



Public Health
England

Main Report

Protecting and improving the nation's health

Changing risk behaviours and promoting cognitive health in older adults

An evidence-based resource for local authorities and commissioners

Prepared by the Cambridge Institute of Public Health, University of Cambridge



About Public Health England

Public Health England exists to protect and improve the nation's health and wellbeing, and reduce health inequalities. We do this through world-class science, knowledge and intelligence, advocacy, partnerships and the delivery of specialist public health services. We are an executive agency of the Department of Health, and are a distinct delivery organisation with operational autonomy to advise and support government, local authorities and the NHS in a professionally independent manner.

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Abbreviations

ADL	Activities of Daily Living
BME	Black, Minority and Ethnic
CBT	Cognitive Behavioural Therapy
CDC	The Centers for Disease Control and Prevention
CIPH	Cambridge Institute of Public Health
COPD	Chronic Obstructive Pulmonary Disease
CVD	Cardiovascular Disease
MCI	Mild Cognitive Impairment
MeSH	Medical Subject Headings
MMSE	Mini-Mental State Examination
NICE	National Institute for Health and Care Excellence
NRT	Nicotine Replacement Therapy
PA	Physical Activity
PHE	Public Health England
QALY	Quality Adjusted Life Year
RCT	Randomised Controlled Trial
SR	Systematic Review

What is the purpose of the resource?

This resource is intended for local authority commissioners and clinical commissioning groups to provide a steer as to what types of interventions they should focus on to help the uptake and maintenance of healthy behaviours and promote cognitive health among older adults living in the community.

It is also intended for providers of lifestyle behaviour change programmes to support the development of evidence-informed prevention packages for older adults.

It is produced in a way that makes it accessible to managers and practitioners with public health as part of their remit, working in the public, private and third sector.

What are the aims?

The aim of this resource is to ensure that everybody has the opportunity to live as well as possible as they age, including the opportunities to make informed choices about their lifestyle and wellbeing and to receive support from appropriately developed services.

To help commissioners and providers focus their resources and efforts to promote healthy behaviours and cognitive health in older age, the report presents tailored summaries of the scientific evidence for three complementary questions:

- what individual-level interventions targeting unhealthy behaviours in people in older age (55+ years) are effective for the primary prevention or delay of cognitive decline or dementia?
- what individual-level interventions in people in older age (55+ years) are effective for increasing the uptake and maintenance of healthy behaviours?
- what issues (barriers and facilitators) prevent or limit, or help and motivate the uptake and maintenance of healthy behaviours in people in older age (55+ years)?

Background

An alarming proportion of mid-life and older adults are physically inactive, smoke, misuse alcohol, have poor eating patterns and are socially isolated despite growing evidence these behaviours can damage their health. These modifiable lifestyle risk behaviours are the leading cause of major non-communicable diseases (such as cardiovascular disease, diabetes, cancer) and are associated with substantially increased mortality and ill health (WHO 2011; Lafortune 2016). This burden is expected to expand considerably with ageing populations.

Encouraging findings from European and UK-based cohort studies found links between successful ageing and a person never having smoked (or having quit), exercising regularly, eating fruit and vegetables daily and drinking only a moderate amount of alcohol. People who adopted all these behaviours lived on average 14 years longer than people who adopted none of them (Khaw 2008), had improved quality of life (Myint 2011) and were more likely to age successfully (Sabia 2012). Finding effective ways to change people's behaviours, however, is a challenging task without a good understanding as to why people engage in unhealthy behaviours or do not undertake healthy ones.

Importantly, there is a strong association between the co-occurrence of these behavioural risks and socio-economic status in the general adult population and older adults (Meader 2016). In the 2008 Health Survey of England, roughly 25% of the population reported having three or more risk factors (smoking, lack of physical activity, consuming alcohol and poor diet), compared with more than 33% in 2003. The prevalence was around 20% for both periods for the 65+ years age group. The survey also showed people from unskilled households are three times more likely to adopt unhealthy behaviours than people in professional groups. Yet the greatest reduction (from 2003 to 2008) in the number of adults in the general population displaying four behavioural risk factors was seen in higher socio-economic and more educated groups (Buck 2012).

Given our ageing population, it is increasingly important that older adults are supported to maintain and improve their physical, mental and social health and wellbeing. There is increasing appetite among commissioners and providers to develop cost-efficient services that are appropriate for our ageing demographic and meet the health and wellbeing needs of older adults. At present, however, most public health guidelines provide general and specific recommendations to promote healthy behaviours in children, the adult population and recently for people in midlife (NICE 2015a; PHE 2015). Few recommendations exist for older adults (NICE 2015b).

This segment of the population is highly heterogeneous and the individuals that make it up are likely to share some of the same issues and challenges when it comes to changing or maintaining

behaviours. To effectively 'reach' that population and have it engage in health promotion initiatives, interventions need to be tailored to – or at least consider – their specific needs and circumstances. This resource was developed to support local authorities and clinical commissioners in this endeavour.

Where does the evidence come from?

The Cambridge Institute of Public Health (CIPH) conducted three rapid evidence reviews to inform the development of the National Institute for Health and Care Excellence (NICE) guidelines on midlife approaches to prevent or delay onset of dementia, disability and frailty published on 20 October, 2015 (NICE 2015a; Lafortune 2016; Kelly 2016). One review looked at the association between risk behaviours in midlife and late life outcomes, one at the effectiveness of interventions to promote healthy behaviours in midlife, and the third looked at barriers and facilitators of behaviour change in midlife. Building on that work, three new systematic reviews of the scientific literature look at the effectiveness of interventions to promote healthy behaviours and cognitive health in *older adults* and the barriers and facilitators of behaviour change in this population. PHE asked the CIPH research team to develop an evidence-based resource for commissioners and local authorities based on the reviews' key findings.

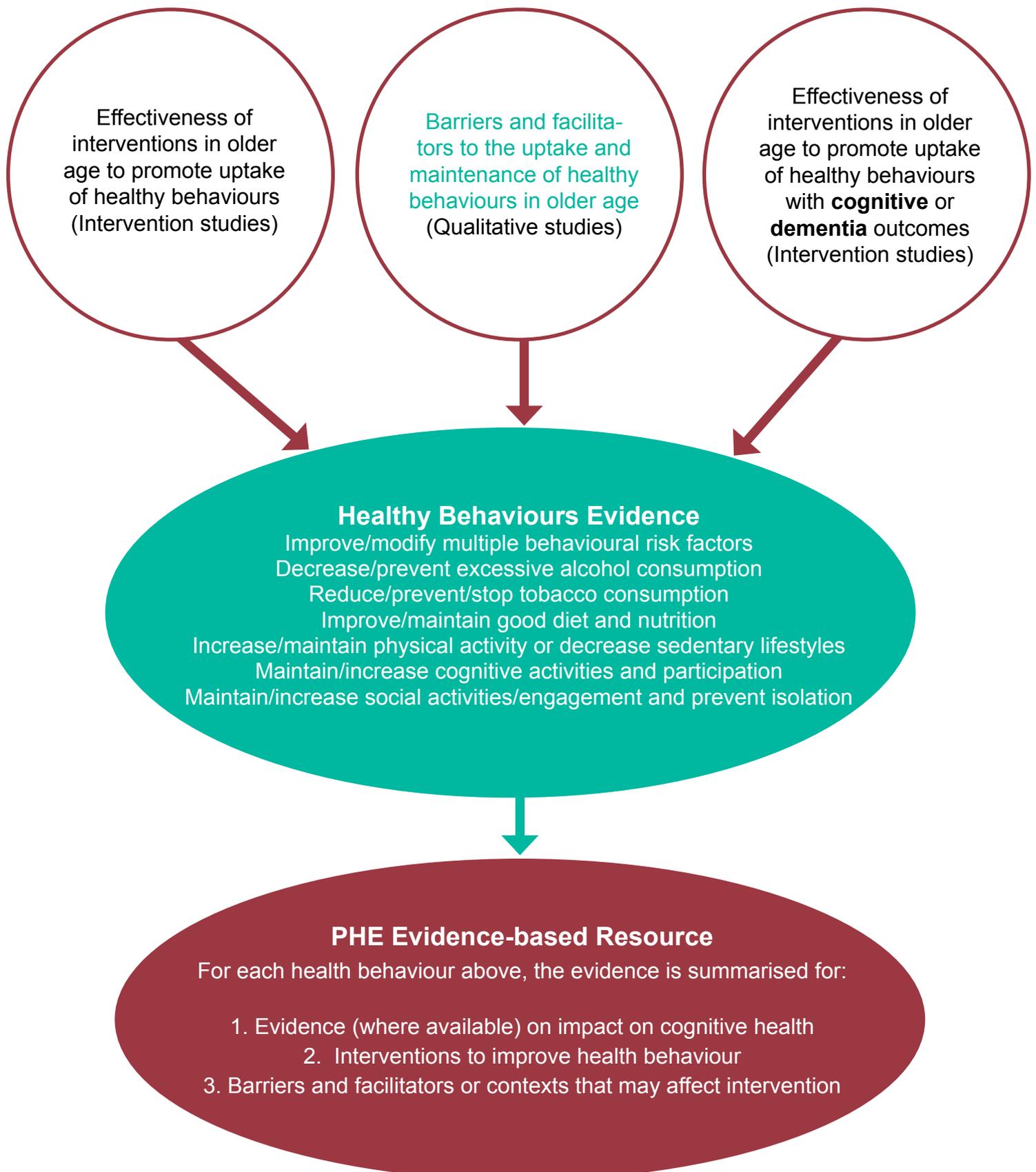
Aims of the reviews

The overarching aim of the systematic evidence reviews is to identify which interventions to promoting healthy behaviours and cognitive health in older adults are the most effective and cost-effective. The specific questions addressed in the reviews are:

- what individual-level interventions targeting unhealthy behaviours in people in older age (55+ years) are effective for the primary prevention or delay of cognitive decline or dementia?
- what individual-level interventions in people in older age (55+ years) are effective for increasing the uptake and maintenance of healthy behaviours?
- what issues (barriers and facilitators) prevent or limit, or help and motivate the uptake and maintenance of healthy behaviours in people in older age (55+ years)?

The protocols for these reviews have been published (Lafortune 2015a; Lafortune 2015b; Lafortune 2015c). The figure on page eight presents how findings from each review were integrated in this resource for each behavioural risk factor where evidence was found.

Evidence synthesis



Participants/population

Our reference population is people aged 55 and over, living in the community, and includes:

- healthy participants
- people with pre-conditions for later ill health such as high blood pressure, high cholesterol, impaired glucose tolerance, being overweight, obese, or cognitively impaired, having functional limitations (not limited to these conditions)
- people on medication as long as the medication did not limit their ability to fully take part in the intervention of interest or directly affect the outcomes, or measurement of the outcomes
- people from disadvantaged populations and minority groups relating to health inequalities and vulnerable communities

! Intervention studies focused on people with previous ill health eg stroke, coronary heart disease, asthma (not limited to these conditions) are excluded. Participants with previous health conditions however will have been included in some studies where there were no contra-indications.

Intervention

All types and designs of intervention studies were eligible for inclusion, including:

- primary intervention studies and systematic reviews (SR) reporting on the effectiveness of interventions targeting modifiable behaviours including diet, physical activity, inactivity, alcohol, smoking, cognitive activity, risk reduction relating to loneliness and isolation (i.e. leisure, social activities, participation), hearing and vision, and sun exposure
- qualitative studies or systematic reviews of issues for people in older age that prevent or limit or which help and motivate these behaviours (barriers and facilitators)

Studies relating to interventions in the following areas are excluded:

- use of prescription drugs/medication (except for medication available 'over the counter' such as nicotine patches or gum for smoking cessation)
- use of dietary supplements
- management of non-communicable chronic disease
- management of existing disability, dementia or frailty
- vaccination
- screening
- national policies, laws and taxation

Comparator

Studies were included whether they had a comparator or not.



A wide range of comparator groups were used. Interventions of the same type may have been compared with different comparator groups making it challenging to combine the findings or derive general conclusions about whether an intervention works or not.

Outcomes

Primary quantitative outcomes from intervention studies include measures of effectiveness in older age (55 years and over) relating to:

- uptake or maintenance or change in healthy behaviours, eg rates of smoking cessation; physical activity uptake, participation or amount; change in diet or components of diet, such as increase in fruit and vegetable intake
- prevalence, incidence or level of cognitive decline or dementia as measured by any appropriate measure including cognitive tests, scans and imaging, professional assessment
- any association reported between behaviour change, setting or delivery and cognitive decline or dementia outcomes
- adverse effects
- cost and cost-effectiveness.

Primary qualitative outcomes relating to issues for people in older age (55 years and over) that prevent or limit or which help and motivate them to take up and maintain modifiable healthy behaviours that may impact on healthy ageing. Examples of healthy behaviours have been listed above. Such issues may also include settings, mode of delivery and personal issues.

Searches

The scientific evidence was identified by searching a wide range of databases using a structured search strategy covering the following key concepts and domains: ageing and older adults; health behaviours and risk reduction relating to diet, physical activity, inactivity, alcohol, smoking, loneliness and isolation (ie leisure, social activities, participation), sun exposure, hearing and vision. The search strategies are easily accessible in the published PROSPERO protocols (Lafortune 2015a; Lafortune 2015b; Kelly 2015a)



Intervention studies that have recruited older adults as part of a “general adult population” without specifying this in the title or abstract were not identified by the searches. The implication is that some evidence relevant to older people may have been missed.

Due to the wide scope of the reviews, the search strategies focused on studies published in English between 2000 and December 2014 with ageing or older adults related terms in the title, abstract or related MeSH indexing to identify interventions studies specifically delivered in older age. The *Intervention Tables* document presents details of the method used to select, quality assess and synthesise the evidence across the three reviews. It also summarises the consultation process.

How the findings are presented

It is increasingly recognised that interventions which target more than one behavioural risk may be an effective and efficient way of improving people's lifestyle. To reflect the reality of developing and commissioning wellness and/or behaviour change programmes as much as possible, the evidence from interventions targeting multiple behavioral risks is presented first, followed by evidence from interventions targeting only one behaviour at a time.

For each behavioural risk, key messages are presented first, followed by a general description of included studies, evidence for the effect of interventions on cognitive/dementia outcomes and uptake and maintenance of behaviours, and finally findings pertaining to barriers and facilitators to behaviour change.

A summary table presents what works, what might work and what doesn't work based on individual studies. The evidence is considered uncertain and marked as "**might work**" where there is conflicting evidence and/or the quality of the evidence is uncertain (eg due to lack of details on how the study was conducted or how the intervention was delivered and to whom; or if there is a high risk of bias due to design or methodological issues). Details for all included studies are presented in summary tables in the *Intervention Tables* document together with the quality rating for each study.

The qualitative evidence pertaining to barriers and facilitators is summarised using simple figures in each section. Summary tables with details of what each statement means can be found in the *Intervention Tables* document together with the quality rating for each study.



No evidence was found for interventions aimed at changing sun exposure, hearing and vision risk behaviours in older adults.

Multi-component





Key findings

Promoting healthy lifestyles across the population and motivating people to take steps to improve their health through action on behavioural risk factors is a critical step towards reducing the risk of dementia.

For older adults:

1. Complex multi-component interventions or “healthy ageing programmes” (targeting three or more health behaviours) could be effective at maintaining or improving cognitive outcomes in older adults
2. Interventions combining cognitive and physical training or diet and physical training could be effective at maintaining or improving cognitive outcomes in older adults
3. The long-term effect of multi-component interventions on cognitive/dementia outcomes is unknown
4. There is insufficient evidence to conclude on the effect of interventions targeting other combinations of health behaviours
5. There is limited evidence for how multi-component interventions compare with interventions targeted at changing only one health behaviour
6. There is limited evidence for the cost-effectiveness of multi-component interventions
7. Implementation of multicomponent interventions should come with built-in evaluation to monitor outcomes and strengthen the evidence base
8. Disadvantaged and minority groups have been understudied. Little evidence is available to guide interventions in these subgroups of older adults
9. Interest in multi-domain/multi-component interventions has increased recently and several trials are ongoing or had not yet published findings when the searches for these reviews were conducted

! These findings must be interpreted with caution.

The risk of bias is unclear for most primary studies due to lack of detail reported in the papers. Most trials conducted to date are underpowered so they may not be sensitive to change, namely for cognitive/dementia outcomes.

Description of studies

The definition of 'multi-component' used in this resource is quite broad to accommodate the diverse and complex evidence base relevant to the development of prevention packages targeting multiple risk behaviours in older adults.

Interest in multi-domain/multi-component interventions has increased recently and several trials are ongoing or had not yet published findings when the searches for these reviews were conducted. The literature on multi-component interventions for this resource include (Tables 1-5):

- two non-systematic reviews (SR) and 38 primary interventions studies reporting on the effect of multicomponent interventions on cognitive outcomes; none reported on dementia outcomes
- one systematic review reporting on uptake and maintenance of multiple healthy behaviours
- two qualitative studies describing barriers and facilitators to multiple behaviour change
- cognitive outcomes in all studies were objectively measured. Health behaviours were self-reported
- most interventions were delivered in community settings except for two studies where the intervention was delivered in clinic or primary care settings (Diamond 2015; Ngandu 2015)
- the risk of bias is unclear for a large proportion of primary studies due to lack of reported detail on sample selection, data collection, the intervention, etc (see quality assessment tables 6-8).

Multi-component interventions with cognitive outcomes

One SR of combined cognitive and exercise interventions (**Law 2014**) found limited evidence of the benefits of these interventions on cognitive function from eight studies; two non-SRs of a range of multicomponent interventions also provided relevant information (**Bamidis 2014; Schneider 2013**). Overall, the evidence suggests that the combination of exercise and mental training, and the combination of diet and behavioural weight management may have a positive effect on brain health. These reviews also conclude there is some evidence suggesting that strategies that target more than one risk behaviour simultaneously may prove more effective than those focusing on a single risk behaviour for cognitive outcomes. Larger high quality RCTs are, however, needed to confirm the effectiveness of multi-component interventions and identify the active ingredients, and to test how they compare with single domain interventions.

Data from 38 primary studies of multi-component interventions reporting on cognitive outcomes are summarised here (see tables 1-4 for details). Studies have been divided into loose categories for ease of interpretation and to deal with the overlap in targeted behaviours:

- complex multicomponent interventions (three or more health behaviours or 'healthy ageing programmes') – table 1
- combined exercise and cognitive training interventions – table 2
- combined exercise and diet interventions – table 3
- combined cognitive and social interventions – table 4

Tickbox Summary

Complex multi-component interventions with cognitive outcomes

				
Intervention	What works	What might work	What doesn't work	Study
Web-based addressing Alzheimer's risk factors		?		Anstey 2015
Community-based volunteering in schools		?		Carlson 2008
Behaviour change with structured goal-setting		?		Clare 2015
Structured health promotion course		?		Cohen-Mansfield 2015
PA sessions and group/individual cognitive stimulation sessions		?		Dannhauser 2014
Group-based psychoeducation about cognitive strategies		?		Diamond 2015
Active ageing programme increased PA, healthy eating		?		Mendoza-Ruvalcaba 2015
Memory training, PA, stress reduction and diet		?		Miller 2012
Diet, exercise, cognitive training and vascular risk monitoring with feedback		?		Ngandu 2015
Group cognitive activity eg art, writing, exercise		?		Pitkala 2011
Group programme of cognitively leisure activities		?		Tesky 2011
Occupational therapy including group and individual sessions			X	Clark 2012
Education about memory change with practical training strategies			X	Wiegand 2013

! Some of these interventions have been included in the social and/or leisure categories as well as they incorporate those elements.

1. Complex multi-component interventions with cognitive outcomes

Thirteen studies tested complex multi-component interventions targeting three or more health behaviours or included healthy ageing programmes with assessment of cognitive outcomes. Of these, nine studies were in cognitively healthy populations and four were in people with mild cognitive impairment (MCI) or memory complaints. Ten studies were RCTs or pilot RCTs (to test study feasibility) and three studies were quasi-randomised or non-randomised controlled studies.

Eleven studies reported some improved cognitive outcomes compared to control groups for objective outcomes. A range of domains, delivery modes and cognitive outcomes were assessed and most these studies reported significant beneficial effects on at least one cognitive outcome. The available evidence is not sufficient to say whether one type of combined intervention is better than another.

A brief summary of these interventions is presented here – details can be found in table 1.

- **Anstey 2015** (RCT): tested a multi-domain web intervention addressing risk factors for Alzheimer's disease, including PA, diet, social and cognitive engagement and management of chronic conditions delivered as a web intervention or as the same web intervention with additional face-to-face small group sessions compared to a computer control that received only health-related web links, videos and information
- **Carlson 2008** (RCT): tested a community-based volunteering programme delivered in primary schools and designed to increase social, physical and cognitive activity. Schools were randomised; participants in some schools received training or in others they did not
- **Clare 2015** (RCT): tested a behaviour change intervention with structured goal-setting to identify up to five goals to work on in the coming year including physical activity, cognitive activity, physical health and diet and social engagement compared to an information control condition. Note: this intervention reported similar mean quality adjusted life years for goal-setting intervention 0.87 (SD 0.17) and control 0.85 (0.18)
- **Cohen-Mansfield 2015** (RCT): tested a structured health promotion course covering health behaviours, dementia, cognitive activity, relationships, depression, home and travel safety, recreation and leisure compared to a wait list control
- **Dannhauser 2014** (cross-over design; not randomised): tested an intervention which comprised physical activity sessions (mainly walking), group and individual cognitive stimulation sessions including adult education sessions in arts and crafts, and cognitive training using games and puzzles compared to a control condition involving the same participants prior

Tickbox Summary

Combined exercise and cognitive training interventions with cognitive outcomes

Intervention	 What works	 What might work	 What doesn't work	 Study
Exergaming with stationary cybercycle		?		Anderson-Hanley 2012
Supervised aerobic and cognitive training		?		Fabre 2002
Weekly physical & web-based cognitive training		?		Gonzalez-Palau 2014
Structured music-based multitask exercise classes		?		Hars 2013
Community leisure activity programme		?		Kamegaya 2013
Cognitive and physical training		?		Legault 2011
Endurance and moderate strength training		?		Linde 2014
Exergaming using Nintendo-Wii games		?		Maillot 2012
Cognitive and physical training in groups of 15-30		?		Oswald 2006
Physical exercise with music		?		Sato 2014
Home-based resistance and computer training		?		Shah 2014
4 months of aerobic and cognitive training		?		Shahil 2013
Cognitive and/or resistance training		?		Singh 2014
Exercise (resistance/aerobic), cognitive tasks		?		Yokoyama 2015
Homebased mental activity plus class-based PA			X	Barnes 2013
Group-based interactive video gaming			X	Hughes 2014
Combined exercise and cognitive intervention			X	McDaniel 2014

to participation in the intervention

- **Diamond 2015** (RCT): tested a group-based psychoeducation programme about cognitive strategies and modifiable lifestyle factors relating to healthy brain ageing, and computerised cognitive training compared to a wait list control group
- **Mendoza-Ruvalcaba 2015** (RCT): tested an intervention to promote active ageing through increased physical activity, healthy nutritional habits and cognitive functioning compared to a control that participated in weekly social activities
- **Miller 2012** (non-RCT): tested an intervention which comprised an educational programme on memory training, physical activity, stress reduction and a healthy diet compared to a control group that did not receive any intervention
- **Ngandu 2015** (RCT): tested an intervention that consisted of diet, exercise, cognitive training and vascular risk monitoring with advice and feedback compared to a control group that received general health advice (including advice on metabolic and vascular risk factors)
- **Pitkala 2011** (RCT): tested a socially stimulating intervention involving group activities consisting of cognitive exercise such as art or writing, or exercise compared to normal care
- **Tesky 2011** (RCT): tested a group programme of cognitively stimulating leisure activities with a booster session; and one comprising of cognitively stimulating leisure activities plus a diet and exercise component; both compared to no intervention.

Two studies did not report a significant effect on cognitive outcomes:

- **Clark 2012** (RCT): tested preventive-lifestyle-based occupational therapy interventions consisting of physical and mental health exercise compared to no treatment (just assessment). No significant difference was found on cognitive functioning. However, due mainly to a significant effect on other outcomes, the study reported a significantly greater increment in QALYs for intervention versus control and an incremental cost effectiveness ratio of £24,868 per QALY
- **Wiegand 2013** (RCT): tested an education intervention about memory and memory change, training in the use of practical memory strategies, and support for implementation of behaviour changes compared to waiting list. No significant difference was found on cognitive functioning



Most of the control conditions received minimal or no intervention so it is not clear from the available evidence how these complex multicomponent interventions compare to single behaviour interventions or interventions that target fewer health behaviours.

Tickbox Summary

Combined exercise and diet interventions with cognitive outcomes

Intervention	 What works	 What might work	 What doesn't work	 Study
Homebased PA and nutrition program		?		Burke 2013
Community centre healthy behaviour promotion		?		Kimura 2013
Dose responses to exercise training		?		Komulainen 2010
Web-based prevention of osteoporosis and falls		?		Nahm 2010
Dietary weight management with exercise		?		Napoli 2014
Individualised health monitoring; group ed/PA		?		Oh 2014
Homebased PA and nutrition program		?		Pasalich 2013
8-week theory-based motivational group		?		Silva-Smith 2013
Tailored PA and eating newsletters		?		Walker 2009 & 2010
Diabetes prevention with group/individual sessions			X	Jaacks 2014
Hypertension training with telephone goal setting			X	Hageman 2014
Mailed study with individualised feedback			X	Harari 2008
Healthy living booklet			X	Kelley 2004
8-week bone-health community program			X	Plawecki 2013
Motivational, educational, and exercise sessions			X	Resnick 2009
Resistance training and dietary education			X	Valente 2011
Tailored life plan for healthier behaviour			X	Vrdoljak 2014
Year-long multifaceted computer programme			X	Werkman 2010

2. Combined physical exercise and cognitive training interventions

Seventeen studies combined exercise and cognitive training or stimulation (table 2). Of these, most studies (n=10) were in cognitively healthy or at risk populations, four were in people with MCI or memory complaints, and two studies included both people with MCI and cognitively healthy participants. Most trials were underpowered and findings should be interpreted with caution.

Eleven studies reported some improved cognitive outcomes for combined interventions compared to control groups. A range of approaches were used and varied cognitive outcomes were reported but these studies reported significant beneficial effects on at least one cognitive outcome. A brief summary of these interventions is presented here – details can be found in table 2.

Of the 11 studies that reported improved cognitive outcomes, two studies were ‘exergaming’ interventions combining physical activity with cognitive stimulation using gaming:

- **Andersen-Hanley 2011** (n=12): tested the use of a stationary bike with virtual reality compared to stationary bike control
- **Maillot 2012** (n=32): tested the use of interactive Nintendo-Wii games compared to receiving no intervention.

Importantly, **Hughes 2014** (n=20) tested group-based interactive video gaming using Nintendo; and found no significant group difference. These trials are underpowered. There is thus insufficient evidence to conclude on the effectiveness of exergaming.

The other nine studies that reported improved cognitive outcomes include:

- **Fabre 2002** (n=32): compared combined aerobic and cognitive training with cognitive training alone, aerobic training alone or usual daily routine control that met as many times as the other groups for leisure activities such as painting or singing
- **Gonzalez-Palau 2014** (n=50): tested an integrated platform which combines cognitive exercises with physical activity within the context of advanced technologies
- **Kamegaya 2014** (n=52): compared a physical and leisure activity programme that included exercise including muscle strengthening to a control that received no intervention
- **Linde 2014** (n=70): compared exercise and cognitive training involving aerobic endurance training and moderate strength training and cognitive training exercises with the same exercise training or cognitive training alone
- **Oswald 2006** (n=375): compared cognitive and physical training with cognitive training alone, physical training alone and psychoeducational training to a control group that received no intervention
- **Sato 2014** (n=119): compared physical exercise with music compared to physical exercise alone. Significant effect was observed only on visuo-spatial test. Note that **Hars 2013** (n=134)

tested structured music-based multi-task exercise classes but found no significant changes in cognitive outcomes compared to control with a delayed intervention

- **Shah 2014** (n=222): compared home-based physical activity (walking and resistance training) and computerised cognitive training, to each component alone
- **Shatil 2013** (n=120): compared combined cognitive and mild aerobic training with cognitive training or mild aerobic training alone or a book reading control group. The aerobic training included aerobic, cardiovascular, strength and flexibility training
- **Yokoyama 2015** (n=27): looked at exercise (resistance and aerobic exercise) and cognitive tasks compared to only exercise (resistance and aerobic exercise) and to routine lifestyle activity control group.

In addition, several of these studies tested combined cognitive and physical activity interventions compared to single intervention (cognitive intervention alone or physical activity intervention alone). Studies that showed beneficial effects of combined cognitive and physical activity intervention compared to single intervention for at least one cognitive outcome include:

- **Andersen-Hanley 2011** (n=12): cybercycle involving virtual reality training better than stationary bike alone
- **Fabre 2002** (n=32): combined aerobic and cognitive training showed better results than aerobic training alone or cognitive training alone
- **Oswald 2006** (n=375; over five years): Significantly improved cognitive outcomes for combined cognitive and physical training compared to physical training alone
- **Satoh 2014** (n=119): exercise and music significantly better than exercise alone.

The other six studies used a range of approaches, mostly in groups, but did not show a significant group difference in cognitive outcomes (**Barnes 2013**; **Legault 2011**; **McDaniel 2014**; **Hughes 2014**; **Hars 2013**; **Singh 2014**). Details can be found in Table 2. Several papers reported a high drop-out rate.

3. Combined exercise and diet intervention with cognitive outcomes

Two RCT studies reported exercise and diet interventions (table 3). One study aimed at weight loss in older adults showed significant improvements in cognitive outcomes in the group allocated to the combined dietary weight management and exercise programme compared to a control group receiving general information about a healthy diet (**Napoli 2014**). The other study conducted in a random sample of older people did not find significant between-group differences at two years follow-up (**Komulainen 2010**).



There is insufficient evidence for the effect of combined exercise and diet interventions on cognitive outcomes in the general older population.

4. Combined cognitive and social interventions with cognitive outcomes

One RCT and three quasi- or non-randomised studies reported variations of cognitive training/ stimulation and social activation programmes. Of these, one study included people with and without cognitive impairment (**Zacharelli 2013**) and the other three papers (evaluating the same programme) were in cognitively healthy participants (**Stine-Morrow 2007, 2008, 2014**). Three studies reported improved outcomes for combined cognitive training and social activation programmes for at least one cognitive outcome compared to control groups (**Zaccharelli 2013, Stine-Morrow 2007, 2008**).

Interventions to increase uptake/maintenance of more than one health behaviour (without cognitive outcomes)

One relevant systematic review compared single health behaviour change interventions versus multiple behaviour change interventions for older adults (**Nigg 2012**) but identified too few multiple health behaviour change interventions to make these comparisons. Nevertheless, 21 RCTs were included that evaluated the effect of health behaviour change interventions in older adults. The primary health behaviours included physical activity, nutrition, alcohol use, and tobacco use either individually or in some combination, including both adoption and cessation behaviours.

The review concluded that more multiple health behaviour change studies are needed in older adults to inform whether such approaches are effective, provide synergy and are cost effective; or if they provide too large a burden, are too confusing and ultimately whether multi-component approaches are a better investment compared with single-component approaches (**Nigg 2012**).

The majority of primary studies included in that review targeted diet and physical activity behaviours either on their own or as part of broader health programmes targeted at prevention of specific health conditions such as stroke, which also reported physical outcomes such as weight, blood pressure or lipids (Table 5). The evidence is quite mixed with some studies showing improvement in both diet and PA, some in one of these behaviours and some showed no change for either behaviour.

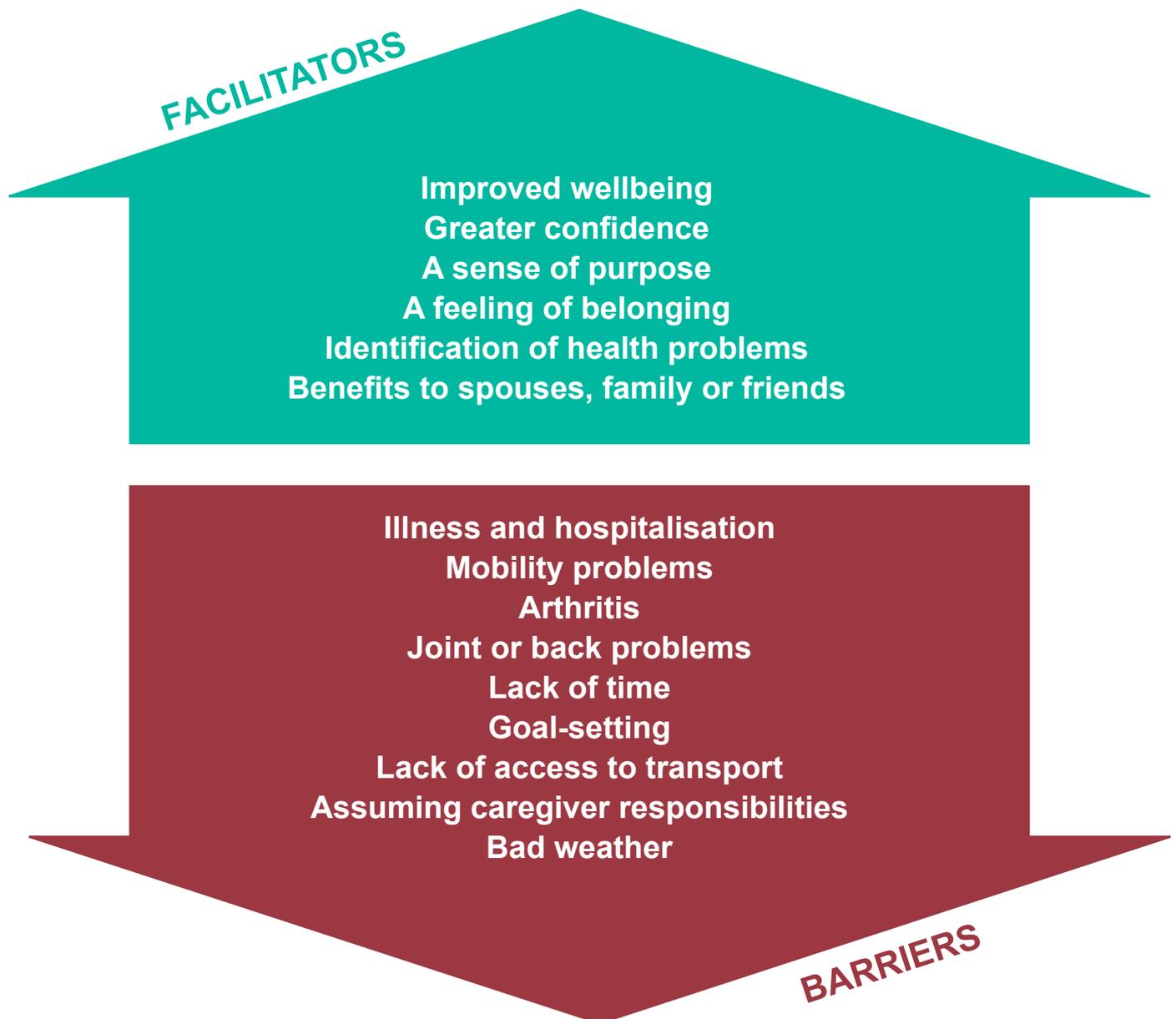
Finally, there is some evidence that interventions aimed at changing more than two behaviours such as diet, physical activity, alcohol consumption and smoking are not effective for changing a single behaviour (**Harari 2008, Vrdoljak 2014**).

Barriers and facilitators to multi-component interventions

Only two relevant qualitative studies reported barriers and facilitators to specific multicomponent interventions (**Clare 2015, Jackson 2009**). The Agewell Trial (**Clare 2015**) conducted qualitative evaluations of participants' experiences in the trial and reported the barriers and facilitators shown opposite:

Barriers and facilitators to lifestyle changes

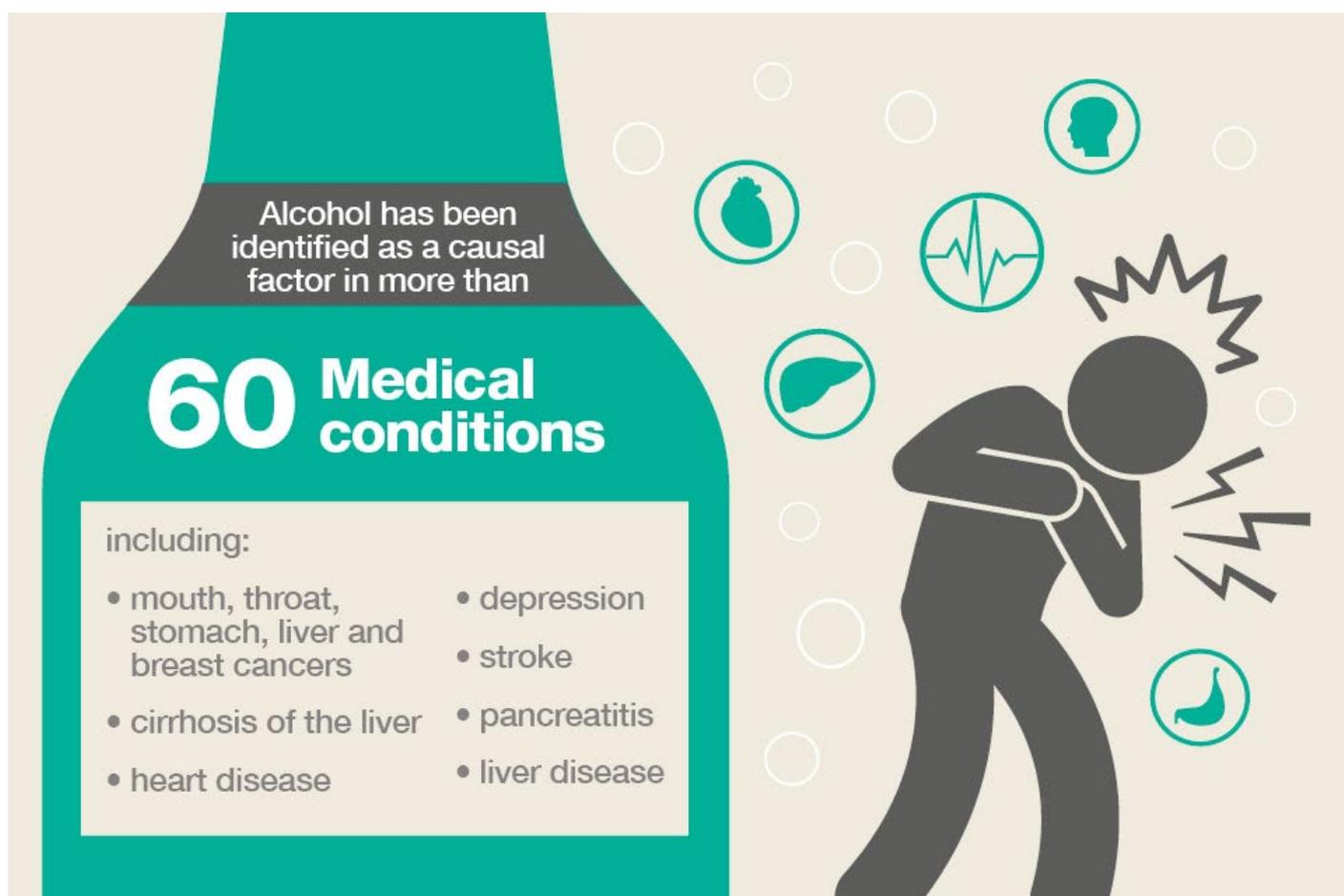
Clare 2015 (Agewell Trial)



Qualitative analyses during the development stage of the Well Elderly II Trial (**Jackson 2009**), which included an ethnically diverse population, identified important factors to enhance cultural sensitivity of the intervention. These include:

- greater stress on family values and consideration of values stemming from religious affiliation
- increased emphasis on pictures and demonstrations to accompany intervention-based reading materials
- modification of nutrition sessions to incorporate culturally specific food choices.

Alcohol





Key Findings

Drinking excessive amounts of alcohol is a risk factor for dementia. Efforts should focus on developing and implementing guidance, policies and interventions to reduce alcohol consumption across the population.

For older adults:

1. The effect of interventions to promote healthy drinking behaviour in older adults has been understudied. As such, little is known of the effect of these interventions on alcohol consumption and cognitive/dementia outcomes in the general older adult population
2. Interventions targeted at changing alcohol consumption in older adults at risk (ie for those who screened positive for at-risk, heavy or hazardous drinking) could lead to a reduction in drinking in follow-ups of up to one year. Evidence for the long-term effect of these interventions on alcohol consumption is not yet available
3. Simple interventions or the fact of performing an assessment may have a positive effect on alcohol behaviour in older adults at risk. However, more intensive interventions, including personalised feedback reports, would be more effective at changing alcohol behaviour in that population
4. Multi-component interventions targeting a range of health behaviours may not be effective in reducing alcohol consumption in older adults.
5. Disadvantaged and minority groups have been understudied. Little evidence is available to guide interventions in these subgroups of older adults
6. Studies are needed to assess the cost-effectiveness of these interventions in older adults

These findings must be interpreted with caution.



The risk of bias is unclear for most primary studies due in particular to self-reported alcohol data and greater attrition in the intervention group for reasons that were unclear.

Description of studies

Two systematic reviews not focused on interventions in older adults reported information of relevance to this review. In addition, this review uncovered 12 intervention studies to prevent and/or decrease excessive alcohol consumption in older adults recruited mainly in the community or during visits to primary care (tables 9 and 10):

- three RCTs included a broader population and relate to primary prevention. One focused on alcohol behaviour, the other two were multi-component interventions targeting a range of behaviours, including alcohol-related outcomes
- eight RCTs and one before-and-after study relate to secondary prevention as they only included participants who screened positive for at-risk, heavy or hazardous drinking
- studies tested a range of interventions types, including personalised and/or physician reports, educational materials, drinking diaries, physician advice, motivational advice or a combination thereof, compared to usual care or some form of low-intensity or brief intervention
- studies reported on both absolute measures of drinking and at-risk drinking
- no studies were found that reported cost or cost-effectiveness for primary or secondary prevention in older adults.

Interventions to promote healthy drinking behaviours' cognitive outcomes

No studies were found that reported the effect of interventions to promote healthy drinking behaviour in older adults on cognitive/dementia outcomes. No interventions reporting these outcomes were found either in a rapid systematic review of interventions targeting healthy behaviours in midlife (NICE 2015).

In light of the consistent evidence from a rapid evidence review (NICE 2015; Lafortune 2016) demonstrating an association between alcohol abstinence and/or heavy drinking and cognitive impairment, there is an urgent need to develop a robust evidence base to mitigate this risk.

Interventions to promote healthy drinking behaviours (without cognitive outcomes)

1. Primary prevention findings

For primary prevention, one RCT (**Fink 2005**) found a significant decrease in alcohol consumption in those assigned to a group where both the patient and physician received a report on the patient's risk classification (plus education) compared to the groups where only the patient received the report (plus education) or usual care (no report, no education).

Two other relevant studies targeted a range of health behaviours and found no benefit for alcohol outcomes specifically, suggesting that interventions targeting a range of health behaviours may not be effective in reducing alcohol consumption in older adults (**Vrdjolak 2014, Harari 2008**).

Tickbox Summary

Interventions to promote healthy drinking behaviours

Intervention	What works	What might work	What doesn't work	Study
Personalised reports, drinking diary, physician advice, phone counselling	✓			Ettner 2014
Combined report (with participant and physician)	✓			Fink 2005
Personalised report and drinking diary	✓			Moore 2011
Integrated care		?		Arean 2008
Speciality referral		?		Arean 2008
Web-delivered brief intervention		?		Cuccaire 2013
Motivational Enhancement and brief advice		?		Gordon 2003
BMI plus telephone booster		?		Hansen 2012
Personalised feedback report		?		Kuerbis 2015
Integrated care		?		Oslin 2006
Speciality referral		?		Oslin 2006
Motivational interviews		?		Schonfield 2010
Stepped-care intervention		?		Watson 2013
Multi-domain health promotion			X	Harari 2008
Tailored life plan for healthier behaviour			X	Vrdoljak 2014

Context for alcohol consumption

Alcohol use is strongly associated with social engagement, enjoyment and quality of life in older adults. Messages about alcohol use need to consider this, not just be simply framed in terms of 'safe units'.

There is a need to understand the context of drinking, the role it plays in older adults' lives and the consequences of stopping.

There may be benefits in emphasising older adults' life experience to use alcohol wisely.

Older adults can be sceptical about alcohol advice.

They can be similarly unclear about the lines between controlled heavy drinking and uncontrolled problem drinking.

Interventions targeted at older men need to be sensitive to concepts of masculinity.

Role of home or daycare services in harm reduction.

There is a lack of studies in disadvantaged and minority groups.

There is insufficient evidence that increased alcohol prices would reduce drinking in older adults.

Finally, a review of mostly observational studies reported no studies on educational or community preventive programmes in older adults; most work has been conducted with younger people (**Anderson 2012**).

2. Secondary prevention findings

Overall, the evidence indicates that interventions targeted specifically at alcohol behaviour in older adults at risk may lead to a reduction in drinking in follow-ups of up to one year. Most studies show a reduction in drinking from baseline to follow-up (in both groups), however only five studies show significant between-group differences (compared to control). This suggests that simple interventions or the fact of performing an assessment may have some benefits in the at-risk older population.

Importantly, there is also evidence that more intensive interventions including personalised feedback reports may be more effective in older adults at risk. The three studies that reported positive effects of interventions on both absolute and at-risk measures of drinking used this approach (**Ettner 2014**, **Moore 2011**, **Fink 2005**). One study (**Fink 2005**) reported an enhanced effect when both the participant and their physician received the feedback report.

Interestingly, a systematic review of 24 systematic reviews covering 56 RCTs has found that brief alcohol interventions were consistently effective for addressing hazardous and harmful drinking in primary healthcare, particularly in middle-aged, male drinkers (**O'Donnell 2014**). There is a gap in evidence in key groups, including women, older and younger drinkers, minority ethnic groups, dependent/co-morbid drinkers.

The optimum brief intervention length and frequency to maintain long-term effectiveness is also among the gaps.



In all studies, the control group also received regular assessments of alcohol use so just being involved in the assessments may have had an impact.

Older adults drinking habits in the context of ageing

	Aira 2008 -	Dare 2014 ++	Haa- rni 2010 -	Jo- han- nes- sen 2015 ++	Jo- seph 2012 +	Kim 2009 +	Tol- va- nen 2005 +	Ward 2011 +	Wil- son 2013 ++
Social/Relaxation									
Alcohol as a social lubricant		X	X		X	X	X		X
Drinking for relaxation		X	X			X			
As a treat/something special		X	X						
Fun and enjoyment			X			X	X		
Quality of life									X
Part of social environment		X						X	
Access issues									
Cost and availability								X	
Health-related aspects									
Drinking for medicinal purposes	X		X			X	X		X
Drinking for relaxation		X	X			X			
In the context of ageing			X	X					
Ill health/drinking behaviour								X	X
Health risks	X	X		X			X	X	X
Driving		X							
Other									
Drinking to deal with negative issues		X	X	X				X	X
Positive Vs negative alcohol identities			X			X	X	X	X
Self-regulating strategies	X	X	X						

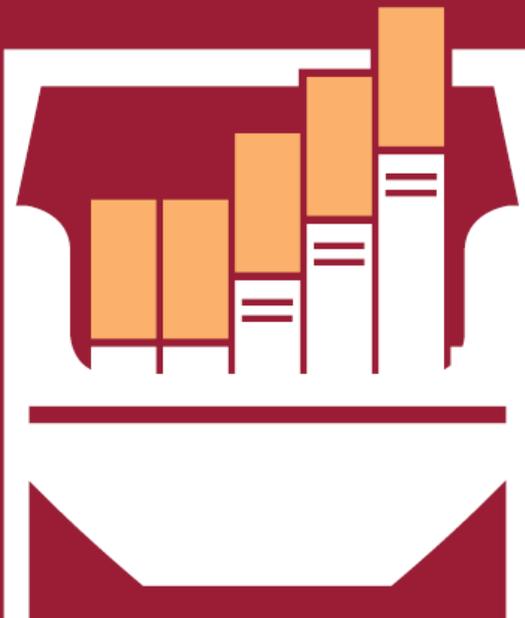
Barriers and facilitators to changing drinking behaviour

Ten primary qualitative studies were found in older adults, specifically with information relevant to barriers and facilitators in older age (see table 11). Nine studies reported data relating to the context in which older adults drink. This information is summarised by study and theme on page 30. One other study reported on the role of home or daycare services. The symbols ++, +, - refer to the quality of these studies (see table xx).

In addition, The VINTAGE report (**Anderson 2012**) reviewed much information relating to prevalence, consumption patterns and health impacts of alcohol use in older adults which, while outside the scope of this review, provides a comprehensive background. It reported that while many reviews examine the effect of alcohol policies in younger people, none were found specifically in older people. In reference to a recent World Health Organisation report on effective alcohol policies (not in older adults specifically), the authors suggested that the policy option that may have the most effective impact on older adults was price.

Smoking

Smoking is one of the biggest lifestyle risk factors for dementia



Smoking doubles the risk of dementia by:

increasing the risk of

cardiovascular disease



diabetes

stroke



narrowing the blood vessels in the heart and brain



causing oxidative stress which damages the brain





Key Findings

Smoking is one of the biggest behavioural risk factor for dementia. Efforts should focus on developing and implementing guidance, policies and interventions to reduce smoking across the population.

For older adults:

1. The effect of smoking cessation interventions on cognitive/dementia outcomes has been understudied
2. Interventions or components for which there is some evidence of effectiveness on smoking behaviour include telephone counselling quitlines, individual counselling, tailored self-help materials, with extended support such as counselling, telephone, computer mailed support – with or without nicotine replacement therapy (NRT)
3. All interventions examined, even minimal ones, showed some beneficial effects on smoking behaviour. However, longer, more intensive interventions with extended support and follow-up, and interventions delivered by physicians could more effective for older adults
4. Extended cognitive behavioural treatments (with or without NRT) can help maintain stable abstinence rates
5. Interventions specifically tailored for older adults had greater impact than non-tailored approaches
6. Multi-component interventions targeting a range of health behaviours may not be effective in reducing smoking in older adults
7. The majority of interventions were conducted in hospital outpatient settings but there is evidence that hospital-based smoking cessation interventions were not viewed favourably by older adults because of disease focus
8. Studies are needed to assess the cost-effectiveness of smoking cessation interventions for older adults
9. Disadvantaged and minority groups have been understudied. Little evidence is available to guide interventions in these subgroups of older adults
10. Older adults with a longstanding smoking history can be difficult to engage in attempts to quit. Providing a range of interventions that address barriers and facilitators may be more effective across the board

Description of studies

The reviews uncovered six relevant systematic reviews of smoking cessation interventions; nine additional intervention studies or analyses measuring smoking outcomes in older adults, seven RCTs and two non-RCTs; six qualitative studies discussing barriers and facilitators (see tables 15-18):

- studies recruited smokers who had largely expressed an intention to quit
- studies overall are fairly well mixed in terms of gender of participants
- settings and who provided the interventions was not clearly reported for most studies
- of the nine studies in older adults, smoking cessation was verified by biochemical methods in four studies and by self-report in the others
- drugs/medication are excluded except for medication available 'over the counter' such as nicotine patches or gum for smoking cessation.

Smoking cessation interventions with cognitive outcomes

No studies were found of the effect of smoking cessation interventions for older adults on cognitive or dementia outcomes. No interventions reporting these outcomes were found in a rapid systematic review of interventions targeting healthy behaviours (including smoking) in midlife (NICE 2015).

Smoking cessation interventions with cessation and reduction outcome

Findings from systematic reviews

Six SRs relevant to this resource were identified but none strictly met the inclusion criteria. Two SR focused on smoking cessation interventions, including pharmacological interventions, in adults aged 50 and older (**Zbikowski 2012**) and in wider populations (**Chen 2015**) – relevant findings are reported below. An earlier non-SR of studies published between 2000 and 2005 reported no studies in people aged 60 and over (**Doolan 2006**).

A further SR that examined population tobacco control interventions and their effects on social inequalities in smoking reported very little evidence in older adults specifically (**Fayter 2008**). Similarly another SR in adults that examined mass media and community interventions did not report conclusions for older adults (**Bala 2013, Secker-Walker 2002**).

The **Zbikowski 2012** review included 13 studies specifically conducted in people over 50 years of age, generally with existing chronic conditions and using pharmacological treatments, non-pharmacological treatments or a combination. Eight of the included studies provided smoking cessation medications (but not all are available over the counter):

- overall, the highest quit rates were achieved with longer, more intensive interventions and the use of combined approaches, including medications and follow-up counselling.

Tickbox Summary

Smoking cessation interventions with cessation and reduction outcomes

				
Intervention	What works	What might work	What doesn't work	Study
Bupropion treatment, CBT counselling, NRT	✓			Hall 2009
Physician counselling CBT alone	✓			Joyce 2008
Physician counselling with pharmacotherapy	✓			Joyce 2008
Telephone counselling quit-line with nicotine patch	✓			Joyce 2008
Telephone support, personal feedback, NRT	✓			Tait 2007
CBT counselling with extended follow-up, NRT	✓			Watson 2013
Set quit date and sign stop-smoking contract		?		Kim 2005
Self-help quitting guide and follow-up mailings		?		Orleans 2000
Educational programme plus behavioural therapy		?		Pothirat 2014
Multi-domain tailored life plan for healthier behaviours			X	Vrdoljak 2014
Multi-domain health promotion			X	Harari 2008

Four studies focused on behavioural counselling interventions (though in two pharmacotherapy was also available) with mixed results:

- one low-intensity helpline intervention with self-help materials found no significant treatment outcomes
- two trials of moderate intensity interventions – one in people hospitalised with cardiovascular disease (CVD) and one in people with post-traumatic stress disorder using medications found improved short-term outcomes. The later also showed longer-term beneficial effects
- two studies examined intensive counselling interventions. One study (**Hall 2009**; details below) found significantly better quit rates; the other (published in 1993) compared three different intensive interventions (counselling and phone; counselling and nicotine gum; counselling and exercise) to exercise only and found no difference in quit rates between groups.

This review also examined physician delivered non-pharmacological interventions in primary care (some of which also offered nicotine replacement). Overall:

- physician-delivered interventions were reported to be more effective than the control condition (with quit rates typically 12-16%)
- age-tailored self-help guides, particularly with additional phone calls or computer mailings, also showed some benefits over non-tailored materials.

The **Chen 2015** review and meta analysis included more studies (n=29), but did not restrict inclusion to only those age 50+ and included some studies in people with existing ill health conditions (e.g. CVD, COPD, mental health) and studies conducted pre-2000. Overall:

- non-pharmacological interventions (16 studies) were associated overall in meta-analysis with higher smoking cessation rates than control groups. However, heterogeneity was high (I² 92.6%). Quit rates were not as high as for pharmacological interventions but higher than for combined interventions compared to control groups
- little research exists in diverse population groups such as ethnic or other minority groups.

! The quality of evidence for non-pharmacological interventions was assessed as low with serious risks of bias and inconsistency.

Findings from primary studies

Most of the primary studies selected for this resource consist of interventions based around some kind of counselling with tailored or personalised information with or without access to nicotine replacement therapy (NRT) (see Table 19). Overall, more intensive interventions were generally more effective than minimal or no intervention in people who are motivated or have expressed an intention to quit:

- cognitive behavioural therapy (CBT) alone appears to be as effective as CBT plus NRT for maintenance of smoking quit rates. However, extended CBT with or without NRT appears to be

more effective than NRT or no further treatment alone for maintenance of smoking cessation after intervention (**Hall 2009**).

- in people motivated to quit, a more intensive behavioural therapy programme plus education about the consequences of smoking may be effective (**Pothirat 2014**)
- telephone counselling Quitline + nicotine patch gave the highest quit rates at both six and 12 month follow-up (**Joyce 2008**) compared to usual care (ie self-help educational materials alone). Also, both physician counselling alone or in conjunction with pharmacotherapy also gave statistically higher quit rates. From the perspective of the public payer, the additional cost per quitter (relative to usual care) ranged from several hundred dollars to \$6,450 – equivalent to £3,541 based on 2008 price exchange
- brief intervention with individual counselling, personalised feedback and NRT may also be effective for some older adults considering quitting smoking (**Tait 2007**).

Also, there is building evidence that programmes that provide extended follow-up may be more effective. For example, **Orleans 2000** provided follow-up computer generated mailings, **Joyce 2008** a telephone counselling quitline, **Tait 2007** follow-up telephone support, and **Hall 2009** extended support. The long-term effect is not known.

There is evidence that multi-domain interventions delivered in general practice and targeting a range of health behaviours may be ineffective in reducing smoking in older adults:

- in one study intervention participants were counselled and given a tailored life plan for adopting healthier behaviour. Each patient received educational leaflets for their detected CV risk factors and a specific appointment was given for the next follow-up visit (**Vrdoljak 2014**)
- in the other study, the intervention involved a mailed health behaviour survey followed up by computer generated personalised written feedback to participants and their GPs (**Harari 2008**).

Finally, brief training in smoking cessation services for healthcare professionals working with older adults improved knowledge and attitudes of the healthcare professionals (**Kerr 2011**; **Kerr 2007**). It is unclear how training of health professionals affects smoking outcomes in older adults in the longer term.

! Differences in the way studies have measured smoking cessation make comparing absolute quit values across studies problematic. Also, there is a risk of bias in many studies due to how the intervention and control groups were selected.

Barriers and facilitators

Six primary qualitative studies were found with specific information relevant to barriers and facilitators to smoking cessation in older age (Tables 20-21). Five studies included either current smokers or a mix of current and former smokers; one included UK primary care healthcare professionals to identify barriers to effective provision of smoking cessation services. All collected data through interviews.

There is a lack of evidence representing the views of older adults from disadvantaged and minority groups such as those of low socio-economic status, BME or other minority groups. One included study was conducted in older Greek-Australian smokers (**Mohammednezhad 2015 BMC Public Health & Int J Environ Res**), but no data from qualitative studies is available from other minority or disadvantaged groups.

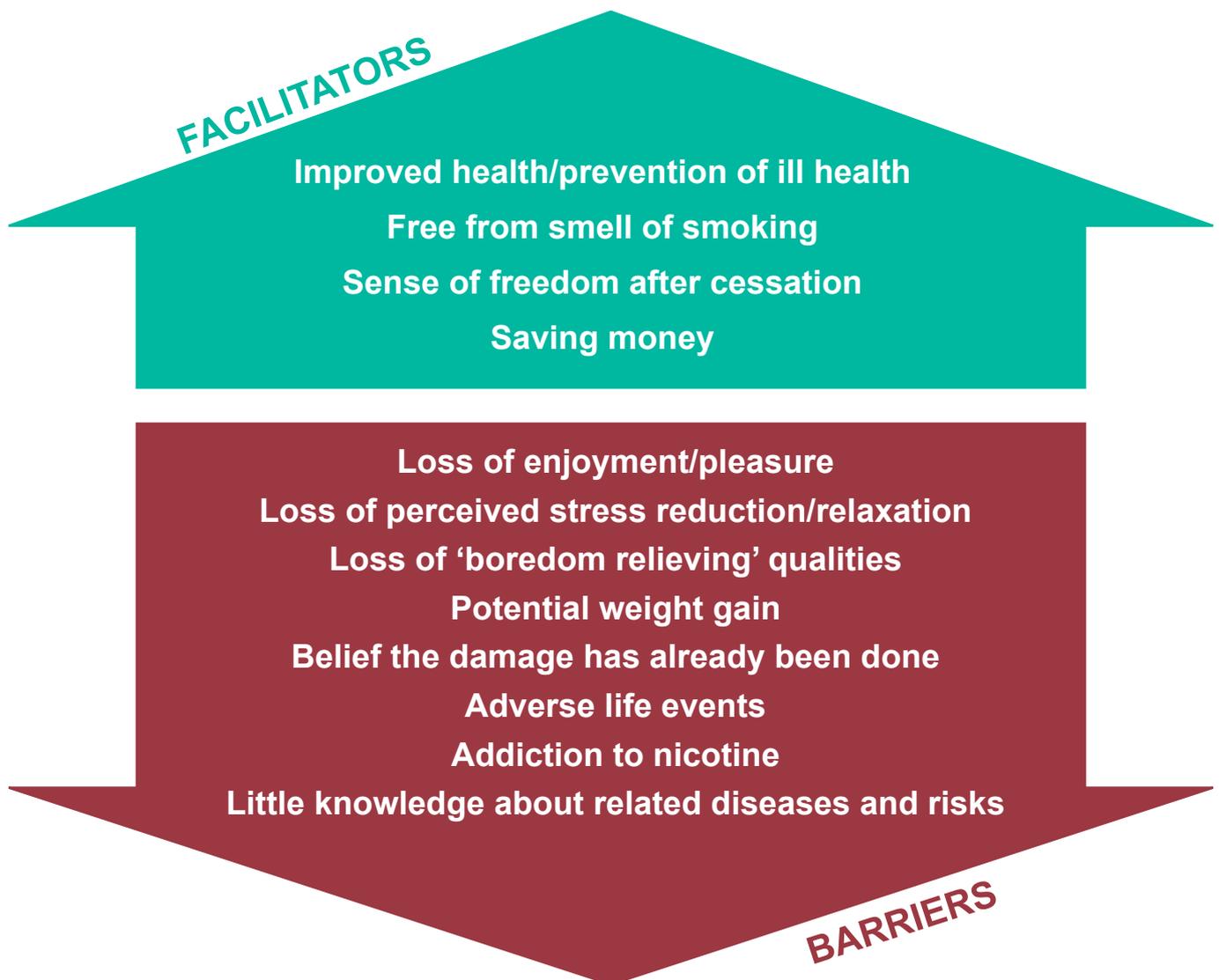
Interestingly, the majority of interventions described previously were conducted in hospital outpatient settings but there is evidence from qualitative studies that hospital-based smoking cessation interventions were not viewed favourably because of disease focus (**Lundqvist 2006**).

Findings from these have been grouped under four broader themes over the next three pages as they all relate to different yet important aspects in the design of interventions and prevention packages:

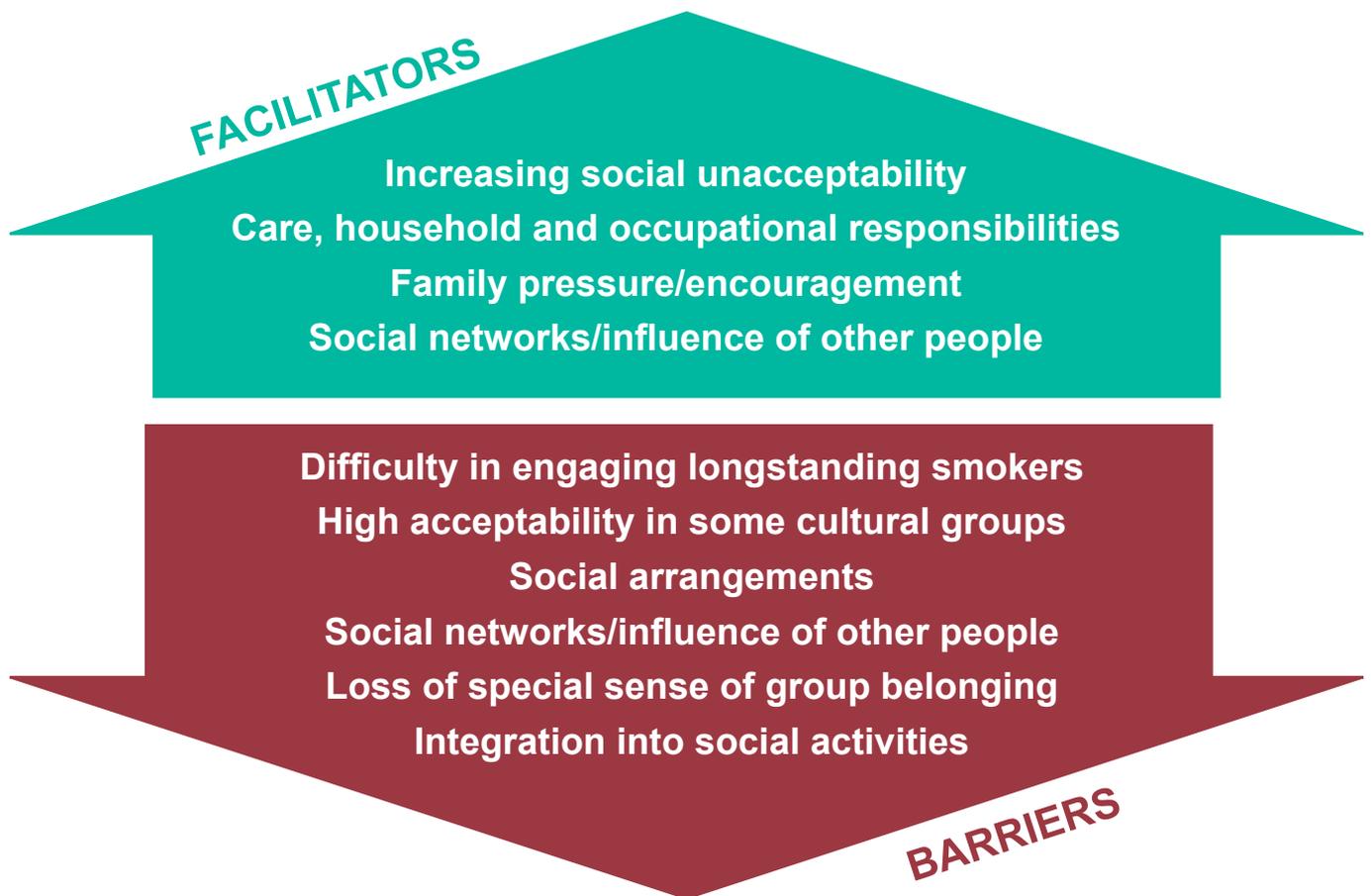
1. Health and quality of life
2. Sociocultural
3. Psychological
4. Smoking cessation routes and services

Tables 20-21 provide more information about the studies.

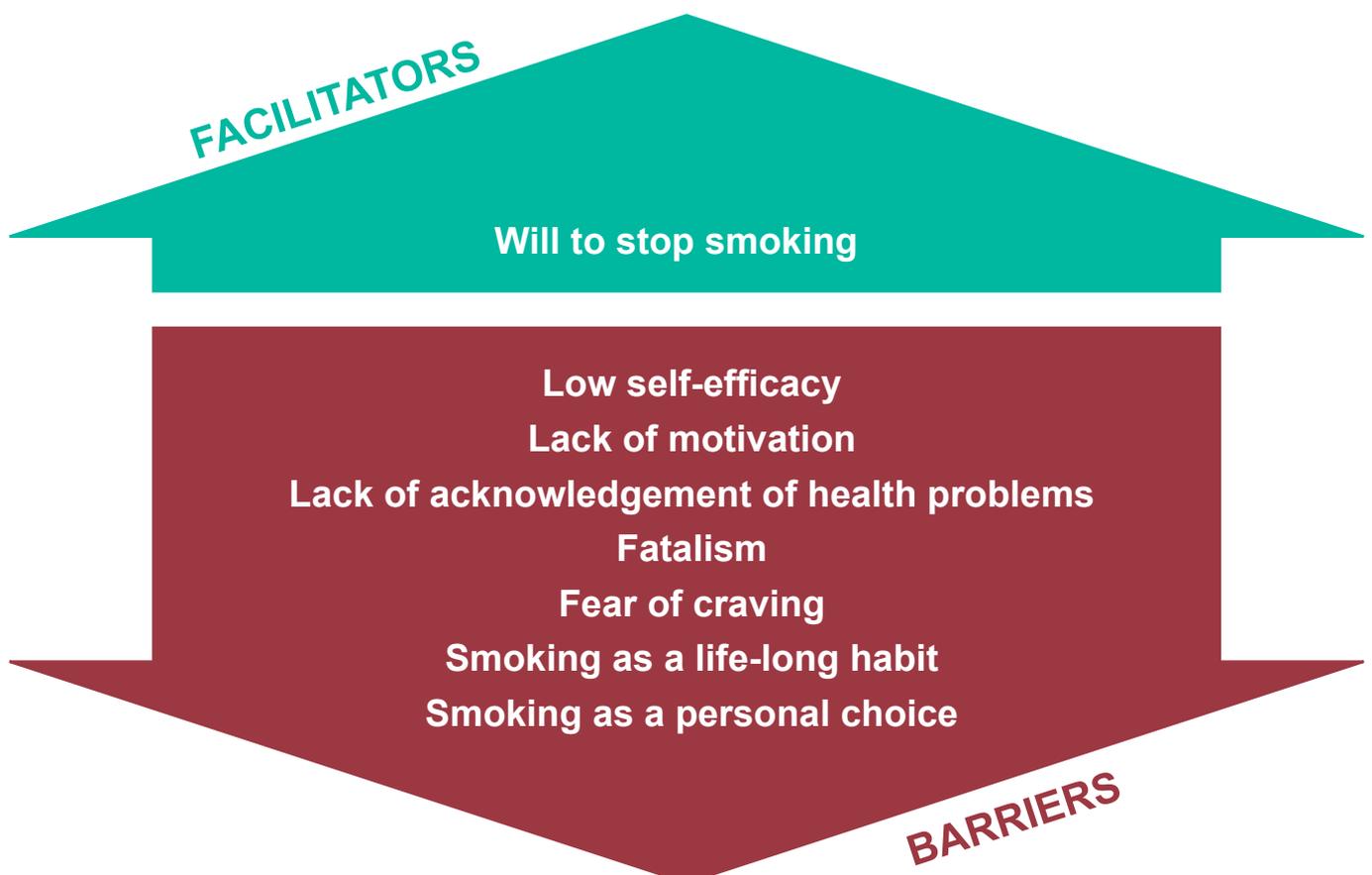
1. Health and quality of life



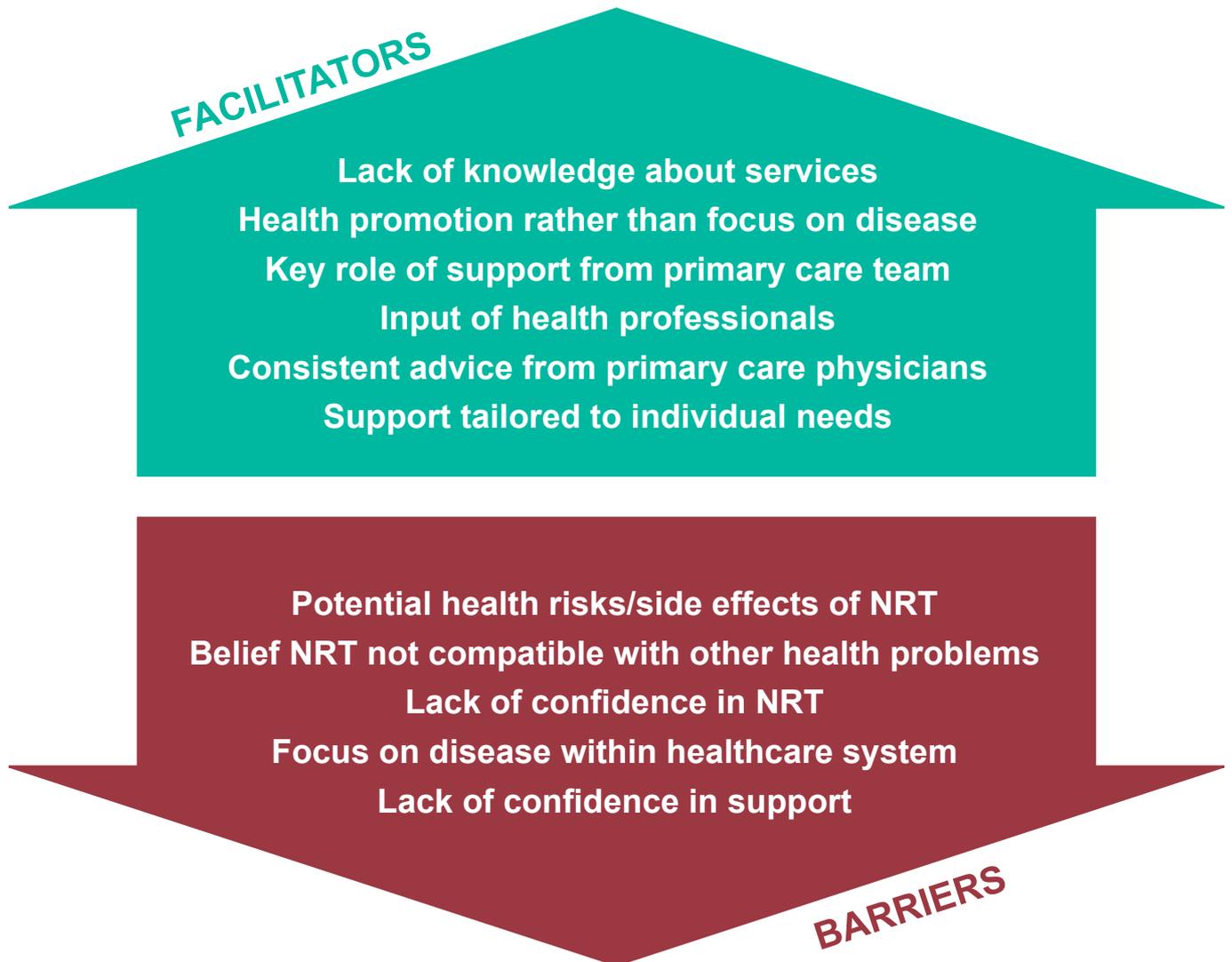
2. Sociocultural



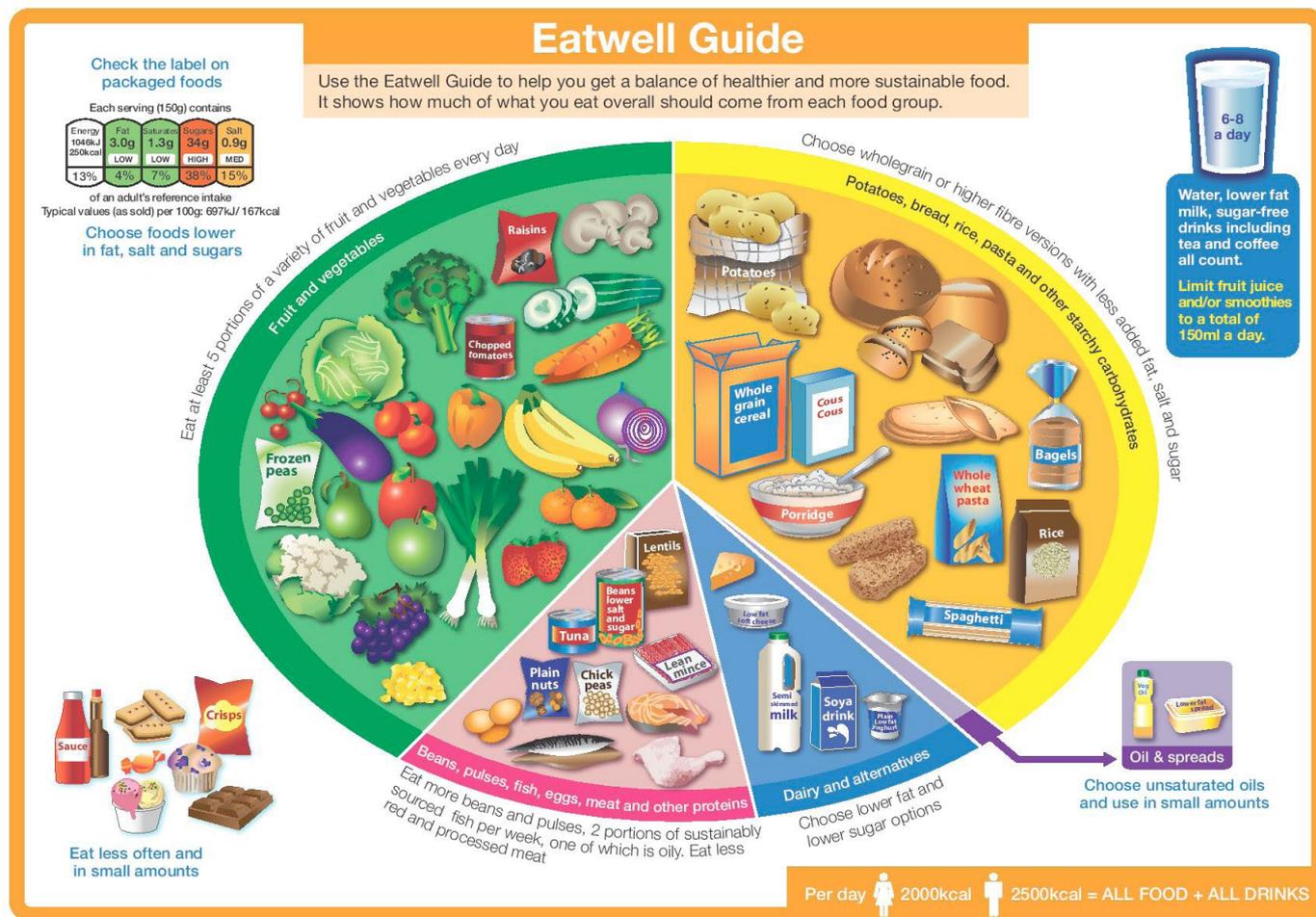
3. Psychological



4. Smoking cessation routes and services



Diet



Source: Public Health England in association with the Welsh Government, Food Standards Scotland and the Food Standards Agency in Northern Ireland

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Key Findings

Eating a poor diet high in saturated fat, sugar and salt is a risk factor for dementia. Supporting people to eat healthily across the population is a concrete step towards reducing that risk.

For older adults:

1. A range of diet and nutritional interventions may have positive effects in older adults
2. There is very limited evidence available of positive effects on cognitive outcomes
3. A primary focus for interventions could be groups that have low fruit and vegetable consumption
4. Interventions to change dietary behaviour with the most positive outcomes were very intensive and may be unwieldy and/or expensive to implement
5. Suitable interventions that demonstrated long-term outcomes used a combination of self-help manuals, personalised dietary information, computer generated personal letters, newsletters, personalised feedback, coaching calls and tailored feedback. In all three, fruit and vegetable consumption was maintained in the mid- to long-term
6. Short-term interventions also showed some preliminary evidence of effectiveness, such as a brief Mediterranean diet intervention but confirmatory evidence is needed from larger studies
7. Studies are needed to assess the cost-effectiveness of diet and nutritional interventions for older adults
8. Disadvantaged and minority groups have been understudied. Little evidence is available to guide interventions in these subgroups of older adults

Description of studies

- 12 primary intervention studies reported on the effect of diet interventions on cognitive outcomes (14 papers; three papers reported data from the same study)
- a further three systematic reviews and 16 intervention studies (and one secondary analysis of an intervention study) were found that reported interventions to improve uptake and maintenance of healthy diet behaviour (without cognitive outcomes). A further three systematic reviews reported information of background relevance

Diet interventions with cognitive outcomes

There is currently very little data from systematic reviews to inform whether diet or dietary components can prevent or delay cognitive decline and dementia.

From the 12 primary studies (table 27):

- two studies (four papers) were found that reported some limited effects of overall dietary pattern in older adults on cognitive and/or dementia or MCI outcomes. There is limited evidence that a low saturated fat/low glycemic index dietary pattern or a Mediterranean diet supplemented with either extra virgin olive oil or mixed nuts may have beneficial effects on cognition and dementia/MCI (**Valls-Pedret 2015**, **Martinez-La-Piscina 2013a**; **Martinez-La-Piscina 2013b**).
- one RCT of dark chocolate and cocoa (**Crews 2008**) compared to similar placebo products found no effect after six weeks.
- two studies reported that cocoa with high flavonol concentration in people with MCI (**Desideri 2012**) or without cognitive dysfunction (**Mastroiacovo 2015**) gave small improved outcomes on the Trail Making Test and the Verbal Fluency Test, but not the MMSE. However, these were very small scale trials which were funded by Mars.
- some beneficial cognitive effects were found for high flavonone orange juice (**Kean 2015**), wild blueberry juice (**Krikorian 2010a**) and pomegranate juice (Bookheimer 2013). However, again these were all small scale trials.
- additionally, one study (**Nadeem 2014**) reported that fruit and vegetable consumption reduced serum amyloid A.

Interventions to increase uptake of healthy diet behaviour (without cognitive outcomes)

From the systematic reviews found, it was reported that dietary interventions delivered in the retirement transition are effective and sustainable in the long-term (**Lara 2014**). For fruit and vegetable intake, more participant intervention contact produced improved outcomes. Programmes that included 'barrier identification/problem solving', 'plan social support', 'goal setting (outcome)', 'use of follow-up prompts' and 'provide feedback on performance' were associated with greater effects of interventions on fruit and vegetable consumption (**Lara 2014**); these

Tickbox Summary

Diet interventions with cognitive outcomes

				
Intervention	What works	What might work	What doesn't work	Study
Low saturated fat or Mediterranean diet pattern		?		Barnett 2015
Low saturated fat/Med diet plus extra virgin olive oil		?		Bayer-Carter 2011
Pomegranate juice		?		Bookheimer 2013
Daily drink of cocoa with high flavonol		?		Desideri 2012
High flavonone orange juice		?		Kean 2015
Wild blueberry juice		?		Krikorian 2010a
Low saturated fat/Med diet plus extra virgin olive oil or nuts		?		Martinez-Lapiscina 2013 a/b
Daily drink of cocoa with high flavonol		?		Mastroiacovo 2015
Fruit and veg consumption vis-a-vis Serum amyloid A		?		Nadeem 2014
Low saturated fat or Mediterranean diet pattern		?		Shah 2013
Mediterranean diet plus extra virgin olive oil		?		Vals-Pedret 2015
Low saturated fat or Mediterranean diet pattern		?		Van de Rest 2015
Dark chocolate and cocoa			X	Crews 2008
Concord grape juice			X	Krikorian 2010b

conclusions support an earlier review (**Bandayrel 2011**) that concluded that nutrition counselling interventions involving active collaboration showed the most promise for positive changes.

Three further systematic reviews were found that reported information of background relevance to this review (but did not formally meet inclusion criteria). **Campos 2011** reported that older adults were less likely than middle-aged or younger people to use nutrition labels on pre-packaged foods to guide selection of food products. **Conklin 2013** reported that retirement had a mixed impact on food spending and/or intake in older adults. **Tada 2014** reported that masticatory ability explains only part of the variance in the elderly's food and nutrient intake.

Of the 16 intervention studies, 12 were RCTs of which six were aimed at improving fruit and/or vegetable intake; four were aimed at improving diet in general/total diet; three were targeted at osteoporosis prevention, calcium or milk intake; two aimed at reducing fat and/or saturated fat; one to implement a Mediterranean diet pattern and one targeting protein consumption. Two studies reported wholegrain outcomes. There were two non-randomised studies. One was aimed at improving fruit and vegetable consumption and one the total overall diet.

Interventions ranged from fruit-tasting sessions designed to be implemented by non-health professionals, community diet and nutrition education sessions, home education sessions, self-help manuals with additional support, newsletters, peer-led community food clubs, hand-held computers. A number of studies included personalised feedback and/or follow-up phone-calls/mailings. Some studies used a mixture of these components.

Beneficial outcomes were reported in almost all intervention studies (Table 27). The exceptions were **Moynihan 2006** (peer-led food clubs) and **Taylor-Davis 2000** (nutrition newsletters):

- evidence is particularly strong to support improved fruit and vegetable intakes - most studies reported this outcome
- there is limited evidence to support beneficial changes to other dietary behaviours targeted in the intervention, including milk and calcium intake and osteoporosis prevention
- one brief pilot study (**Lara 2015**) showed an improved Mediterranean dietary pattern score overall when intervention and control groups were combined
- there is good evidence that dietary changes can be maintained in the mid (six months) to longer term (>one year). Studies that reported outcomes at six months reported maintenance of beneficial changes (**Bernstein 2002, Carcaise-Edinboro 2008**). Improvements were also maintained at one year in some studies (**Greene 2008, Patterson 2004, Kristal 2000, Keller 2006**). Keller reported maintenance of beneficial outcomes at three years and Patterson at five
- there is some limited evidence (**Appleton 2013**) that intervention may be more successful in lower consumers of fruit and vegetables

Tickbox Summary

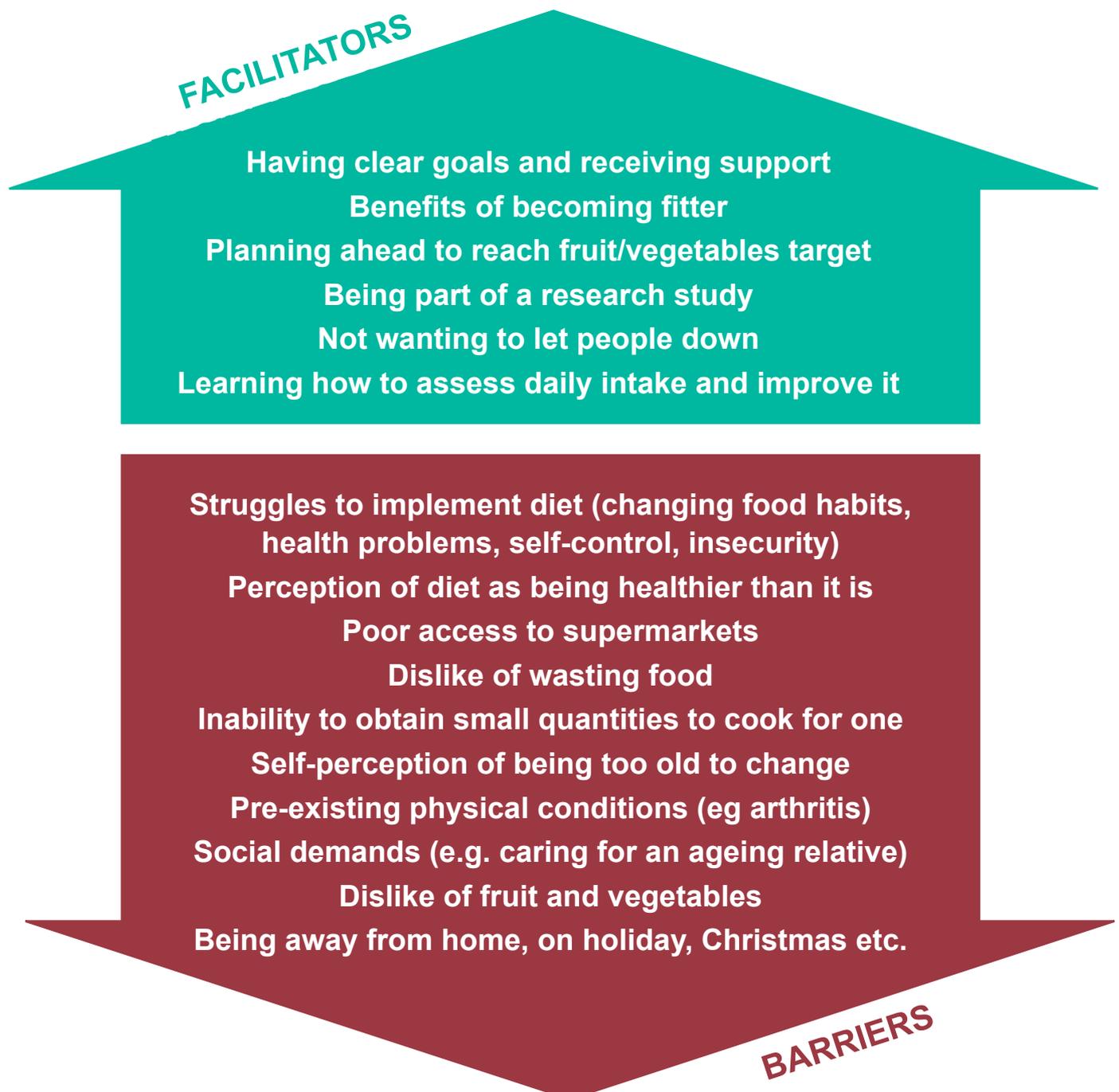
Interventions to increase uptake of healthy diet behaviours

Intervention	What works	What might work	What doesn't work	Study
Activity-led, long-term community diet sessions	✓			Keller 2006
Hand-held computer for veg/wholegrain intake		?		Atienza 2008
Weekly community diet and nutrition education sessions		?		Babatunde 2000
Additional milk intake		?		Barr 2011
Follow-up phone-calls/ mailings		?		Bernstein 2002
Education, feedback, computer mailings		?		Carcaise-Edinboro 2008
In-home education sessions led by a dietitian		?		Francis 2009
Fruit/vegetable manual with support and feedback		?		Greene 2008
Community diet and nutrition sessions		?		Hermann 2000
Group education, recipes, menus, phone support		?		Lara 2015
Self-help manual with personalised dietary info		?		Kristal 2000
Long-term intensive group diet and nutrition sessions		?		Patterson 2004
Lecture, nutrition sessions with personalised feedback		?		Rousset 2006
Fruit-tasting sessions in community-based groups			X	Appleton 2013
Peer-led community food clubs			X	Moynihan 2006
Bi-weekly nutrition newsletters			X	Taylor-Davis 2000

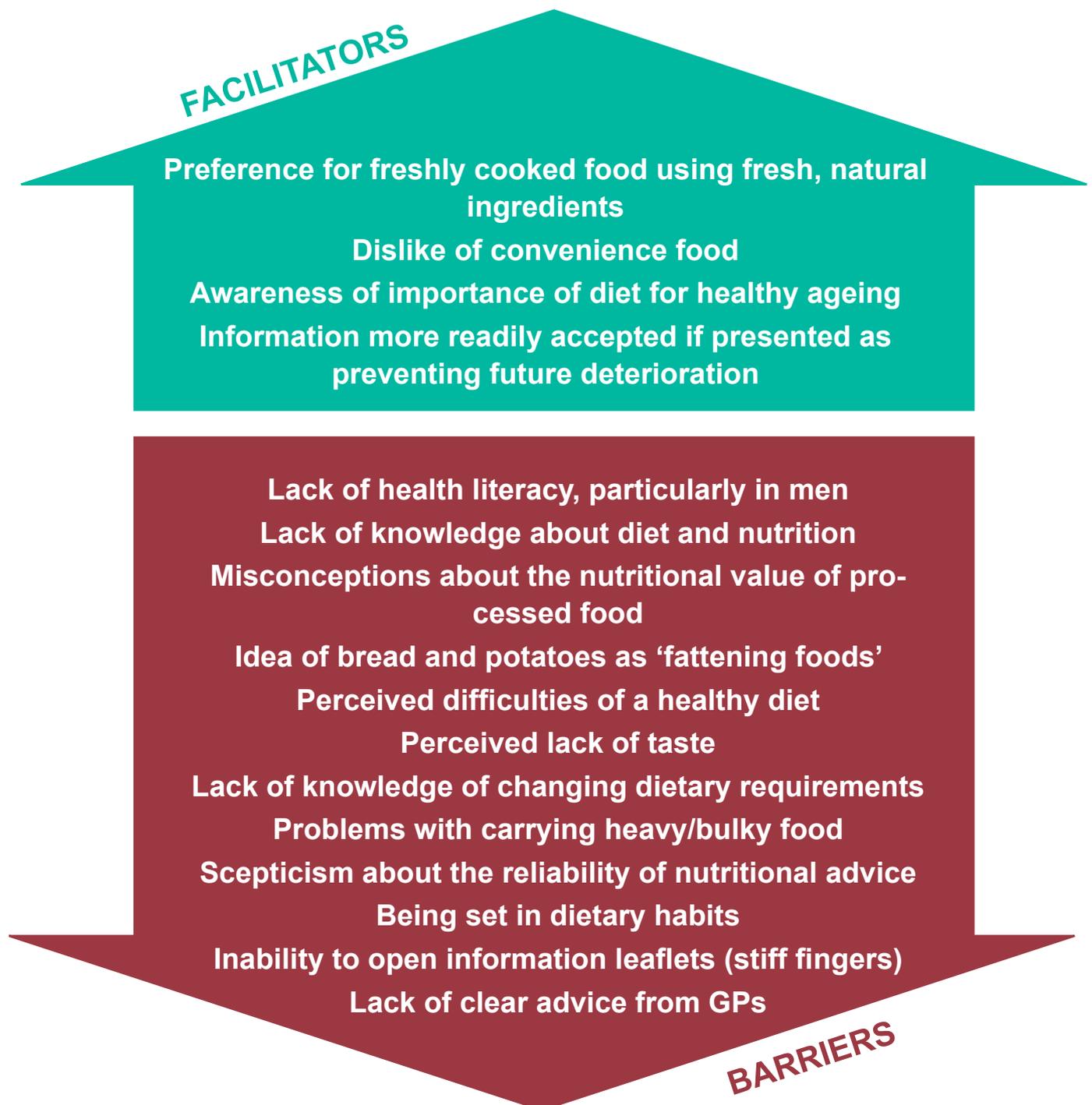
Barriers and facilitators to dietary changes

- three primary studies were found that reported qualitative data from older adults in general (**Drummond 2006, McKie 2000, Pettigrew 2012**).
- five qualitative studies were found that were conducted in older people participating in dietary interventions (**Hammarstrom 2014; Moynihan 2006; Hyland 2007, Penn 2008, Sandison 2008**).

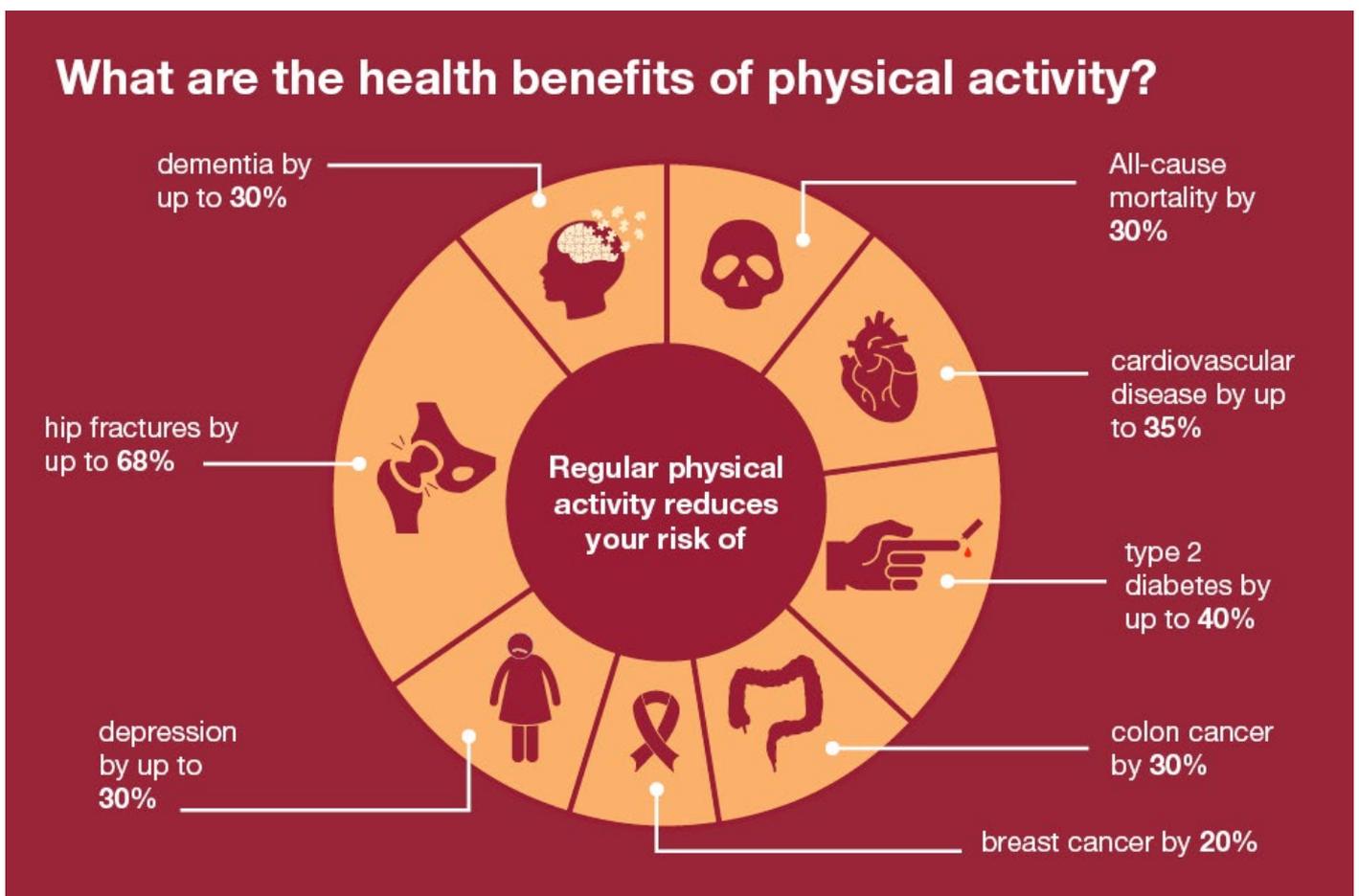
Findings are presented in the figures below (see table 28)



Barriers and facilitators to healthy dietary behaviours in older adults



Physical activity





Key Findings

A lack of regular physical activity along with a sedentary lifestyle increases the risk of dementia. Encouraging, enabling and supporting everyone to build physical activity into their daily lives is a concrete step towards reducing that risk.

For older adults:

1. Physical activity can offer small benefits to brain health yet evidence on how much activity is required to produce this effect is lacking
2. In the absence of evidence on the minimum level of physical activity that is effective for maintaining brain health and increasing participation in physical activity, public health messages should be aimed at promoting acceptable levels of physical activity above normal daily activities in older adults
3. There is strong evidence to suggest that individual or group-based physical activity interventions can lead to increased uptake of physical activity in older adults. Evidence on long-term effectiveness (>2 years) is generally lacking
4. Evidence suggests that interventions might not be effective in the very short-term but may be in the long-term (range between 9 to > 12 months); multi-modal interventions helped by behavioural cognitive techniques were useful for increasing physical activity uptake at 12 months among those at risk of chronic conditions such as impaired glucose intolerance, hypertension and obesity
5. Short duration exercise could be effective for increasing physical activity uptake in the frail older population
6. Interventions delivered via general practices and/or primary care practices are effective for increasing short term uptake of physical activity
7. To maintain long-term participation in physical activity, individualised interventions modelled using behavioural theories are more likely to change behaviour
8. When designing interventions aimed at increasing physical activity in older adults, considering barriers and facilitators to behaviour change is critical

Description of studies

Thirty-five systematic reviews (SRs) were included (tables 39-42):

- reporting on physical activity (PA) for delaying cognitive decline: 12 SRs of mostly randomised controlled trials for a total of 7,751 participants. Ten of these SR were of high or good quality
- reporting on PA uptake and maintenance: 16 SRs of randomised controlled trials for a total of 75,194 participants. All but one SR was of high or good quality
- reporting on barriers and facilitators: seven qualitative SRs for a total of 15,921 participants. Of these, four reviewed purely qualitative studies, while the rest included a mixture of studies
- duration of interventions varied between six weeks and 90 months, while the length of follow-up post-intervention ranged from two weeks to 48 months
- population samples were recruited from community settings including, but not limited to, home, work place, community and day centres, sheltered housing and primary care
- of the 35 included reviews, one was targeted at older post-menopausal women; three reviews specifically looked at frail older populations; and one focused on a minority ethnic South Asian population
- ten of the 35 SRs included older populations with pre-conditions for later ill health such as high blood pressure and high cholesterol, impaired cognitive function, mood disorder, impaired mobility and disability, and impaired glucose tolerance

! Information on dosage of PA (ie frequency, intensity, time) was poorly reported or omitted (i.e. > 50% of systematic reviews).

Physical activity for the primary prevention or delay of dementia or cognitive decline

Twelve SRs reported quantitative outcomes related to short term effect (four weeks to 52 weeks) in cognitive function.

! None of the reviews reported primary studies which measured incidence or prevalence of dementia as main outcomes.

Physical exercise

Eight SRs evaluated the effectiveness of physical exercise on cognitive outcomes. Physical exercise refers to planned, structured, and repetitive physical activity that has as a final or intermediate objective the improvement or maintenance of physical fitness. Exercise could be supervised, unsupervised, and performed in a group or individually (CDC 2009). Six high and good quality SRs reported minimal but varied positive effects of a variety of exercise training (ie strengthening, aerobic, Tai Chi, flexibility, balance) on cognition in the older population (**de Melo Coelho 2013; Colcombe 2003; Gates 2013; Ohman 2014; Tseng 2011; van Uffelen 2008**).

Tickbox Summary

Physical activity with cognitive outcomes

Intervention	 What works	 What might work	 What doesn't work	 Study
Aerobic training: Cycling, walking, jogging, weights...	✓			Angevaren 2008
Tri-weekly flexi-tone training	✓			Carvalho 2014
Supervised aerobic training	✓			Colcombe 2003
Walking	✓			Scherder 2014
Structured daily exercise and music therapy		?		Balsamo 2013
Resistance exercise with diet advice		?		Chang 2012
Varied PA including Nordic walking, acute aerobics		?		de Melo Coelho 2013
Aerobic exercise training		?		Gates 2013
Mixed physical exercise		?		Ohman 2014
Strengthening and aerobic training		?		Pterson 2010
Thrice weekly mixed physical exercise		?		Tseng 2011
Aerobic, strength and flexibility exercises		?		Uffellen 2008

One poor quality review (**Balsamo 2013**) reported inconclusive evidence due to lack of power (note: five out of eight included studies showed a positive effect). The other poor quality review reported evidence of ineffectiveness (**Chang 2012**).

In spite of a wide range of effect sizes, **Colcombe 2003**'s meta-analysis reported that aerobic fitness training improved cognitive performance in healthy older adults and markedly in the executive processing region of the brain. Finally, a review of six RCTs reported that aerobic exercise increased Brain Derived Neurotrophic Factor (BDNF), a biomarker for functional brain recovery in older adults (**de Melo Coelho 2013**).



Heterogeneity in type, composition and dose of exercise interventions, mode of delivery and cognitive outcome measures used in the primary studies included in selected reviews contributed to a wide variation in the effects reported, making it difficult to draw definite conclusions.

Walking

One high quality SR and meta-analysis of eight RCTs found that walking improved executive functions in cognitively intact sedentary older persons. No significant effect was found on executive functions in older adults with cognitive impairment (**Scherder 2014**).

Dose-response



No systematic review has reported evidence on the dose-response or threshold effect of exercise on cognitive function in the older population.

Mild Cognitive Impairment (MCI)

Three high quality SR reported evidence of minimal effectiveness of exercise on cognitive functions in the older population with mild cognitive function (**Gates 2013; Ohman 2014; van Uffelen 2008**). Ohman (2014) and Uffellen (2008) reported positive effects on one or several domains of cognition including global cognition, executive function and attention. Gates (2013) reported some evidence of positive effect on verbal fluency, global cognition, and memory. Aerobic and combined exercises were reported to be the most effective for improving cognitive function in older adults with MCI. In contrast, Gates (2013) reported that aerobic exercise did not improve executive function.



SRs reported limitations in primary studies such as small sample sizes, poor quality, and heterogeneity in interventions/outcome measures. Findings for MCI must thus be treated with caution.

Interventions to promote uptake and maintenance of physical activity

Physical Activity (PA) specific interventions

These interventions involve carrying out stand-alone observable physical action. They include but are not limited to leisure-time PA (eg dancing, swimming), non-leisure PA (occupational and household), and exercise (eg aerobic, strengthening, flexibility).

Four out of five SRs reported positive effects of PA specific interventions on uptake and maintenance of PA:

- a high quality SR (**Asikainen 2004**) of 28 RCTs found high attendance (mean 84%), low dropout (mean 13%) and low injury rates (mean 3%) for short-term (≤ 1 year) walking interventions in post-menopausal women
- a high quality SR (**Stevens 2014**) reported that tailored PA interventions significantly increased PA levels in older adults
- one poor quality SR (**Cyarto 2004**) reported positive effect of progressive resistance training among older adults. However, this conclusion should be treated with caution due to limited information on the primary studies included in the review
- a high quality SR (**Clegg 2012**) found completion rates of home-based exercise for frail older adults to be generally high (median 83%, range 65-88%). Interventions of shorter duration generally had higher completion rates compared with those of longer duration. The review also reported high rates of adherence to exercise interventions
- conversely, one high quality SR (**de Vries 2012**) reported ineffective findings on physical exercise therapy aimed at improving PA levels in the frail elderly based on two RCTs pooled in a meta-analysis. (The review did find a positive effect of PA on mobility in that population)



Due to great variation in reported outcome measures, target population and settings, it is difficult to extrapolate the effectiveness and/or overall effect size of physical activity from individual studies.

Non-PA interventions

These included studies of interventions to increase PA uptake that do not involve any observable or participatory PA.

Three good quality reviews (**Chase 2013**; **Neidrick 2012**; **van der Bij 2002**) which mostly included health education, counselling, goal setting, motivational interviewing and other behavioural change techniques reported that these interventions were effective for improving uptake of PA in the short-term (≤ 2 years). None of these reviews reported a long-term intervention effect on PA behaviours in older adults.

Multi-component interventions

Four SR (**Chase 2013**; **Fairhall 2011**; **Hobbs 2013**; **Nigg 2012**) identified studies which investigated multi-component interventions aimed at promoting the uptake and maintenance of PA in older adults. The components of reviewed multi-component interventions varied between intervention studies:

- two good quality SR (**Chase 2013**; **Fairhall 2011**) examined studies which combined cognitive and behavioural interventions components including supervised exercise, telephone prompting, telephone counselling, face-to-face activity planning, goal setting and health education. One review (**Chase 2013**) reported inconclusive findings on the effect of multi-modal interventions on short-term PA behaviour in older adults but reported varied but positive long-term effects (range between 9 to > 12 months). The other SR (**Fairhall 2011**) reported that multi-modal behavioural intervention with an exercise component had a larger effect on participation than exercise intervention alone, however, the difference was not statistically significant
- a good quality review (**Hobbs 2013**) reported that multi-modal interventions helped by behavioural cognitive techniques were useful for increasing short-term PA uptake among those at risk of chronic conditions such as impaired glucose tolerance, hypertension and obesity. None of these studies reported intervention effects on long-term PA maintenance
- a third high quality SR and meta-analysis (**Nigg 2012**) looking at the combination of physical activity and nutrition related behaviours also reported inconclusive findings on short-term PA behaviour in older adults

Delivery (mode and settings)

Eight SRs provided evidence on the association between settings, mode of intervention delivery and uptake of PA among older adults:

- three SRs (one good, one high and one poor quality) reported that interventions delivered in primary care centres and general practices can produce at least short-term increases in physical activity (**Cyarto 2004**; **Neidrick 2012**; **Stevens 2014**). The evidence is too limited to evaluate whether long-term changes can be achieved
- two high quality SRs reported that tailored interventions were more effective in increasing PA level when compared with generic interventions (**Hobbs 2013**; **Stevens 2014**)
- one good quality SR reported that group-based PA interventions increased short term participation by a mean of 84% (range= 55%-100%) but that participation declined after one year (**van der Bij 2002**)
- another good quality SR and meta-analysis (**Conn 2003a**; **Conn 2003b**) reported that studies testing centre based exercise reported significantly larger effect sizes than studies with home-based exercise
- one high-quality (**Muller 2014**) review reported that non-face-to-face interventions were effective in the short- and long-term for improving PA levels in older adults (one week to

Tickbox Summary

Interventions to promote maintenance and uptake of physical activity

Intervention	 What works	 What might work	 What doesn't work	 Study
Walking, resistance training, aerobics	✓			Asikainen 2004, Clegg 2012, Stevens 2014
PA programmes with activity professionals	✓			Conn 2003a, Asikainen 2004
Walking and exercise maintenance	✓			Conn 2003b
Strength, endurance, balance & mobility training	✓			de Vries 2012
Non-face-to-face PA	✓			Muller 2014
Home based exercise with multiple components		?		Clegg 2012
Motivational interviewing strategies		?		Chase 2013, Conn 2003b, Neidrick 2012
Progressive resistance training		?		Cyarto 2004
Fall reduction exercises: strength, balance, Tai Chi		?		Fairhall 2011
Lifestyle PA (gardening, walking); plus exercise		?		French 2014
Remote feedback on home-based PA		?		Geraedts 2013
Multimodal with PA and maintenance		?		Hobbs 2013, Chase 2013
PA promotion with self-reported questionnaires		?		Neidrick 2012
Single Vs multiple health behaviour changes		?		Nigg 2012
Tailored PA (aerobic, strength and balance)		?		Stevens 2014
Home-based, group and educational PA		?		Van der Bij 2002

24 months); but findings from one high quality meta-analysis (**Hobbs 2013**) of only two RCTs suggest that the mode of delivery may not necessarily be important for intervention effectiveness

Intervention dose/intensity

Three SRs reported mixed evidence on the effects of intervention dose / intensity on the uptake of PA among older adults:

- one good meta-analysis reported that intense direct contact with activity professionals doubled the effect size of the interventions (**Conn 2003a**). Conversely, a high quality meta-analysis showed that interventions that had more intervention contacts (≥ 11 contacts) did not have a detectable effect on PA levels at 12 months while interventions with less contacts (< 11 contacts) did (**Hobbs 2013**)
- a third high quality review reported a positive dose-response effect of non-face-to-face interventions aimed at improving PA uptake (**Muller 2014**). However, one out of its six primary studies reviewed reported a negative intervention effect for newsletters

Interventions with theoretical underpin

Behavioural interventions such as physical activity are sometimes difficult to evaluate due to their complex nature. Some studies use theoretical models as a basis for developing effective behavioural interventions in order to understand their likely mechanism of effect. Three good (**Chase 2013; Conn 2003b; French 2014**) and two high quality reviews (**Hobbs 2013; Muller 2012**) discussed the use of behavioural theories in developing interventions and their associations with PA uptake/maintenance.

Four reviews (**Conn 2003b; French 2014; Hobbs 2013; Muller 2014**) including one meta-analysis reported positive associations between theory-based interventions and short term PA uptake. One good quality study reported that behavioural change techniques such as motivational interviewing and goal setting were useful for enhancing long-term (≥ 2 years follow-up) PA behaviour change (**Chase 2013**).

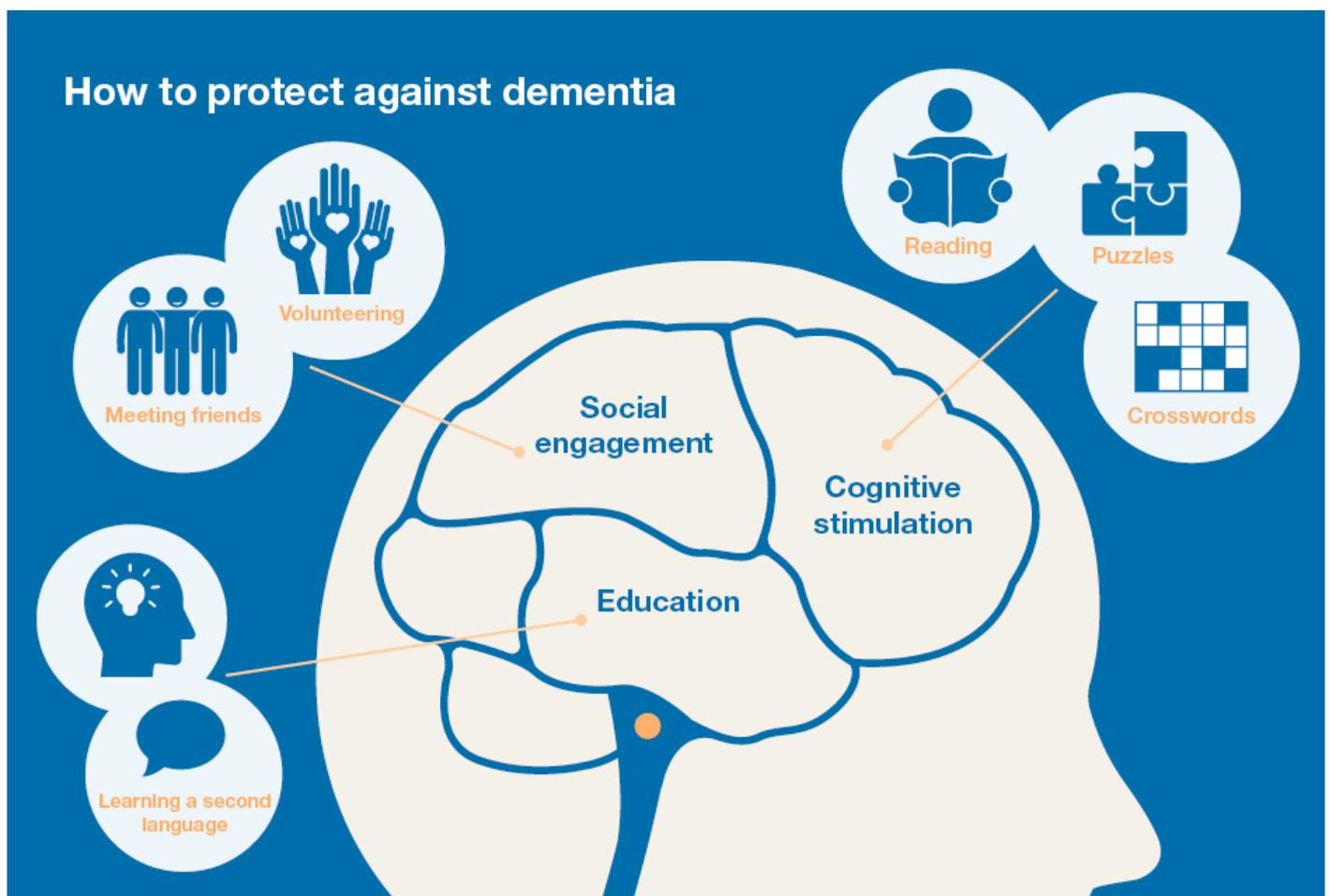
Gaps in evidence

- there is limited evidence on the doses and intensities of interventions that would increase uptake and maintenance of physical activity
- we do not know the minimum required dose of physical activity needed to improve cognitive function in the older population
- there is no evidence on whether or not physical activity can prevent/delay onset of dementia
- few reviews reported findings from studies with disadvantaged population such as minority ethnic groups or frail older adults

Barriers and facilitators to uptake of physical activity in older age



Cognitive stimulation





Key Findings

Encouraging people to be socially active and mentally stimulated is one of the building blocks of a comprehensive approach to promote a healthier lifestyle and reduce the risk of dementia.

For older adults:

1. There is consistent evidence from recent, well-conducted systematic reviews that cognitive training interventions can have beneficial effects on cognitive function. Less evidence is available for mild cognitive impairment
2. No evidence was found on the effect of cognitive training interventions on long-term dementia outcomes
3. A wide range of cognitive training types were included and it may be that benefits are design-specific
4. However, there is limited but good evidence on which aspects of intervention design are most beneficial:
 - home-based cognitive training programmes are less effective than group-based cognitive training
 - no additional benefit to training sessions more than three times a week
 - sessions less than 30 minutes are less effective
5. Computerised cognitive training appears to have some beneficial effects at least equivalent to other cognitive training and may be more feasible and enjoyable to implement
6. There is some evidence that cognitive training compared to physical activity interventions may have similar effects



These findings should be interpreted with caution.

Limitations of included studies include small sample sizes and issues with how trials are designed.

Description of studies

Cognitive training refers to 'specifically designed training programmes that provide guided practice on a standard set of cognitive tasks, aimed at improving performance in one or more cognitive domains' (**Kelly 2014, Martin 2011**). Mentally stimulating activities that could be included as a part of daily living such as crosswords or playing music have been included in the section on Leisure.

Interventions to promote uptake of cognitive training with cognitive outcomes

SRs that included only cognitively healthy participants

A SR and meta-analyses of RCTs (N=31) of cognitive training or mental stimulation interventions included only older adults without cognitive impairment (**Kelly 2014**). Comprehensive meta-analysis was conducted across a wide range of cognitive domain outcomes. Fourteen trials provided efficacy evidence for cognitive training vs no intervention control; ten trials for cognitive training vs active controls.

From meta-analysis, compared to active controls (other mentally stimulating activities), cognitive training improved performance on measures of executive function (ie working memory and processing speed) and composite measures of cognitive function. There were no significant differences between groups for immediate recall, delayed recall or attention. Data were not available for face-name recall, verbal fluency, reasoning or everyday functioning. Transfer of training effects were reported in nine out of 10 individual trials and five reported transfer to untrained tasks within the same domain and six to other cognitive domains in trials compared to active controls.

Compared to no intervention, cognitive training improved performance on measures of memory and subjective cognitive function in meta-analysis. There were no significant differences between groups for memory measures of recognition and delayed recall or for the executive measure of working memory. Data were not available for verbal fluency, reasoning, attention and processing speed in the executive domain or for composite measures of cognitive function and everyday functioning. Transfer of training effects were reported in five out of seven individual trials, four reported transfer to untrained tasks within the same domain, one to other cognitive functions.

Included studies examined a range of cognitive training interventions including computer-based training, cognitive and working memory training and brain training video games but little evidence was available as to which types of intervention were most effective. There was limited data available to evaluate the effect of training in group vs individual settings. Only two studies were available and overall effects from the limited data were not significant. Maintenance of training effects was reported in nine out of 10 cognitive training interventions, lasting from three to six months.

Tickbox Summary

Interventions to promote uptake of cognitive training

Intervention	 What works	 What might work	 What doesn't work	 Study
Specific training program of cognitive tasks	✓			Kelly 2014
Computer-based training and interactive gaming	✓			Kueider 2012
Interactive computer games plus a physical component		?		Bleakley 2015
Cognitive tasks or aerobic exercise		?		Hindin 2012
Cognitive training versus PA		?		Karr 2014
Computerised training		?		Lampit 2014
Cognitive interventions		?		Li 2011
Cognitive training		?		Reijnders 2013
Memory rehabilitation and training		?		Stott 2011
Cognitive intervention programmes		?		Tardif 2011
Cognitive exercise training		?		Valenzuela 2009
Memory training		?		Zehnder 2009

Gross 2012 examined non-pharmacological memory training interventions in cognitively healthy, older community-dwelling adults. N=35 intervention studies were included. Mean standardised difference in pre-post change between memory-trained and control groups, was 0.31 standard deviations (SD; 95% confidence interval (CI): 0.22, 0.39). The pre-post training effect for memory-trained interventions was 0.43 SD (95% CI: 0.29, 0.57) and the practice effect for control groups was 0.06 SD (95% CI: -0.05, 0.16). Training in multiple strategies was associated with larger training gains in minimally adjusted models but was not significant after adjustment for multiple comparisons. There was no evidence that training in any particular strategy, age, session length or type of control had significant effects. The majority of memory training programs taught between two and seven different strategies. The most common combination of strategies was at least three from: method of loci, association, categorization, and visual imagery, only 29% of programs employed a single training strategy.

Tardif 2011 examined cognitive intervention programmes in healthy elderly. Nine out of 14 studies targeted memory as the principal cognitive function to train or stimulate. Face-name associations, mental imagery, paired associations, and the method of loci were the main techniques taught to participants. Improvements were observed on at least one outcome measure in each study.

SRs that included both cognitively healthy participants and people with MCI

- **Reijnders 2013** examined cognitive training interventions in healthy older adults and people with MCI and reported results narratively. N=35 intervention studies (RCTs and clinical studies) were included, of which six were in people with MCI, the rest were in healthy older adults. A wide range of training strategies were employed in the included studies: to improve memory performance such as working memory by computerized training or training of the categorization span task; use of memory strategies; improving memory self-efficacy by a multifactorial training program or aimed at improving cognitive functioning in general such as providing a computer course; plasticity-based adaptive cognitive training; multifactorial cognitive training; or community-based programs or improving learning abilities by training metacognitive skills; executive functioning by a real-time strategy game; attentional skills by training a selective attention task; and fluid intelligence by novel stimulating activities. The results show evidence that cognitive training can lead to significant improvements in various aspects of objective cognitive functioning, including memory performance, executive functioning, processing speed, attention, fluid intelligence, and subjective cognitive performance
- **Martin 2011** conducted a Cochrane systematic review of cognitive training RCTs in healthy older adults or people with MCI. They reported wide variation across studies in terms of factors that could potentially influence outcomes, such as overall length of intervention, number of treatments, group sizes, assurance of equal training procedures, combination of training contents within and across sessions, training and similarity of trainers, pre-existing training

experience or matching of evaluation instruments to training contents. Most of the included studies focused on memory training interventions, and very few on speed improvements or training of executive functioning. There were few studies of cognitive interventions lasting longer than six months. There was sufficient data for meta-analysis for seven cognitive domains but overall significant combined effects were only found for two outcomes (immediate and delayed recall) compared to no treatment control

Despite the limitations of the available data, most individual interventions were effective, with significant improvements following training for the treatment group. However, the observed effects did not exceed improvements in the active control conditions so the authors concluded that the effects of cognitive training may not be specific, similar effects may also be achieved by other interventions.

SRs in people with MCI only

- **Li 2011** conducted a SR and meta-analysis of cognitive training interventions in people with MCI. N=20 intervention studies were included of which 17 were included in the meta-analysis. People with MCI benefited significantly more from the cognitive intervention than MCI control group in overall cognition, overall self-ratings, episodic memory, executive function/working memory. The effect sizes of separated domains in the MCI intervention group were all larger than the MCI control group, although the differences did not reach significance (for MMSE, semantic memory, attention/processing speed, visuo-spatial ability, language, self-rated memory, depression, anxiety or ADL). A range of types of intervention were included, including training of processing and memory, attention, episodic memory, problem-solving, computer assisted cognitive training. Six studies reported follow-up after intervention. There was evidence of significant benefit maintained at follow-up for overall cognition
- **Texeira 2012** examined the effect of non-pharmacological interventions on cognitive function in older, community-dwelling people with MCI. Six cognitive training interventions were included, including computerised cognitive training (and one PA intervention). All six included studies reported at least one significantly improved measure of cognitive function, all six reported improved episodic memory and one study also reported improved executive function
- **Stott 2011** reported on memory interventions in people with MCI. N=10 intervention studies were included. There is some evidence that people with MCI can learn specific information, although there was little evidence to suggest that memory training can generalize to untrained functions. There was some limited evidence of ability to learn to compensate for memory difficulties and contradictory findings regarding improvement in everyday life

Other SRs

- **Valenzuela 2009, Zehnder 2009, Papp 2009, Metternich 2008 and Jean 2010** also reported

SRs of cognitive and memory training interventions and these are summarised in the Intervention Tables for completeness. These reviews have been superseded by several more up-to-date reviews so conclusions have been based on data from the recent reviews

- **Huckans 2013** reported a SR of cognitive rehabilitation therapies based on any systematic behavioural therapy conducted in community-dwelling older adults with MCI. This review includes and synthesises lifestyle training studies with cognitive and multicomponent studies so the specific effect of cognitive training studies alone is difficult to separate

SRs and meta-analyses of computerised cognitive training in cognitively healthy participants only

- **Lampit 2014** included RCTs in a meta-analysis that examined studies with at least four hours of computerised cognitive training in older adults without dementia or other cognitive impairment. Fifty-two studies were included. Intervention designs varied considerably, but included computer, video and playstation games, brain-training programmes and in-house computer programmes. The overall effect size (Hedges' g , random effects model) for computerised cognitive training versus control was small and statistically significant, $g = 0.22$ (95% CI 0.15 to 0.29). Small to moderate effect sizes were found for nonverbal memory, $g = 0.24$ (95% CI 0.09 to 0.38); verbal memory, $g = 0.08$ (95% CI 0.01 to 0.15); working memory (WM), $g = 0.22$ (95% CI 0.09 to 0.35); processing speed, $g = 0.31$ (95% CI 0.11 to 0.50); and visuo-spatial skills, $g = 0.30$ (95% CI 0.07 to 0.54). No significant effects were found for executive functions and attention. Analyses of effective design factors showed that home-based programmes were less effective than group-based training, and that more than three training sessions per week was ineffective versus three or fewer. There was no evidence for the effectiveness of working memory training, and only weak evidence for sessions less than 30 minutes. Durability of training effects were not examined
- **Kueider 2012** examined computerised cognitive training interventions in people without dementia or cognitive impairment. Pre-post training effect sizes for intervention groups ranged from 0.06 to 6.32 for classic cognitive training interventions, 0.19 to 7.14 for neuropsychological software interventions, and 0.09 to 1.70 for video game interventions
- **Bleakley 2015** conducted a SR of the physical and cognitive effects of interactive computer games in older adults (aged 65+) covering literature from 2000 to 2011. The baseline cognitive status of participants was not fully reported but most studies appear to have been conducted in cognitively healthy participants. Studies were included if they reported the effect of interactive games with a physical component (aerobic, strength, balance, flexibility) on physical or cognitive outcomes. Twelve studies were included of which five were RCTs and two were controlled studies. Studies relating to rehabilitation after injury were excluded. However, only two studies reported cognitive outcomes (**Rosenberg 2010**, **Studenski 2010**), most studies reported physical outcomes. Of these, one study was conducted in older adults with depression (**Rosenberg 2010**) and the other examined interactive video dance games for healthy older

adults (**Studenski 2010**). Both studies that reported cognitive outcomes were before and after studies without a control group, no RCTs were found. Both studies found positive but non-significant effects on cognitive function

SRs or meta-analyses that compare cognitive training interventions with physical activity in cognitively healthy participants only

- **Hindin 2012** conducted a meta-analysis comparing extended cognitive practice interventions with aerobic interventions in healthy older adults. N=42 intervention studies were included, of which 25 reported extended cognitive practice interventions and 17 were aerobic interventions. Extended practice cognitive training involves many trials of basic tasks such as phoneme span or choice response time with or without strategy instruction (hundreds to thousands). Only strategies likely to generalise to other untrained outcomes were included. Both extended cognitive practice training and aerobic interventions produced significant results of similar magnitude
- **Karr 2014** conducted a SR and meta-analysis that compared the effect of cognitive training interventions with physical exercise interventions on executive function specifically. N=46 intervention studies were included of which 23 related to physical exercise interventions, 21 to cognitive training interventions and two to both exercise and cognitive training. However, it should be noted that this review includes a number of studies that we have included in our multicomponent section so their delineation of exercise interventions and cognitive training interventions may include other components. Included studies were in healthy people, people with dementia and MCI. Dementia outcomes were sought but not found. Both PA and cognitive training significantly improved executive functions but there was no significant difference in effect size between the two interventions

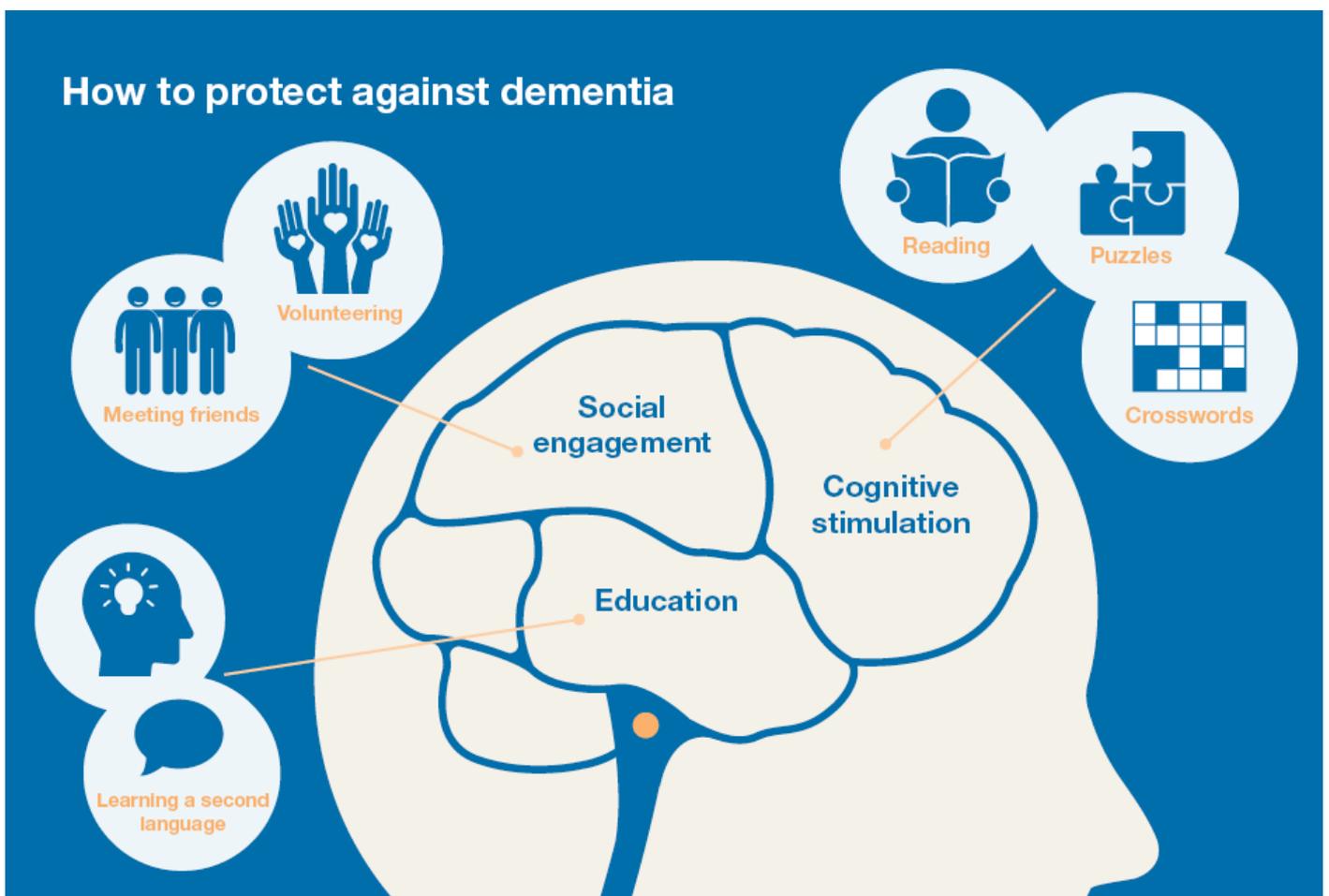
Interventions to promote uptake or maintenance of cognitive training

No systematic reviews or primary studies were found that specifically focused on promoting or maintaining cognitive training without cognitive outcomes. As such, we have no information on the extent to which cognitive training activities are maintained in the medium or long term.

Barriers and facilitators to cognitive training in older adults

No SRs were found that specifically examined barriers or facilitators to uptake or maintenance of cognitive training. However, two studies included in the **Bleakley 2015** systematic review reported qualitative analysis of older adults' experiences with interactive computer games (primary studies: **Graves 2009**, **Young 2011**) and reported there was evidence that these interventions are well tolerated and enjoyable.

Social





Key Findings

Addressing loneliness and encouraging people to be socially active are important building blocks of a comprehensive approach to promote a healthy lifestyle and reduce the risk of dementia.

For older adults:

1. There is limited but promising evidence of the positive effects of social participation on cognitive outcomes. Sufficiently powered trials and well designed evaluations are needed to confirm these effects
2. Interventions involving group participation in educational, social activity or support programmes can reduce social isolation in older adults
3. Effective activities include: reading to children in schools, art/writing sessions and community-based group exercise. There was some evidence that long-term effectiveness is improved by providing activities that enhance self-esteem and personal control, eg skills training
4. There is limited evidence that interventions to increase social roles (eg volunteering) can be effective
5. Occupational therapy interventions can be effective in improving or maintaining social participation in older adults with low vision
6. There is consistent evidence that the use of web- and internet-based technologies can improve social support and social networks among older adults; and limited evidence that training older people in web and internet technologies may reduce loneliness
7. However, evidence suggests that older adults sometimes did not understand the purpose of social networking sites, and have concerns about privacy, protection of personal information and inappropriate content
8. Barriers and facilitators to social participation must be accounted for when designing interventions to promote social participation and/or prevent or reduce social isolation and loneliness in older adults
9. Studies are needed to assess the cost-effectiveness of cognitive stimulation interventions for older adults
10. Disadvantaged and minority groups have been understudied

Description of studies

The definition of “social participation” in the scientific literature is quite broad, ranging from studies looking at promoting social participation, social support and acquiring new social roles to those focused on preventing or addressing social isolation and loneliness (**Bickerdike 2014**). Included studies primarily aim to improve social participation and reduce social isolation, with some also reporting cognitive/dementia outcomes in independently living, community-dwelling older adults.

For the purpose of this resource, the evidence is presented first for interventions with cognitive/dementia outcomes, then for two broad categories of interventions: 1) studies aimed at promoting or maintaining social behaviours in older adults (primary prevention); 2) studies aimed at reducing loneliness and isolation. Barriers and facilitators to social participation are presented last.

Overall, 11 SRs and 11 primary studies are included (see Tables 42-44 and 46-48 for quality assessment).

- Eight interventions studies conducted in community settings report cognitive/dementia outcomes.
- One overview of SRs (**Bickerdike 2014**) and nine SRs were included. Three SRs report on the effectiveness of interventions aimed at promoting or maintaining social behaviours in older adults; seven SRs report on reducing loneliness and isolation.
- One SR, two primary studies and one evaluation present information on barriers and facilitators to social participation, broadly defined.
- Much of the outcome data was self-reported.



There is some overlap between studies that relate to social activities, leisure activities or multicomponent interventions. As a result, some studies have been put in more than one category.

Social interventions with cognitive outcomes

Eight interventions studies conducted in community settings aimed to increase social participation and reported cognitive/dementia outcomes (six RCTs; one quasi-RCT; one non-RCT). Most studies were in cognitively healthy older adults and in predominantly female populations; two also included people with memory complaints (**Cohen-Mansfield 2015**) or MCI (**Carballo-Garcia 2013**) (see Table 44). Interventions and control groups were diverse, and often included other activities such as leisure activities (art groups, book groups etc.), problem solving, volunteering activities. Finally, a wide range of outcome measures were used, making it difficult to compare outcomes between studies.

Tickbox Summary

Social interventions with cognitive outcomes

Intervention	 What works	 What might work	 What doesn't work	 Study
Group cognitively stimulating leisure activities	✓			Tesky 2011
Volunteer school roles, e.g. reading and library support		?		Carlson 2008
Structured cognitive activity on health behaviours		?		Cohen-Mansfield 2015
Group therapy with various cognitive stimulation exercises		?		Carballo-García 2013
Novices learned digital photography and/or quilting		?		Park 2014
Therapeutic writing, group exercises and art		?		Pitkala 2011
Engaged lifestyle with creative problem solving		?		Stine-Morrow 2007
Team-based competitive problem solving		?		Stine-Morrow 2008
Creative problem solving with no explicit instruction		?		Stine-Morrow 2014
Group interactive video gaming using Nintendo Wii			X	Hughes 2014

Overall, there is limited but promising evidence of positive effects of social participation on cognitive outcomes. Most interventions that incorporated a social component had positive effects on at least one reported cognitive outcome. Only one study found no positive effects (**Hughes 2014**).

! There is some overlap between studies that relate to social activities, leisure activities or multicomponent interventions. As a result, some studies have been put in more than one category.

Interventions to promote or maintain social participation in older adults

Three SRs looking at very different dimensions were identified:

- **Berger 2013** examined occupational therapy interventions in people with low vision. Thirteen studies were included, with nine RCTs rated as providing strong evidence (Level I RCTs). Overall, strong evidence was found for using a problem-solving approach to maintain social and leisure participation in older adults with low vision. There was moderate evidence that a combination of services (ophthalmic nursing, ophthalmology, optometry, social work, occupational therapy, rehabilitation counselling) may also be effective
- **Heaven 2013** examined social roles in people during the retirement transition. These were defined as 'participatory activities related to a particular position in a social network, which may provide a sense of purpose, worth, identity, or structure to life' and included volunteering, working for pay, further education, training'. Seven studies were included, with three RCTs. Evidence suggests that providing 'explicit roles' was effective, with evidence that interventions promoting learning and engagement opportunities can reduce social isolation (e.g. University of the Third Age online learning). Additionally, the Experience Corps (US) study reported that social role interventions on average cost \$205,000 for each quality adjusted life year (QALY) gained by the older participants (Frick 2004). The authors concluded this was only cost-effective when considering the benefits to those who received support from the volunteers
- **Morris 2014** reviewed smart technologies for older adults living at home. Studies using a range of concepts of social connectedness were included covering social support, participation, empowerment, engagement, isolation and loneliness. Out of 18 studies, 12 were RCTs. Across all studies, 58 different outcome indicators of social connectedness were reported, with six studies finding statistically significant improvements in social support in interventions of less than one year. Evidence on outcomes of loneliness and empowerment were mixed

Interventions to reduce existing loneliness and isolation in older adults

The evidence for this section is derived from an overview of systematic reviews of interventions for loneliness and social isolation (**Bickerdike 2014**), and seven individual SRs.

- four SRs considered group interventions (**Cattan 2005, Dickens 2011, Medical Advisory**

Secretariat 2008, Findlay 2003). Overall, group activities such as reading to children in schools or art, writing and exercise sessions seemed to produce improvements in social, mental or physical health. There was also evidence that long-term effectiveness may be improved by activities that enhance self-esteem and personal control (e.g. skills training or the planning, development and delivery of activities). Most studies did not demonstrate any statistically significant effects of one-to-one interventions. Overall, group-based interventions show some potential for reducing loneliness and social isolation but there is uncertainty about the magnitude of benefit (**Bickerdike 2014**)

- both **Dickens 2011** and **Choi 2012** assessed computer training and internet use but there was limited evidence of benefit. The poor quality of included studies made it difficult to generalise
- **Cattan 2005, Dickens 2011** and **Medical Advisory Secretariat 2008** evaluated telephone-based interventions, but none showed a beneficial effect on loneliness based on quantitative outcomes. However, a qualitative evaluation of a telephone befriending service (**Cattan 2011**) found a range of positive outcomes
- one SR looked specifically at social therapeutic interventions to reduce loneliness in older adults (**Hagan 2014**). The 17 included studies were classified into three broad categories: (1) group interventions; (2) one-to-one mentoring interventions; (3) interventions using new technologies. Only one study found a significant reduction in loneliness, based on a Mindfulness Based Stress Reduction (MBSR) programme in a small cohort. Three studies examined supported-living group interventions including gender-segregated social activity groups, a cognitive enhancement programme and group-based Nintendo-Wii activities. Although there was no significant impact on loneliness, other beneficial impacts included increased life satisfaction, better social identification, and reductions in depression and anxiety. Of the six studies that investigated new technologies, three found a significant reduction in loneliness
- another SR reviewed health promotion interventions to prevent social isolation and loneliness (**Cattan 2005**). Thirty studies were included, with 16 RCTs, but only ten were rated 'effective'. Six of the eight rated ineffective were delivered on a one-to-one basis. The authors concluded there is strong, consistent evidence that educational and social group activity interventions can alleviate social isolation and loneliness among older adults. The most effective of these targeted specific groups (e.g. caregivers, the widowed, the physically inactive)
- one SR and meta-analysis focused on computer and internet training interventions to reduce loneliness and depression (**Choi 2012**). Six intervention studies supplied moderate evidence that computer and internet training help reduce loneliness
- **Dickens 2011** reviewed interventions designed to alleviate social isolation and loneliness generally. Of the 32 included studies, 16 were classified RCTs, another 16 quasi-experimental studies. Interventions were categorised as offering activities (social or physical programmes), support (discussion, counselling, therapy or education), internet training, home visiting or service provision. 79% of group-based interventions and 55% of one-to-one interventions

reported at least one improved participant outcome. Over 80% of participatory interventions produced beneficial effects compared with just 44% non-participatory. The review concluded that the most effective interventions included a theoretical basis, and offered social activity/support within a group format. Interventions in which older adults are active participants appeared most effective

- an earlier review of interventions to reduce social isolation amongst older adults was also relevant (**Findlay 2003**). Seventeen intervention studies were included, including six RCTs, with some effectiveness in one-to-one interventions to reduce the rates of suicide and group interventions using teleconferencing to bring people together. A further study evaluating service provision discovered decreased rates of social isolation and loneliness in a retirement village.
- **Bickerdike 2014** found limited evidence of benefit of telephone support programmes. However, a qualitative evaluation (**Cattan 2011**) found a range of strongly beneficial effects

Barriers and facilitators to social participation in older adults

Evidence pertaining to barriers and facilitators to social participation in older adults comes from one SR, and three primary studies (see Table 45).

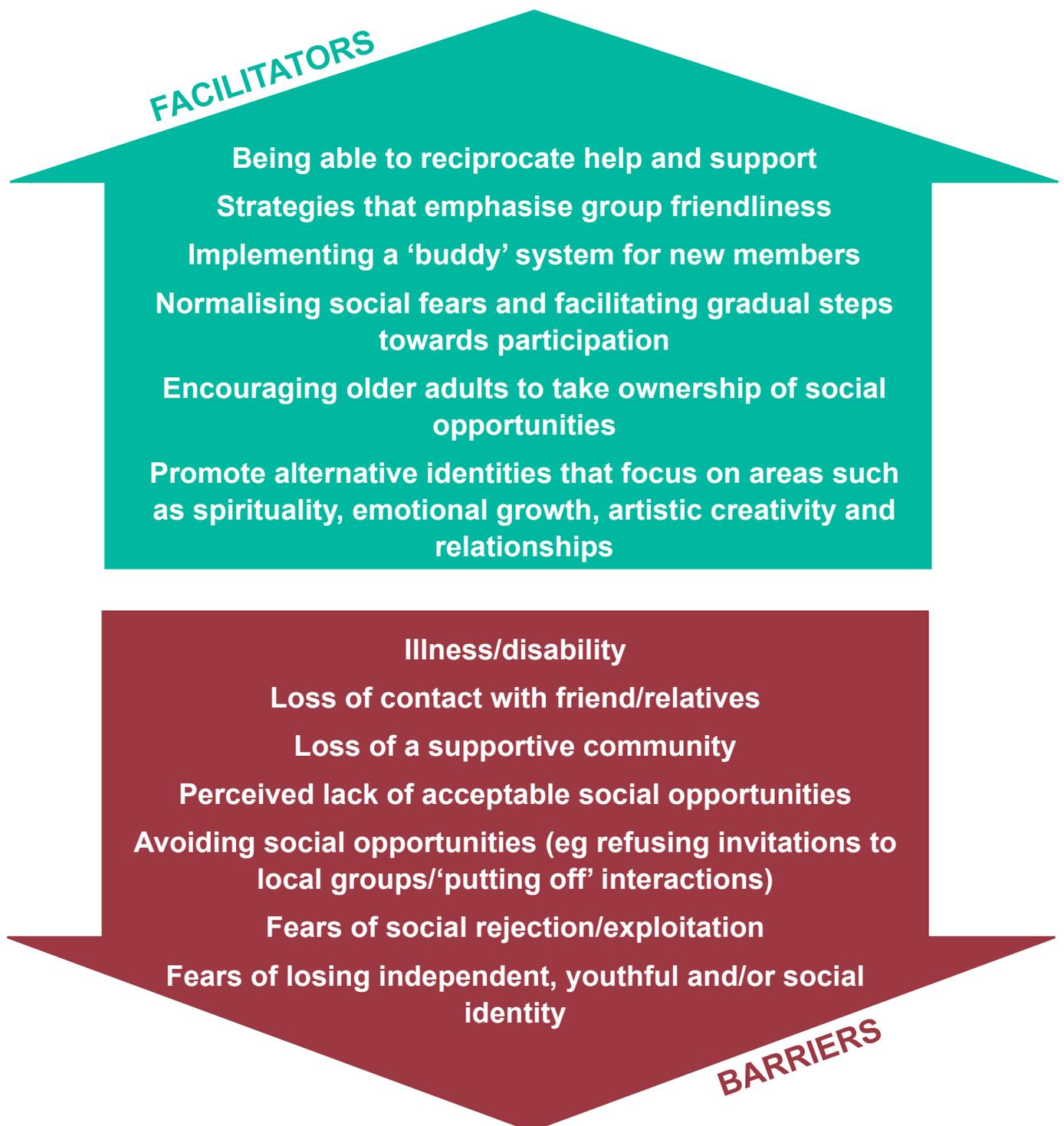
The SR focused on social networking sites and included 18 primary studies (**Nef 2013**). Five reported the results of field tests of social networking sites; 13 articles assessed attitudes of older adults towards social networking sites. The main finding was that older adults sometimes did not understand the purpose of social networking sites. They also had concerns about privacy, protection of personal information and inappropriate content.

Two primary qualitative studies reported qualitative data relating to social behaviour: one was conducted in older adults specifically (**Goll 2015**) and one examined the role of hairdressers in providing social support (**Anderson 2009**). The last study reporting relevant information was a qualitative evaluation of a UK national telephone befriending service (**Cattan 2011**).

Goll 2015's findings are summarised opposite, while further details are provided in table 45.

Barriers and facilitators to social participation

(Goll 2015)



Leisure

What counts as moderate physical activity

Any physical activity is better than none. It is never too late to get more active to improve health. Activities could include:

walking



gardening



hiking



dancing



cycling



active recreation



swimming



Key Findings

A lack of regular physical activity along with a sedentary lifestyle, social isolation, and lack of mental stimulation increases the risk of dementia. Encouraging, enabling and supporting everyone to engage in leisure activities is a concrete step towards reducing that risk.

For older adults:

1. Most of the interventions which have been studied had positive effects on at least one cognitive outcome compared to controls receiving no intervention (volunteering in schools, productive or receptive engagement, cognitively stimulating leisure activities (reading, playing games or music), learning to play the piano, daily completion of a crossword)
2. There is a small amount of preliminary evidence that meditation may have some beneficial effects for age-related cognitive decline, however, this is based on studies with small sample sizes and high risk of bias
3. Little evidence was available to determine the effect of gardening on cognitive function
4. No studies reported on the effect of leisure activities on longer term dementia outcomes



These findings should be interpreted with caution.

Limitations of included studies include small sample sizes and issues with how trials are designed.

Description of studies

There is some overlap between studies that relate to social activities, leisure activities or multicomponent interventions. This section focuses on studies not included in the social section. Studies that involve a leisure activity component with other activities are in the multi-component section.

- two SRs and a further six primary intervention studies reported on the effect of leisure interventions on cognitive outcomes
- two primary intervention studies broadly aimed to promote participation in leisure activities

Leisure interventions with cognitive outcomes

Of the two SRs found, one included the evidence for the effect of meditation interventions on age-related cognitive decline (**Gard 2014**). Twelve studies were included, of which six were RCTs that included different types of meditation that ranged from transcendental meditation to yogic meditation and mindfulness techniques. Most studies reported benefits of at least one measure of cognitive function, but most also had small sample sizes and a high risk of bias.

The other systematic review examined the evidence for the benefits of gardening (**Wang 2013**). Most of its 22 included studies were cross-sectional and there was little data on cognitive outcomes. So overall, little evidence was found for the effect of gardening on cognitive function.

Of the six primary intervention studies included, all used an RCT design. Five studies were in cognitively healthy community-dwelling adults. One study included only people with MCI who lived in the community (**Hughes 2014**). All were conducted in predominantly female populations. All interventions were conducted in community settings. Interventions included: volunteering in schools (**Carlson 2008**); productive or receptive engagement (**Park 2014**); cognitively stimulating leisure activities (reading, playing games or playing music) (**Tesky 2011**); learning to play piano (**Bugos 2007**); daily completion of a crossword (**Murphy 2014**); Wii gaming (**Hughes 2014**).

Most of the interventions which have been studied had positive effects on at least one cognitive outcome compared to controls receiving no intervention (volunteering in schools, productive or receptive engagement, cognitively stimulating leisure activities (reading, playing games or music), learning to play the piano, daily completion of a crossword).

No studies reported on the effect of leisure activities on long-term dementia outcomes.

Small sample sizes and a high risk of bias make robust conclusions difficult.

Tickbox Summary

Leisure interventions with cognitive outcomes

				
Intervention	What works	What might work	What doesn't work	Study
Learning to play piano		?		Bugos 2007
Volunteering in schools, helping children to read etc.		?		Carlson 2008
Volunteering in schools (as Carlson)		?		Fried 2004
Occupational engagement with physical/social activities, healthy eating		?		Zingmark 2014
Life of Wellness Program with occupational therapists		?		Matuska 2003
Daily completion of a crossword		?		Murphy 2014
Productive engagement and receptive engagement		?		Park 2014
Cognitively stimulating activities: reading, playing games or music		?		Tesky 2011
Interactive gaming via Nintendo Wii Sports			X	Hughes 2014

Interventions to improve uptake/maintenance of leisure activities

Of the two primary studies that broadly aimed to promote participation in leisure activities, one study was a pilot RCT (**Zingmark 2014**), the second a before-and-after study (**Matsuka 2003**). Both studies were conducted in cognitively healthy older adults. Both studies focused on interventions to increase occupational engagement and were delivered by occupational therapists. Both studies reported some small positive effects in social outcomes, but the statistical significance was unclear in **Zingmark 2014**.



Much of the outcome data was self-reported.

It is difficult to draw robust conclusions based on the small numbers and quality of the studies.

Barriers and facilitators

No studies were identified.

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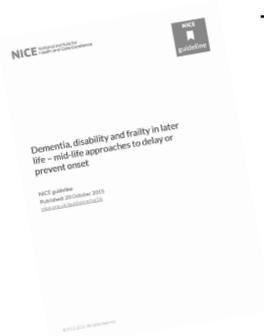
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Related guidance

In October 2015 the authors of this study were behind the National Institute for Health and Care Excellence (NICE) guidance: **Dementia, disability and frailty in later life – mid-life approaches to delay or prevent onset**



This was a suite of three systematic reviews that examined the risk factors for dementia, disability and frailty during mid-life (defined as adults aged 40–64, or those aged 39 years or under in disadvantaged populations). The aim was to delay the onset of these conditions and increase the amount of time that people can be independent, healthy and active in later life by helping people stop smoking, be more active, reduce alcohol consumption, improve their diet and, if necessary, maintain a healthy weight.

Download the mid-life guidance at: <https://www.nice.org.uk/guidance/ng16>

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