use of a range of communication materials (such as media and personal communication), were most effective for improving diet and reducing smoking, in disease-free populations in a range of clinical settings as part of disease-prevention programs.

Recommendations or implications arising from the evidence

Interventions to change the health behaviour of women of childbearing age from disadvantaged backgrounds will require an educational approach and should provide continued support after the initial intervention (of months not weeks). Family involvement and social support from peers may also be important elements of interventions that aim to improve diet.

- II. Oldroyd J, Burns C, Lucas P, Haikerwal A, Waters E. The effectiveness of nutrition interventions on dietary outcomes by relative social disadvantage: A systematic review. *Journal of Epidemiology and Community Health*, 2008; 62(7): p. 573-9.

Study methods

Effect of group level nutrition interventions to promote healthy eating delivered at a group level to low socioeconomic status groups (ethnic minorities and those of low income or educational level) or studies where it was possible to disaggregate data by socioeconomic status, on dietary inequalities across SES groups. English only, CINAHL and MEDLINE; 1990-2007.

Study findings

Nutrition interventions have differential effects by socioeconomic status, although in this review there was only limited evidence that nutrition interventions widen dietary inequalities.

Level of evidence - Level 3

Quality of evidence

Systematic review of RCTs and concurrent controlled trials of interventions. Six studies were included. Owing to heterogeneity of study characteristics, a meta-analysis was not conducted. All six studies had some methodological weakness, using standard measurement criteria: none provided power calculations; all collected outcome data using self-reported food intake over the past 24 hours (e.g., food frequency questionnaire).

Summary of evidence

Four studies were in the educational setting (three elementary schools, one vocational training). The first found greater increases in fruit and vegetable consumption in children from high income families after 1 year (mean difference 2.4 portions per day, $p < 0.0001$) than in children in low-income families (mean difference 1.3 portions per day, $p < 0.0003$). The second did not report effect sizes but reported nutrition intervention was less effective in disadvantaged areas ($p < 0.01$). The third found that 24-h fruit juice and vegetable consumption increased more in children born outside the Netherlands ("non-native") after a nutrition intervention (beta coefficient = 1.30, $p < 0.01$) than in "native" children (beta coefficient = 0.24, $p < 0.05$). The vocational training study found that a better educated group achieved 34% of dietary goals compared with a group with more non-US born and non-English speakers, which achieved 60% of dietary goals. Of the two studies conducted in primary care settings, the first found that intervention resulted in a difference in added fat consumption between intervention and control group of -8.9 g/day for blacks and -12.0 g/day for whites ($p < 0.05$), while the second study reported greater attrition among ethnic minority participants compared to white participants ($p < 0.04$).

Recommendations or implications arising from the evidence

All six studies showed that nutrition interventions have differential effects by SES, but they provided only limited evidence for widening of inequalities. Due to small numbers of included studies, the possibility that nutrition interventions widen inequalities cannot be excluded. This needs to be considered when formulating public health policy.

Physical activity

1. Banks-Wallace J, Conn V. Interventions to promote physical activity among African American women. *Public Health Nursing*, 2002; 19(5): p. 321-35.

Study methods

Strategies to increase physical activity among African American women, or where African American women comprised at least 35% of the sample, for studies which included direct measures of physical activity behaviour. English language, MEDLINE and CINAHL; 1984 to 2000.

Study findings

Both positive and negative outcomes were reported for the interventions tested, suggesting that African American women can increase their physical activity in response to interventions. Diverse interventions, settings, and measures were found. Common methodological weaknesses included lack of randomization of subjects, single-group design, instruments without documented validity and reliability, significant attrition, and questionable timing of outcome variable measurement. The diversity of the interventions and effects meant that overall conclusions were limited.

Level of evidence - Level 4

Quality of evidence

Review of literature, unclear if systematic. 18 studies (1,623 subjects) included. Seven studies were focussed exclusively on African American women, and other studies included from 41% to 98% African American women. One study was an unpublished dissertation, and 17 were published reports in refereed journals. Attrition was a significant problem, varying from 3% to 41% with five studies reporting over 20% attrition. Seven of the 18 studies used random assignment to experimental and comparison groups, while eight used single-group pre-post designs, and two compared experimental subjects to non-equivalent control groups. Only three studies used an interval greater than six months between the intervention and dependent variable assessment. The absence of random assignment in multiple studies limits confidence in causal relationship in the studies. The common use of single-group designs is another significant methodological weakness in the body of literature.

Summary of evidence

Only four studies used interventions designed exclusively to increase physical activity; the remaining 14 studies targeted both dietary and physical activity behaviours. Two studies with individually delivered intervention continued for 6 months of intervention, and the remainder varied from 6 to 18 weeks. Most studies (14) described specific design strategies that enhanced the likely cultural relevance of the interventions. The interventions yielded mixed results in terms of effectiveness for promoting physical activity. Six studies that used direct measures of activity reported significant increases in physical activity behaviour. Five studies, which used direct measures, did not find statistically significant increases in activity at the final measure of the dependent variable. One study with an indirect measure of activity (heart rate) found significant increases following the intervention, and another study that used heart rate measures did not find statistically significant increases. Ten studies reported decreased weight, body mass index, and waist measurement. Four of the seven studies that measured the outcome one month or less after completing the intervention found significant increases in activity behaviour. Two of the three studies that measured physical activity at least 6 months following intervention delivery did not find significant increases in activity behaviour. Several studies reported measures of outcome that could be attributed to either diet or physical activity behaviour change and did not

report on any measure that could be confidently attributed to physical activity. Four of these studies reported significant improvements in health indices such as weight and glycated haemoglobin. Five studies with supervised exercise sessions found increased activity outcomes and five others found no significant increase in activity. The two studies testing the same intervention (PATHWAYS) found improved health indices that could be attributed to either the recommended diet or the recommended activity change. Of the four studies explicitly basing their intervention on a theoretical framework, two reported mixed positive findings, one reported lack of increased activity, and one reported weight loss (intervention focussed on both diet and activity behaviour). Summarising findings across other aspects of interventions is difficult due to diversity of methods.

Recommendations or implications arising from the evidence

Diversity of study designs, interventions, and outcomes is the most notable finding of the review. The inconsistent and limited changes in physical activity behaviour of African American women in response to these many different interventions suggest that further research is needed to find appropriate interventions in this population.

Aboriginal or Torres Strait Islander people

Primary prevention of OA/OP risk factors, including intervention impact measures

Smoking

1. Power J, Grealy C, Rintoul D. Tobacco interventions for Indigenous Australians: A review of current evidence. *Health Promotion Journal of Australia*, 2009; 20(3): p. 186-94.

Study methods

Effective interventions for smoking cessation among Aboriginal Australians. Australia only, MEDLINE, APAIS Health, CINAHL, Rural and Remote Health, Australian Family and Society Abstracts, Cochrane database, PysCLIT, Social Sciences Citation Index, Academic Search Premier, Web of Science, Informit e-library, JSTOR, targeted Google web-based search, key Australian tobacco websites; 2001-2007.

Study findings

Face-to-face counselling or quit support in conjunction with NRT is likely to increase quit rates among Aboriginal people. Training Aboriginal Health Workers to provide brief smoking intervention may also contribute to increased quit rates.

Level of evidence - Level 4

Quality of evidence

Systematic review, in-depth interviews and workshops with practitioners and researchers working in Aboriginal health. Seven Australian programs with well-designed rigorous evaluations were included. Four programs with limited evaluation were also identified. The authors note that no studies reached an evidence level above NHMRC III-3, but also noted that this was indicative of research methodologies appropriate to this population.

Summary of evidence

There was limited research conducted in this area between 2001 and 2007, and a major proportion were not adequately evaluated. There were some useful findings from the range of studies reviewed, which appeared to be mainly based in rural and remote communities. Aboriginal people have been shown to have high recall around the main messages of mainstream mass media campaigns, although there is no information on Aboriginal specific programs. While school based tobacco prevention and cessation programs have been developed for Aboriginal students, these have been small in scale, often not fully implemented and only evaluated qualitatively. Interventions to reduce tobacco sales to minors in community stores were met with strong local resistance, and were not successful. Several small studies looked at NRT as an intervention to support smoking cessation, and one study achieved a quit rate of 10%. This type of intervention may be more successful in a community rather than primary care setting, however due to the barrier for Aboriginal people of attending primary care. Face-to-face counselling alone was not found to be effective, but was more successful when coupled with free NRT. A group based intervention run through an Aboriginal Health Service, with a quit management plan and free NRT achieved a quite rate of 19%-success was attributed to providing sessions in culturally appropriate space. Brief intervention is seen as inappropriate for was this cultural group, particularly given the high prevalence of smoking, but programs utilising training of Aboriginal Health Workers to deliver brief advice have been shown to reduce daily smoking. Quit support and brief advice may work for pregnant women, but a high proportion of pregnant Aboriginal women do not attend doctors, so coverage for this type of intervention may be limited. Community interventions which involve multiple strategies such as sponsorship of events, quit support groups, introducing smoke free community locations and local media campaigns are difficult to evaluate using smoking rate as an end point, however one multi-component community intervention in Aboriginal communities had a positive effect upon knowledge of the harmful effect so smoking and a trend to decreased smoking rates. The best evidence supports individual level smoking cessation strategies such as NRT and/or counselling as likely to be effective for Aboriginal people motivated to quit, particularly utilising Aboriginal Health Workers as the intervention agent. There is not good evidence for strategies to overcome the cultural barrier of normalisation of smoking within Aboriginal communities.

Recommendations or implications arising from the evidence

There is evidence that individually targeted smoking cessation strategies, such as NRT with support may be effective in increasing quit rates for Aboriginal Australians. Culturally appropriate strategies and settings should be used.

Nutrition

- I. McDonald EL, Bailie RS, Rumbold AR, Morris PS, Paterson BA. Preventing growth faltering among Australian Indigenous children: Implications for policy and practice. *Medical Journal of Australia*, 2008; 188(8 Suppl): p. S84-6.
- II. McDonald EL, Bailie RS, Morris PS, Rumbold AR, Paterson BA. Interventions to prevent growth faltering in remote Indigenous communities. 2006, Australian Primary Health Care Research Institute & Menzies School: Canberra.

Study methods

Effect of preventive models or programs on patterns of growth faltering in children (aged under five years) in remote Australian Aboriginal communities. No country exclusions, MEDLINE, CINAHL, PsychInfo, ERIC, SCI Expanded, Cochrane Library, Informit (Databases: Indigenous Australia, Family & Society Plus), Health InfoNet, websites of key stakeholder, government and non-government agencies, no defined timeframe.

Study findings

Growth faltering may be prevented by community based nutrition education/counselling and interventions consisting of more than one strategy that involve carers, community health workers and community representatives; that are designed to meet program best-practice requirements; and that address the underlying causes of growth faltering.

Level of evidence - Level 2-5

Quality of evidence

Systematic review, all types of study design. 51 articles referring to 44 individual programs and seven review articles included. Study designs included systematic and narrative reviews (7), RCTs (18), quasi- experimental designs (cohorts are assembled according to whether or not exposure to the intervention has occurred) (3), controlled before and after designs (4) and other (19). In the latter category the study designs were generally considered very poor with few or no quality criteria met. These included descriptive study (2), observational study (2), program evaluation (2), cohort with matched, unmatched or historic control (8), before and after with no control (1), and cross sectional survey (4). The methodological rigour of the studies was highly variable. This reflects the diversity of the study designs used, types of intervention, and difficulties associated with carrying out studies in contexts of poverty.

Summary of evidence

Studies used either one or a combination of the following interventions: food supplements (children and pregnant or lactating women), growth monitoring, education/counselling (for carers of children, community workers or health workers), de-worming, vitamin and mineral supplements, multiple micronutrient supplements and multifaceted studies. Few programs (4) focussed on Australian Aboriginal children. Evidence supporting interventions to prevent growth faltering is limited by a lack of good quality data- methodological problems included failing to identify and address the direct and indirect causes of growth faltering among the research population, not reporting the social, economic, environmental and other contextual factors that would impact on the success of interventions. While the observed effects are modest, it appears that community-based nutrition education/counselling and multifaceted interventions involving carers, community health workers and community representatives, when these are designed to meet program best-practice requirements and address the underlying causes of growth faltering, may be effective in preventing growth faltering. Other interventions, such as food distribution programs, growth monitoring, micronutrient supplementation and de-worming should only be contemplated in the broader context of primary health care programs and/or when there is an identified local need.

Recommendations or implications arising from the evidence

For remote Aboriginal communities, development and implementation of programs should involve a consideration of the evidence for potential impact, strength of community support and local feasibility. Given the lack of strong evidence supporting programs, any new or existing programs require ongoing evaluation and refinement.

Alcohol

1. Gray D, Siggers S, Sputore B, Bourbon D. *What works? A review of evaluated alcohol misuse interventions among Aboriginal Australians. Addiction, 2000; 95(1): p. 11-22.*

Study methods

Effect of evaluated intervention strategies for reducing excessive consumption of alcohol, and related harm, among the Australian Aboriginal population. Australia's National Centre for Research into the Prevention of Drug Abuse electronic data base on Aboriginal alcohol and other drug issues.

Study findings

The impact of most interventions for reducing excessive consumption of alcohol, and related harm, among Australia's Aboriginal population appears limited but this may be somewhat a function of inadequate resourcing and program support.

Level of evidence - Level 5

Quality of evidence

Systematic review of Australia's National Centre for Research into the Prevention of Drug Abuse Aboriginal alcohol and other drug issues reports. 14 reports included.

Summary of evidence

Studies were grouped and systematically reviewed under the broad categories of treatment, health promotion education, acute interventions and supply reduction. While a broad range of intervention strategies has been employed, few systematic evaluations have been undertaken and the methodologies employed have been generally insufficient to allow robust generalisation. The three evaluations which covered some 18 treatment programs were either inconclusive or suggested only modest gains. Importantly, all three treatment evaluations showed that, at least somewhat, effectiveness of programs was impacted by administrative deficiencies and/or lack of staff expertise. Similarly, evaluated health promotional programs have also not been shown to be successful, although the methodologies used were in the main less than robust. Evaluations of health promotion programs highlighted the need for greater staff support and more educational resources. 'Sobering-up shelters' have been shown to be an acceptable intervention strategy to both community members and police, and there is evidence that they provide a cost-effective means of keeping intoxicated people away from police lock ups. As yet, however, there is no quantitative evidence of their impact on indicators of alcohol related harm. Of those interventions evaluated, restrictions on the supply of alcohol appear to have produced the most tangible results. Nevertheless, even here evaluations demonstrate considerable variation in the effect and the authors of all these reports emphasise that, alone, restrictions are not likely to provide any long-term solution.

Recommendations or implications arising from the evidence

Despite the limitations of the evaluation reports, it appears there is a need to employ a broader range of treatment models and complementary intervention strategies. Interventions are generally inadequately resourced. There is some support for supply reduction interventions. Most importantly, there is a pressing need for more rigorous evaluation studies in cooperation with Aboriginal community organisations. These few studies suggest that, similar to other populations, there is no simple solution to the problem of excessive alcohol consumption among Aboriginal people.

Physical activity

- I. *Teufel-Shone NI, Fitzgerald C, Teufel-Shone L, Gamber M. Systematic review of physical activity interventions implemented with American Indian and Alaska Native populations in the United States and Canada. American Journal of Health Promotion, 2009; 23(6): p. S8-32.*

Study methods

Physical activity interventions implemented in American Indian/Alaska Native populations in the United States and Canada. English language, MEDLINE, PubMed, ERIC, Sociological Abstracts, grey literature (Computer Retrieval of Information on Scientific Projects, dissertation abstracts, and web-based search engines: Google, MSN, Alta Vista, AOL, Dogpile, web-sites for Centers for Disease Control and Prevention, American Public Health Association, Association of American Indian Physicians, Indian Health Service (IHS), Wisconsin Department of Instruction, Montana State University, University of Arizona Health Science Center, Children and Adolescent Nutrition and Fitness Program), reference lists, relevant conference abstracts and proceedings; January 1986 to September 2006.

Study findings

Effective American Indian/Alaska Native interventions demonstrated an impact on individual health and community resources. Program sustainability was more likely where programs included locally trained personnel, local leadership and stable funding.

Level of evidence - Level 4

Quality of evidence

Systematic review of peer-reviewed and grey literature. 64 different American Indian/Alaska Native interventions were identified (28 peer-reviewed and 36 in the grey literature).

Summary of evidence

Most interventions were conducted in southwest US in reservation communities with participants 18 years and younger; 41% of the 27 evaluated interventions reported significant changes in health, behaviour or knowledge. Effective American Indian/Alaska Native interventions demonstrated impact on individual health and community resources. Program sustainability was linked to locally trained personnel, local leadership and stable funding.

Recommendations or implications arising from the evidence

Culturally acceptable and scientifically sound evaluation methods are needed to assess the long-term effectiveness of American Indian/Alaska Native interventions. Service programs would benefit from a regular evaluation process that program staff can maintain.

- II. Coble JD, Rhodes RE. *Physical activity and Native Americans: A review. American Journal of Preventive Medicine, 2006; 31(1): p. 36-46.*

Study methods

Physical activity behaviours (measured leisure-time physical activity, occupational activities, household activities, exercise, and sport) and interventions in Native Americans (aged 18 years and older). USA and Canada, English-language; 1990 to November 2005.

Study findings

Results indicate that age, gender, and social support are important factors associated with physical activity. The remaining correlates show inconsistent or indeterminate results due in part to the paucity of research. Intervention details were not described.

Level of evidence - Level 5

Quality of evidence

Systematic review, of any experimental or observational evaluation studies, cross-sectional designs, controlled or uncontrolled prospective/retrospective design studies, intervention studies, and phenomenologic and interpretive studies. Studies that employed historic designs and intervention designs where physical activity was not the dependent variable were excluded. Reviewed articles include 28 quantitative, 4 qualitative, and 3 intervention studies. Due to wide variation in results and few studies measuring a given correlate, a meta-analysis was not conducted.

Summary of evidence

Studies were reviewed according to ecologic models of health behaviour, which take into account several correlates to explain human behaviour, including demographic, personal health, environmental, and psychosocial. Correlates were included if they appeared at least three times in the literature. The number of studies that identify an association between a correlate and physical activity was divided by the total number of potential associations for that relationship. If an association occurred 0% to 33% of the time, no overall association was evident. If an association occurred 34% to 59% of the time, the overall association was inconsistent. Finally, if an association was evident 60% to 100% of the time, the overall association would be considered consistently positive or negative. Results indicate that age, gender, and social support are important factors associated with physical activity. The remaining correlates show inconsistent or indeterminate results due, partly due to the limited available research. As Native Americans age, physical activity levels tend to decrease, and overall physical activity levels of Native Americans tend to be lower than in non-minorities. Native American men are more active than Native American women. Social environment appeared to be an integral part of the physical activity behaviour of Native Americans, from several small to moderate effect sizes. Education, employment, income, health, body weight, and the physical environment were not consistently associated with physical activity in Native Americans.

Only three intervention studies met the inclusion criteria, a non-controlled community-based exercise program to increase physical activity in a group (n=20) of Native American elders over a 6-week period; an RCT of a culturally sensitive intervention designed specifically for Alaska Native American women (n=76); and a randomised pilot of adherence to various lifestyle interventions in a randomised pilot study among Pima Indians from Arizona (n=95). Although in total, all interventions appeared to show an increase in physical activity levels, the very small sample sizes limit any conclusions that can be made regarding the true efficacy of these interventions. Intervention details were not described, and given the poor methodology and unknown relevance to Australian Aboriginal populations, these were not sourced.

Recommendations or implications arising from the evidence

The most important finding of this review was that very little is known about the physical activity behaviours of Native Americans. Age, gender, and social support were the most consistent correlates of physical activity identified. Although many of the associations were not unique to Native Americans, they should be considered indeterminate until more research, especially those using longitudinal designs, has been completed.

People at higher risk of vitamin D deficiency due to ethnicity or culture

Primary prevention of OA/OP

1. Mahomed K, Gulmezoglu AM. Vitamin D supplementation in pregnancy. *Cochrane Database of Systematic Reviews*, 2000; (2): CD000228. DOI: 10.1002/14651858.CD000228.

Study methods

Effects of vitamin D supplementation for pregnant women considered to be at-risk of vitamin D deficiency (vegetarians, those who remain indoors or whose clothing leaves little exposed skin and living in sunless climates) pregnancy outcome, from trials with clinical endpoints. No country or language exclusions, Cochrane Pregnancy and Childbirth Group trials register (October 2001) and the CENTRAL (Issue 3, 2001).

Study findings

There is not enough evidence to evaluate the effects of vitamin D supplementation during pregnancy. From two available trials, in one, supplemented mothers had higher mean daily weight gain and a lower number of low birth weight infants while in the other, the supplemented group had lower birth weights.

Level of evidence - Level 4

Quality of evidence

Systematic review of acceptably controlled trials. Two trials (232 women) were included.

Summary of evidence

In one trial conducted in London, mothers had higher mean daily weight gain and a lower number of low birth weight infants. In a French trial, however, the supplemented group

had lower birth weights. Neonatal hypocalcaemia was less common (0/107 vs. 6/96) in the supplemented groups and craniotabes (softening of skull) was diagnosed in 6 control babies, compared to 2 in the supplemented group in the London trial.

Recommendations or implications arising from the evidence

Symptomatic neonatal hypocalcaemia showed a consistent pattern in the only two trials that report this outcome. The conflicting data on birth weights could be due to chance given the small numbers of women studied. Although vitamin D supplementation seems to have been well tolerated there is inadequate information about its safety in the trials published to date. Vitamin D supplementation in the later part of pregnancy should be considered in vulnerable groups, such as Asian women living in Northern Europe, and possibly others in climates with long winters.

Children (and healthy bones)

Primary prevention of OA/OP

- I. Huncharek M, Muscat J, Kupelnick B. *Impact of dairy products and dietary calcium on bone-mineral content in children: Results of a meta-analysis.* *Bone*, 2008; 43(2): 312-21. DOI: 10.1016/j.bone.2008.02.022.

Study methods

Impact of dietary calcium/dairy supplementation on summary mean difference BMC in children (18 years and less), for studies with a sample size of at least 50 participants. English language, MEDLINE, Current Contents (up to March 2003), Cochrane Database; 1966 to 2006.

Study findings

Increased dietary calcium/dairy product intake, with and without vitamin D, significantly increases total body and lumbar spine BMC in children with low base-line intakes.

Level of evidence - Level 1

Quality of evidence

Meta-analysis, RCT intervention trials and observational studies. 21 RCTs (3,821 participants) were included.

Summary of evidence

An initial meta-analysis of 21 RCTs using total body BMC as the outcome, yielded a non-statistically significant increase in total body BMC of 2 g (supplemented vs. controls). A sensitivity analysis revealed substantial statistical heterogeneity, due to the impact of baseline calcium intake, whereby studies which included those with adequate intake at baseline were less likely to show an effect. Pooling the three reports utilising low calcium intake subjects yielded a statistically significant summary mean BMC of 49 g (24.0-76.6). Pooling two RCTs using calcium/dairy supplement plus vitamin D was also associated with an increase in lumbar spine BMC of, on average, 35 g (-6.8-41.8). The lack of data using BMC measurements at other anatomic sites as well as sparse data from non-randomised studies, precluded further statistical pooling.

Recommendations or implications arising from the evidence

Increased intake of dietary calcium/dairy products, with and without vitamin D, significantly increases total body and lumbar spine BMC in children with low base-line intakes. The authors suggest that further work is needed in order to resolve whether calcium/dairy intake translates into decreased fracture risk as well as osteoporosis in later life.

- II. Lerch C, Meissner T. Interventions for the prevention of nutritional rickets in term born children. *Cochrane Database of Systematic Reviews*, 2007; (4): CD006164. DOI: 10.1002/14651858.CD006164.pub2.

Study methods

Effects of intervention (any intervention compared with placebo or no intervention), with minimum duration of the intervention three months for children under 12 months or six months for children over 12 months, on the prevention of nutritional rickets in term born children. No language exclusion, The Cochrane Library, MEDLINE, EMBASE, LILACS, reference lists, author contacts; 1957 to 2007.

Study findings

There were few published studies of interventions for the prevention of nutritional rickets in term born children. Vitamin D prevented rickets in children up to three years of age in Turkey. In China, a combined intervention of vitamin D, calcium and nutritional counselling led to a decreased risk of rickets in children up to three years of age, although there was conspicuous treatment noncompliance. In a study conducted in pre-pubertal girls in China rickets did not occur in control or intervention groups who received calcium or calcium plus vitamin D. In France, rickets were not observed in children of about twelve years of age who received vitamin D or placebo.

Level of evidence - Level 3

Quality of evidence

Systematic review, RCTs, controlled clinical trials or prospective cohort studies. Four studies (approximately 1700 participants) included. Three studies were RCTs, two of which were cluster randomised; one trial was a controlled trial with researcher controlled group assignment. There was marked clinical heterogeneity of studies.

Summary of evidence

Study participants were aged from one month to 15 years, and trials lasted between nine months to two years. In children up to three years of age in Turkey, vitamin D compared to no intervention showed a RR of 0.04 (95% CI 0 to 0.71). Despite conspicuous non-compliance, a Chinese trial in children up to three years of age comparing a combined intervention of supplementation of vitamin D, calcium and nutritional counselling showed a RR of 0.76 (95% CI 0.61 to 0.95) compared to no intervention. In two studies conducted in older children in China and in France no rickets occurred in both the intervention and control groups. Because of the clinical heterogeneity in nutritional rickets itself as well as between the included studies neither a quantitative nor a qualitative data synthesis is reasonable. Adverse effects were only addressed in one study, in which no hypercalcaemia was observed after administration of vitamin D. No study investigated health-related quality of life or economic costs of the interventions.

Recommendations or implications arising from the evidence

There are only few studies on the prevention of nutritional rickets in term born children. Given pathophysiological aspects, the high frequency of nutritional rickets and the favourable risk-benefit ratio it is reasonable to offer preventive measures (vitamin D or calcium) to all children up to two years of age. Further groups of high risk are children living in Africa, Asia or the Middle East and migrants from these regions into areas where rickets is not frequent.

Primary prevention of OA/OP risk factors, including intervention impact measures

Nutrition

1. Thomas J, Sutcliffe K, Harden A, Oakley A, Oliver S, Rees R, Brunton G, Kavanagh J. *Children and healthy eating: A systematic review of barriers and facilitators*. 2003, EPPI-Centre, Social Science Research Unit, Institute of Education, University of London: London.

Study methods

Barriers to and facilitators of healthy eating amongst children aged four to 10 years old. Intervention studies from any country, UK only non-intervention research, English language, MEDLINE, EMBASE, CINAHL, ERIC, Social Science Citation Index, PsycInfo, BiblioMap (EPPI-Centre register of health promotion research), PrevRev (an internal EPPI-Centre database containing references from previous reviews), DARE, HealthPromis (Health Development Agency register), CENTRAL, Cochrane Database of Systematic Reviews, Cochrane Heart Group internal trials register, up to 2001.

Study findings

There is a relatively solid evidence-base for informing policy and practice for the promotion of fruit and vegetables to children aged four to 10. Findings from good quality trials indicated that interventions can have a small, but significant positive effect, increasing children's fruit intake by one-fifth of a portion per day and their vegetable intake by nearly one-fifth of a portion per day. Targeted interventions for parents with risk factors for cardiovascular disease and interventions which focussed on one message (e.g., increasing fruit and vegetables) demonstrated larger intervention effects.

Level of evidence - Level 2

Quality of evidence

Meta-analysis, 19 intervention studies included. Also included a synthesis of children's views about barriers and facilitators to eating fruit and vegetables, and a cross-study synthesis to triangulate the meta-analysis and the synthesis.

Summary of evidence

The 19 interventions included in the meta-analysis were largely school-based, often combining education on health benefits of fruit and vegetables with experiential components such as food preparation and taste-testing. The majority targeted and/or involved parents. Some included structural change such as modification of school provided food. Some interventions targeted more than one outcome (e.g., fruit and vegetable consumption, fat intake, knowledge, self-efficacy, BMI, and physical activity).

The 19 studies varied in terms of whether they measured fruit consumption (10 studies); vegetable consumption (12 studies); or fruit and vegetable consumption combined (13 studies). Some studies also measured knowledge about fruit and vegetables (n=7); preferences for fruit and vegetables (n=3) or self-efficacy regarding preparing or cooking fruit and vegetables (n=6).

Pooling the effect sizes from the 10 studies on fruit consumption revealed that overall, the evaluated interventions had a small but statistically significant positive effect on increasing fruit consumption (pooled effect size [SMD] of 0.13), equivalent to an increase of one-fifth of a portion of fruit per day. Pooling the effect sizes from the 12 available studies revealed that overall, the evaluated interventions had a small but statistically significant positive effect for increasing vegetable consumption (pooled effect size of 0.23), equivalent to an increase of a little less than one-fifth of a portion of vegetables per day. Pooling the effect sizes from 13 studies examining this outcome revealed that overall, the evaluated interventions had a small but statistically significant positive effect on fruit and vegetable consumption combined (pooled effect size of 0.25), equivalent to an increase of nearly half of one-portion of fruit and vegetables per day. Pooling the effect sizes from six studies which assessed the impact of their interventions on knowledge revealed that, overall, children's knowledge increased significantly (effect size 0.70).

The largest effect size was for a study aiming to increase fruit and vegetable consumption, by Epstein, et al. [119], which achieved an increase of two portions per day. There were several distinctive features of this intervention: it was community-based; it targeted parents as much as children; and it featured a six month intensive intervention, starting with eight weekly meetings, followed by four biweekly and then two monthly meetings. The parental intervention included education, bio-feedback, 30 minute therapist meetings, and 30 minute group meetings. Workbooks and other program materials were taken home each week for the children.

The results of the meta-analysis suggest that implementation of these interventions will, on average, increase children's fruit intake by one-fifth of a portion per day and their vegetable intake by a little less than one-fifth of a portion per day, a small but significant positive effect. Bigger effects are associated with targeted interventions for parents with risk factors for cardiovascular disease (increasing fruit and vegetable intake by almost two portions) and with those interventions which do not 'dilute' their focus on fruit and vegetables by trying to promote physical activity or other forms of healthy eating (for example, reduced intake of sodium and fat) in the same intervention (effects sizes were three times higher in these studies). Single component interventions, such as classroom lessons alone or providing fruit only tuck shops, were not effective. The meta-analysis revealed it is easier to increase children's consumption of fruit than vegetables.

The findings of eight studies which examined the views of children in the UK concerning healthy eating in general or eating fruits and vegetables in particular were also synthesised (involving 1091 children aged five to 11, and 92 mothers). Children from both lower and higher SES families were represented. Nine implications for appropriate interventions for promoting fruit and vegetables to children were noted, ranging from simple strategies such as 'branding fruit and vegetables as tasty rather healthy' or 'do not promote fruit and vegetables in the same way' to more challenging strategies such as

'make health messages relevant and credible to children' and 'create situations for children to have ownership over their food choices'.

From the cross-study synthesis, the components of effective interventions included:

- Encouraging children to accept or like the taste of fruit or vegetables, rather than highlighting the health benefits;
- Minimal emphasis on the benefits for future health; and
- Treating fruit and vegetables differently.

Recommendations or implications arising from the evidence

Interventions involving parents and which were focussed on one outcome, such as increasing fruit and vegetable consumption, were more effective. A cross study synthesis suggested that interventions which brand fruit and vegetables as being tasty rather than healthy, which create opportunities for children to influence the social context in which they eat, which involves health messages which are relevant and credible for children would be worth evaluating.

Obesity

1. Kamath CC, Vickers KS, Ehrlich A, McGovern L, Johnson J, Singhal V, Paulo R, Hettinger A, Erwin PJ, Montori VM. *Clinical review: Behavioral interventions to prevent childhood obesity: A systematic review and metaanalyses of randomized trials. Journal of Clinical Endocrinology and Metabolism, 2008; 93(12): 4606-15. DOI: 10.1210/jc.2006-2411.*

Study methods

Efficacy of interventions delivered in the home, school, clinic, or community setting by healthcare professionals, community members, or health authorities, aimed at changing lifestyle behaviours (i.e., increased physical activity, decreased sedentary activity, increased healthy dietary habits, decreased unhealthy dietary habits) to prevent obesity in children and adolescents (aged 2-18 years), as measured by lifestyle behaviours and BMI. MEDLINE, ERIC, EMBASE, CINHAL, PsycInfo, DISSERTATION abstracts, Science Citation Index, Social Science Citation Index, and CENTRAL, reference lists, review articles, expert suggestion; from database inception to February 2006.

Study findings

Paediatric obesity prevention programs caused small changes in target behaviours and no significant effect on BMI compared with control. Strategies attempting to reduce unhealthy behaviours (i.e., decreasing sedentary behaviours and dietary fat) seem to be more effective than those promoting positive behaviours (i.e., increasing physical activity and consumption of fruits and vegetables).

Level of evidence - Level 3

Quality of evidence

Meta-analysis of RCTs, using Cochrane Collaboration methods. 34 RCTs with measures for BMI, of which 29 RCTs had complete data for at least one behavioural end-point were included. Most reports were missing data on the proposed quality dimensions, and none satisfied all quality criteria. Of the 34 included, only four (12%) studies had allocation concealment, one (3%) had participant or provider blinding, five (14%) had blinding of

data collectors, and 11 (32%) had loss to follow-up over 20%, representing poor quality methods. Studies focusing on physical activity interventions alone were methodologically weaker.

Summary of evidence

Informational components (passive information and/or education) were part of every intervention. Interventions included behavioural components more often than cognitive components and social support. Only half of the RCTs used environmental strategies. Most RCTs targeted more than one behaviour; with dietary behaviour targeted slightly more often than physical activity. Six studies targeted all four lifestyle behaviours. Physical activity was typically targeted along with healthy diet and unhealthy diet; decreased sedentary activity was the least targeted behaviour. The pooled effect size for physical activity (22 comparisons; 9891 participants) was 0.12 [95% CI=0.04-0.20; I²=63%], for sedentary activity (14 comparisons; n=3003) was -0.29, (CI=-0.35 to -0.22; I²=0%), for healthy dietary habits (14 comparisons, n= 5468) was 0.00 (CI=-0.20; 0.20; I²=83%), and for unhealthy dietary habits (23 comparisons, n=9578) was -0.20 (CI=-0.31 to -0.09; I²=34%). The effect of these interventions on BMI (43 comparisons, n=32,003) was trivial (-0.02; CI=-0.06–0.02; I² =17%) compared with control. Trials with interventions lasting more than six months (vs. shorter trials) and trials with post-intervention outcomes (vs. in-treatment outcomes) yielded marginally larger effects. There were no sex-treatment interactions, and trials in children found larger reductions in sedentary activity than trials in adolescents.

Recommendations or implications arising from the evidence

This meta-analysis was underpowered to detect interactions between the interventional components and the outcomes of interest. Some trends suggest greater effects on healthy behaviours (physical activity and healthy diet) associated with reinforcement and beneficial effects on physical activity and sedentary activity with multiple-component cognitive techniques, however, this is not certain. Trials evaluating promising interventions applied over a long period, using responsive outcomes, with longer measurement timeframes are urgently needed.

II. Poolaban A, Taylor L, Clar C, Helms P, Smith WCS. *Prevention of childhood obesity: A review of systematic reviews. 2008, Scottish Evidence Based Child Health Unit, University of Aberdeen: Aberdeen.*

Study methods

Prevention of childhood obesity targeting children (up to 18 years), teachers or parents, including any type of intervention, (i.e., physical activity, dietary, or behavioural change and a combination of approaches) undertaken in the school, community, family, primary care or a combination of these settings, delivered by teachers and other school staff, researchers, peers or a combination of these, for children with normal weight, aimed at preventing obesity, where weight changes were assessed using an anthropometric measure (e.g., BMI, body weight, percentage body fat). English language, MEDLINE, EMBASE, Cochrane Library, websites (such as NICE, the database of centre of reviews and dissemination, NHS Research and Development HTA website, Scottish Intercollegiate Guidelines Network (SIGN) website); 1992 to 2005.

Study findings

Overall, the interventions reviewed did not have an impact on the weight status of children.

Level of evidence - Level 2

Quality of evidence

Systematic review of systematic reviews. Five systematic reviews met the final inclusion criteria. Evidence was strong in three reviews and moderate in the other two.

Summary of evidence

Physical Activity: The three reviews of physical activity interventions all agreed that the primary studies were of poor quality due to use of short term interventions, limited follow up and small sample sizes. One review in 2001 found that there was good quality evidence that physical activity promotion in the school setting was not effective in changing BMI. A second review in 2002 concluded that there remained serious doubt about the long-term efficacy, clinical significance and generalisability of published physical activity interventions for children. The third review in 2005 concluded there was limited good quality data about obesity prevention in children and adolescents, but that there was evidence to suggest school-based interventions may be more promising than family-based trials.

Behavioural Change: There was only one moderate quality review, in 2000, of nine different behavioural interventions, which found that behavioural interventions were variable in nature and studies were generally of poor quality. While these studies did demonstrate improved self-reported eating and physical activity levels, the majority of studies found no positive impact on weight.

Combined Approaches: A Cochrane review in 2005 which considered combined approaches (physical activity and diet singly and in tandem) included 10 long-term studies (i.e., follow-up greater than 12 months), and 12 short-term trials (i.e., follow-up of three to 12 months). Two of the long-term studies focussed on physical activity, two focussed on diet and the other six a combination of physical and diet: there was no treatment effect that could be attributed to dietary interventions alone; one study found a significant effect of physical activity on BMI in girls, but one did not. Combined approaches of physical activity and diet were similarly disappointing: four studies showed no treatment effect, one study had a significant effect on skin fold thickness, but not BMI. There were no studies that compared dietary and physical activity interventions. None of the 12 short-term studies considered diet alone. Of four studies which intervened with physical activity, two showed significant effects on BMI, and one of these also found an effect on skin fold thickness. Eight short term studies considering diet and physical activity combined found no significant positive results.

Recommendations or implications arising from the evidence

Overall, the interventions to date have not had an impact on the weight status of children and further high quality research to examine these issues more fully are recommended. Available evidence suggests that obesity is a product of social, economic, lifestyle and cultural changes which require comprehensive, co-ordinated, multi-component

approaches to diet and physical activity over many years. High quality research is needed to identify the best intervention in this age group.

III. *Stice E, Shaw H, Marti CN. A meta-analytic review of obesity prevention programs for children and adolescents: The skinny on interventions that work. Psychological Bulletin, 2006; 132(5): 667-91. DOI: 10.1037/0033-2909.132.5.667.*

Study methods

Effect of obesity prevention programs (including any intervention expected to result in reduced weight gain or risk for obesity onset), for children and adolescents (up to 22 years old), which used a proxy measure of body fat as an outcome (e.g., BMI or skinfold thickness). The review focussed solely on weight gain prevention effects, as assessed by differential change in body fat measures, and exclusively on studies that tested whether change in outcomes over time was significantly greater in the intervention group vs. the control group. PsycInfo, MEDLINE, Dissertation Abstracts, and CINHALL, reference lists, journal contents, reviews, expert contact; 1980 to 2005.

Study findings

Of 64 obesity prevention programs identified, 21% produced significant prevention effects that were typically pre to post effects. Larger effects were found for programs targeting children and adolescents compared to preadolescents and females, programs that were relatively brief, programs solely targeting weight control vs. other health behaviours (e.g., smoking), programs evaluated in pilot trials, and programs where participants were self-selected into the intervention. Factors such as including mandated improvements in diet and exercise, sedentary behaviour reduction, delivery by trained interventionists, and parental involvement, were not associated with significantly larger effects.

Level of evidence - Level 3

Quality of evidence

Meta-analysis of controlled trials. 46 trials met the inclusion criteria, resulting in a total of 64 effect sizes for the review. A total of 51 of the 64 prevention programs used random assignment to condition, of which 13% were randomised at the participant level, 2% were randomised at the group level, and 85% were randomised at the school level.

Summary of evidence

The majority of studies focussed on both males and females, but 14 included only females and two only males. The majority of interventions were school-based programs (84%). The average effect size across all studies was very small ($r=0.04$), but was significantly larger than zero ($z=2.94$, $p<0.01$). Only 13 interventions (one of which was evaluated in two trials), or 21% of the programs evaluated, found significant positive intervention effects based on an alpha level of .05. There was significant heterogeneity in effect sizes ($Q=204.41$, $p<0.001$), indicating that there was statistically meaningful variability across the effect sizes produced by the interventions. The average effect size for these 13 interventions was $r=0.22$ ($p<0.001$), which corresponds to a medium effect size and is of clinical significance.

There are several issues to note in regard to the interventions that produced weight gain prevention effects. First, successful programs were relatively intensive: on average they involved 40 hours of intervention time (range 3-120 hours). Second, only 2 of the 13

successful programs were primarily conceptualised as obesity prevention programs, with most described as general health education interventions, cardiovascular disease prevention programs, physical activity interventions, and eating disorder prevention programs. Third, only 3 programs (5% of the total programs evaluated) produced weight gain prevention effects that persisted over a significant follow-up period, with the remainder only demonstrating change pre to post-test, and all weight loss effects fading by 3-year follow-up. Fourth, only one successful program has been replicated in multiple trials of this intervention.

The review also found that intervention effects were stronger for children and adolescents relative to preadolescents, with the strongest effects for adolescents. Interestingly, interventions with a relatively shorter duration (in weeks) produced significantly larger effect than those that were longer in duration, suggesting disengagement from longer programs. Similarly, interventions targeting multiple health behaviours, which are necessarily longer in duration, had smaller effect size than those solely focussed on obesity prevention. There was evidence that pilot trials tend to produce larger effects than large demonstration trials, most likely due to implementer enthusiasm. Interventions where participation was self-selected showed larger effect sizes, potentially due to the higher motivation of these participants.

Recommendations or implications arising from the evidence

Overall, this review found that most interventions do not produce weight gain prevention effects. For most successful programs, while change is clinically meaningful, effects are usually short term. Future trials should follow-up promising findings and address methodological limitations of past work (including a lack of long-term follow-up).