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Promoting health, preventing disease: is there an economic case?

Report

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POLICY SUMMARY 6

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Sherry Merkur, Franco Sassi,
David McDaid

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This policy summary is one of a new series to meet the needs of policy-makers and health system managers.

The aim is to develop key messages to support evidence-informed policy-making and the editors will continue to strengthen the series by working with authors to improve the consideration given to policy options and implementation.

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Executive summary

A core question for policy-makers will be the extent to which investments in preventive actions that address some of the social determinants of health represent an efficient option to help promote and protect population health. Can they reduce the level of ill health in the population? How strong is the evidence base on their effectiveness and, from an economic perspective, how do they stack up against investment in the treatment of health problems? Are there potential gains to be made by reducing or delaying the need for the consumption of future health care resources? Will they limit some of the wider costs of poor health to society, such as absenteeism from work, poorer levels of educational attainment, higher rates of violence and crime and early retirement from the labour force due to sickness and disability?

This policy summary provides an overview of what is known about the economic case for investing in a number of different areas of health promotion and non-communicable disease prevention. It focuses predominantly on addressing some of the risk factors for health: tobacco and alcohol consumption, impacts of dietary behaviour and patterns of physical activity, exposure to environmental harm, risks to mental health and well-being, as well as risks of injury on our roads.

It highlights that there is an evidence base from controlled trials and well-designed observational studies on the effectiveness of a wide range of health promotion and disease prevention interventions that address risk factors to health. Moreover, the cost-effectiveness of a number of health promotion and disease prevention interventions has been shown in multiple studies. Some of these interventions will be cost-saving, but most will generate additional health (and other) benefits for additional costs.

In many cases combinations of actions, for example in the areas of tobacco, alcohol and road injury prevention, are often more cost-effective than relying on one action alone. In terms of individual actions the use of taxes to influence individual choices on the use of tobacco and alcohol, as well as the consumption of food, is consistently seen as a cost-effective intervention to promote better lifestyle choices. Media-based campaigns, in contrast, are not always effective or cost-effective. Interventions targeted at children often have the most potential to be cost-effective because of the longer time-frame over which health benefits can be realized.

While some interventions may take several decades to be seen to be cost-effective, for example impacts on the risk of obesity, there are some health promotion and disease prevention actions that are cost-effective in the short term, for instance related to the protection of mental health in the workplace. There are opportunities to invest in cost-effective health promoting

interventions that can be delivered universally as well as to target population groups, for instance in schools or workplaces.

However, this evidence base must be treated with caution, given that many interventions have only been assessed in a small number of settings, and different economic methods and assumptions are made in different studies. Most of the economic evidence identified has been undertaken in high-income countries, with very few studies applied to other settings in the WHO European Region.

Moreover, much of the evidence on the long-term costs and benefits of interventions has been estimated using simulation modelling approaches synthesizing data on effectiveness, epidemiology and costs. This reflects the lack of long-term observed effectiveness data for many public health and health promoting interventions. It also means that policy-makers need to be cautious on assumptions made about the persistence of effect of health promoting interventions, for example the likelihood of long-term behaviour change.

The issue of equity is also a particularly important consideration. If the uptake of a public health intervention is higher in more affluent groups in society then one unintended consequence of investment in a public health programme could be to inadvertently widen health inequalities. We have little data from our review on the impact of interventions on health inequalities. Finally there are also challenges to be met to in order to help encourage the implementation of cost-effective health promotion and disease prevention actions.

Notwithstanding these caveats, it is clear that there is an economics evidence base for health promotion and disease prevention. The challenge now is to strengthen this evidence base further and look at ways in which it may be used to translate evidence-based knowledge into routine everyday practice across all of the WHO European Region. For instance, given that these actions are often delivered outside of the health system it is helpful to speak the same language and highlight the economic benefits of most interest to the sectors that are responsible for funding each action.

Key messages

There is an evidence base from controlled trials and well-designed observational studies on the effectiveness of a wide range of health promotion and disease prevention interventions that address risk factors to health. These include measures to reduce the risk of smoking and alcohol consumption, increase physical activity and promote more healthy diets, protect psychological and emotional well-being, reduce environmental harms and make road environments safer.

Many of these actions may be both funded and delivered outside of the health sector.

There is also an evidence base suggesting that a number of cost-effective health promotion and disease prevention interventions are available. Some of these interventions will be cost-saving, but most will generate additional health (and other) benefits for additional costs. However this evidence base must be treated with caution, given that many interventions have only been assessed in a small number of settings and different methods and assumptions are made in different studies.

Combinations of actions, for example in the areas of tobacco, alcohol and road injury prevention, are often more cost-effective than relying on one action alone.

The use of taxes to influence individual choices on the use of tobacco and alcohol, as well as the consumption of food, is consistently seen as a cost effective intervention to promote better lifestyle choices.

Much of the evidence on the long-term costs and benefits of interventions has been estimated using simulation modelling approaches synthesizing data on effectiveness, epidemiology and costs. This reflects the lack of long-term observed effectiveness data for many public health and health promoting interventions. It also means that policy-makers need to be cautious on assumptions made about the persistence of effect of health promoting interventions, e.g. the likelihood of long-term behaviour change.

Interventions targeted at children often have the most potential to be cost-effective because of the longer time-frame over which health benefits can be realized.

While some interventions may take several decades to be seen to be cost-effective, for example impacts on the risk of obesity, there are some health promotion and disease prevention actions that are cost effective in the short term.

There are opportunities to invest in cost-effective health promoting interventions that can be delivered universally as well as to target population groups, for instance in schools or workplaces.

Most of the economic evidence identified is from research undertaken in high-income countries, with very few studies applied to other settings in the WHO European Region.

In order to help encourage the implementation of cost-effective health promotion and disease prevention actions it is helpful to highlight economic benefits of most interest to the sectors that are responsible for funding these actions.

1 Introduction

European health systems face considerable challenges in promoting and protecting health at a time when the pressure on budgets and resources is considerable in many countries. New estimates of the global burden of disease for non-communicable diseases, including heart disease and stroke, diabetes, cancer, chronic lung diseases, low back pain and poor mental health, indicate that in western, central and eastern Europe they account for 85%, 80% and 75% respectively of the global burden of disease. Similarly injuries, particularly on the roads or as a result of self-harm, account for a further 10%, 11% or 18% of total disease burden (Institute of Health Metrics, 2013).

The importance of these challenges is recognized in the new health policy framework and strategy of the WHO European Region, Health 2020 (WHO, 2013). This is focused on improving the health and well-being of populations, reducing health inequalities, strengthening public health and ensuring the sustainability of health systems. Importantly, it takes a whole-of-government and whole-of-society perspective, emphasizing the importance of actions which go well beyond the traditional boundaries of the health sector and ministries of health.

A core question for policy-makers will be the extent to which investments in health promotion and preventive actions addressing some of the social determinants of health can pay off. Can they reduce the level of ill health in the population? How strong is the evidence base on their effectiveness and, from an economic perspective, how do they stack up against investment in the treatment of health problems? For example, are there potential gains to be made by reducing or delaying the need for the consumption of future health care resources? Will investments in health promotion and preventive actions limit some of the wider costs of poor health to society, such as absenteeism from work, poorer levels of educational attainment, higher rates of violence and crime and early retirement from the labour force due to sickness and disability?

Growth in the evidence base

The last 20 years have certainly seen a dramatic growth in both the volume and quality of evidence on the effectiveness and cost-effectiveness of *health care* interventions. Many countries formally make use of such evidence when considering whether to reimburse new health care interventions and procedures. Less attention has focused on the strength of the evidence for some health promotion and disease prevention strategies, despite their integral contribution to health policy. Poor health behaviours can have many adverse external impacts, for instance the risk of violence to other family members

because of alcohol abuse or the dangers of passive smoking in workplaces. Some of these poor behaviours may be due to addiction, a lack of information on risk or a misplaced belief that these negative consequences of poor health can definitely be avoided. They may also reflect social injustice, emphasizing the importance of addressing socioeconomic and cultural factors that can lead to inequalities in health status.

This policy summary provides an overview of what is known about the economic case for investing in a number of different areas of health promotion and non-communicable disease prevention focused predominantly on addressing some of the risk factors for health: tobacco and alcohol consumption, impacts of dietary behaviour and patterns of physical activity, exposure to environmental harm, risks to mental health and well-being, as well as risks of injury on our roads. The subsequent sections of this summary summarize some of the findings from a new synthesis on the state of the art in the economics of health promotion and disease prevention (McDaid, Sassi & Merkur, forthcoming). All costs are reported in 2012 international dollars.

In addition, the summary seeks to place this evidence in context, including considering the consequences of inequalities in health. It considers some of the challenges in translating this evidence base into implemented actions that often may be funded and delivered by non-health sector budget holders.

2 Tobacco smoking

Smoking brings enormous physical harm to its users. There is a huge body of knowledge documenting its manifold risks, its high public costs and the effective means to control its use. It is the cause of 1 250 000 Europeans' deaths each year, causing 21% of all deaths, including 330 000 in the Russian Federation and around 100 000 in each of the United Kingdom, Germany, Ukraine and Italy. The WHO European Region's smoking rates are among the highest in the world with 40% of men smoking, 18% of women and 24% of young people aged 15 years (WHO, 2011d).

Evidence-based tobacco control policies are shown to be highly cost-effective and many are cost-saving (Table 1) (Townsend, forthcoming). Price is a major factor determining use and the prices of the "cheapest cigarettes" vary twentyfold between countries, while prices of the "most sold cigarettes" vary ninefold. Each 10% difference in price is associated with a 2.5–5% difference in cigarette consumption in the opposite direction, and price differences account for much of the threefold difference in smoking rates between European countries, which are highest in countries where prices are lowest, among lower socioeconomic groups, the unemployed and lone parents. They are a major cause of inequalities in health and mortality.

Raising cigarette prices across Europe even to the average European Union (EU) price of \$5.50 would save hundreds of thousands of lives per year including 100 000 in the Russian Federation (Townsend, forthcoming). Public health advocates continue to appeal for higher tobacco taxes on the basis of social costs, and few individuals would deny the justification of a tax increase based on the health benefits.

The most cost-effective tobacco control policy is *raising taxes*. A 10% price increase could result in 0.6 to 1.8 million fewer premature deaths in eastern European and central Asian countries, at a cost of only \$5 to \$125 per disability-adjusted life-year (DALY) in the short run (Ranson et al., 2002; Lai et al., 2007; Chisholm et al., 2006; Ortegón et al., 2012; Vos et al., 2010). Several studies have estimated that the reduction in demand would be twice as much in the long run as in the short run, given a continuous increase in real price to keep pace with inflation. Research from many countries reports on increases in government tax revenue following from tobacco tax rate increases, and also falls following reductions in the real tax rate.

A comparative cost-effective modelling study estimated the incremental cost per quality-adjusted life-year (QALY) of various *cessation interventions* over and above the non-intervention control rate of quitting. Brief opportunistic advice from a general practitioner (GP) with telephone or self-help material (A) was the most cost-effective, next was opportunistic advice alone from a GP or hospital nurse (B), and lastly opportunistic advice plus nicotine replacement therapy (NRT) (C) was still cost-effective but at four times the cost of B and eight times the cost of A (Parrott, Godfrey & Kind, 2006). The more effective methods, being expensive, are not the more cost-effective and there is debate as to whether NRT works at a population level. Other modelling studies also point to the cost-effectiveness of smoking cessation measures (Vos et al., 2010; Ranson et al., 2002; Chisholm et al., 2006).

A particularly important area for cessation relates to *pregnant women*. A United Kingdom study estimated that spending \$24–\$64 per pregnant smoker on low-cost smoking cessation interventions would be cost-saving (Public Health Research Consortium, 2010). Evidence from a number of studies in high-, middle- and low-income countries indicates that these are cost-effective (Hurley & Matthews, 2008; Ratcliffe, Cairns & Platt, 1997; Secker-Walker et al., 1997; Ha & Chisholm, 2011; Chisholm et al., 2006).

Population-based approaches to smoking cessation using *mass media campaigns* are important because they raise awareness and change attitudes about the risks of using tobacco and the benefits of quitting; however, these tend to be neglected so important tobacco control opportunities have been missed (Lawrence, Mitrou & Zubrick, 2011; Flay, 1987; WHO, 2003). Widespread media reporting of research findings showing the harmful

effects of tobacco have been particularly effective where knowledge of the health consequences of tobacco use is low, as is often the case in emerging economies (Jha & Chaloupka, 1999).

Advertising bans were the earliest responses to the need for tobacco control. The effects are not easy to measure due to the time required to achieve the full effect, which may then last for many years. The tobacco advertising ban was estimated to have reduced consumption in New Zealand by 5.5% (Department of Health, 1989), in Canada by 4%, (Department of Health, 1992), in Finland by 7% (Pekurinen, 1989), and in Norway by 16% (Laugesen & Meads, 1991). An OECD study of 22 countries reported a significant effect of different levels of advertising restriction, scored from 1 to 10, with each point associated with a 1.5% decrease in consumption (Laugesen & Meads, 1991). On average, it is estimated that advertising bans reduce smoking by some 7%, but partial bans have little or no effect on smoking as the tobacco industry simply re-channels its marketing to other media (Saffer & Chaloupka, 1999).

Other actions to improve consumer information, including labelling, smoking restrictions in public places and advertising bans, often generate savings in health care expenditures which offset any implementation costs. Even when this is not the case, the cost-effectiveness of these interventions is among the best in the entire health sector (less than \$1115 per DALY saved or QALY gained), with the potential to avoid a major proportion of the health and economic burden of smoking (Chisholm et al., 2006).

Warning labels on cigarette packs are recommended by the Framework Convention on Tobacco Control, are a requirement for EU countries, and are among the most direct and prominent means of communicating with smokers (Hammond, 2011). To increase the potential for effectiveness, warning labels should be prominent, placed on the largest surfaces of the packages, and be very distinct graphically from the rest of the package design (Strahan et al., 2002). Australia requires by law plain packaging of cigarettes, and India, New Zealand and the United Kingdom have all considered bills for plain packaging.

Preventing smoking in public places has been shown to reduce smoking prevalence and increase cessation. In a recent review of 37 studies of smoke-free policies in worksites or communities (1976–2005), 21 reported reduced prevalence of 3.4% and a further 11 studies reported increased cessation of 6.4%; 4 of the studies demonstrated economic benefits (Hopkins et al., 2010). A time series analysis of 21 countries or states which had implemented comprehensive smoke-free legislation reported that the legislation had increased the rate at which prevalence was declining in some locations, but in the majority had no measurable impact on existing trends (Bajoga et al., 2011). Some countries have reported reductions in heart disease deaths following smoke-free legislation and it is generally considered to be highly successful.

Such interventions have also been shown to be cost-effective (Chisholm et al., 2006). The most effective means of reducing *youth smoking* is to reduce adult smoking, via the mechanism of price increases, smoke-free policies, and of good, well-directed multimedia programmes.

A number of economic studies indicate that *combining many of these interventions* leads to greater health benefits while still being cost-effective (Chisholm et al., 2006; Lai et al., 2007; Ortegon et al., 2012). Adequate implementation and monitoring, government policies formulated without influence from the tobacco industry, and action against corruption are needed to support policies.

3 Physical inactivity

Physical activity is a leading factor in good health. However, more than one in three people living in the WHO European Region are not active enough (WHO, 2011a). This makes physical inactivity a leading risk factor both in terms of mortality and morbidity, imposing a financial burden that ranges between \$150 and \$300 per individual per year (Cavill, Kahlmeier & Racioppi, 2006).

There is a strong economic case for investing in efforts to tackle physical inactivity (Cecchini & Bull, forthcoming), as shown in Table 2. Policies and programmes towards this end are varied, generally aimed at reducing the risk of chronic conditions and with a strong focus on counteracting obesity. In this section, we take stock of policies already in place and examine the available evidence on the effectiveness and cost-effectiveness of the most promising prevention interventions.

Mass media campaigns have been shown to have a positive, moderate effect on the increase of physical activity in targeted populations (Leavy et al., 2011; Cavill & Bauman, 2004; Kahn et al., 2002). Moreover, when used to increase physical activity, mass media campaigns are among the best buys to tackle non-communicable diseases with a good cost-effectiveness ratio and could even be cost-saving in a few cases (WHO, 2011c; Lewis et al., 2010; Sassi et al., 2009; Cobiac et al., 2009; Vos et al., 2010; Cecchini et al., 2010).

School-based interventions aim at increasing the amount of physical activity of children attending school, mainly by providing additional information on the benefits of increased physical fitness and by providing increased opportunities and time to undertake physical activity. A growing literature is focused on encouraging walking and cycling to school (Lee, Orenstein & Richardson, 2008; NICE, 2008c), though cycling interventions do not appear to be as effective as walking interventions in increasing students' physical activity levels. School-based interventions exclusively aimed at increasing physical activity have a lower cost-effectiveness ratio compared to mass media campaigns and primary-care

interventions (WHO, 2011c). However, some school-based interventions may be cost-effective (Lewis et al., 2010; Sassi et al., 2009; Wang et al., 2003); in particular, interventions that combine actions on physical activity and diet seem to be more efficient than interventions on a single domain.

Primary-care interventions show positive and moderate effectiveness on reported levels of physical activity (Breckon, Johnston & Hutchison, 2008; Fleming & Godwin, 2008; Williams et al., 2007). In some cases, this is correlated to an improvement of physiological parameters, such as blood pressure or lipid profile. Compared to other approaches, primary-care interventions have a good cost-effectiveness ratio, despite the higher costs of some approaches (Garrett et al., 2011; Lewis et al., 2010; Sassi et al., 2009; WHO, 2011c). In an assessment of four interventions, two of which were in primary care (exercise referral and brief interventions), the National Institute of Health and Care Excellence (NICE) concluded that only the "brief intervention" approach should be recommended (NICE, 2008c).

Typical *worksite programmes* employ a range of strategies rather than a single action, and are usually offered to all employees. Examples of approaches include supporting active travel (e.g. walking and cycling to/from work) through provision of adequate facilities (e.g. bike storage, showers), incentives and discounts for fitness clubs, health education programmes and individual employee health checks (Bull, Adams & Hooper, 2008). But, compared to other approaches, worksite interventions offer smaller population coverage (Sassi et al., 2009; Cecchini et al., 2010). Recent reviews have reported positive effects on physical activity behaviour, fitness, anthropometric measures and lipids (Proper et al., 2003; Abraham & Graham-Rowe, 2009; Conn et al., 2009; Dugdill et al., 2008). On job-related outcomes, such as reduction of absenteeism and stress, the effect sizes were positive but not always significant. WHO grades worksite interventions as being quite cost-effective (i.e. less than three times gross domestic product [GDP]/capita per DALY prevented), mainly because of higher implementation costs (WHO, 2011c). A better cost-effectiveness ratio may be achieved once other factors (e.g. decreased absenteeism) are taken into consideration (NICE, 2008b; Bending, Beale & Hutton, 2008; Lewis et al., 2010).

The promotion of walking through *travel/transport-related interventions* may be effective in achieving a positive increase in walking trips (Ogilvie et al., 2007). The evidence on efforts to encourage cycling, which often includes health education combined with modifications to infrastructure and/or travel conditions (e.g. bike lanes, off-street paths and traffic-calming actions) is equivocal. There is good evidence, however, that a comprehensive set of infrastructures can lead to increases in cycling; for instance, a 3% increase in the proportion of bicycle trips was found in a Dutch example when cycle

route networks were extended. Several cost–benefit analyses in high-income countries suggest positive returns from investment in cycle trails (Sassi et al., 2009). An economic assessment (Beale, Bending & Trueman, 2007) carried out for the National Institute for Health and Clinical Excellence (NICE) guidelines on creating an environment that supports physical activity (NICE, 2008a) suggests that travel/transport-related interventions could be cost-effective under a number of assumptions. Two health economic assessment tools (HEAT) that assist in the assessment are HEAT walking and HEAT cycling. Application of these tools and further research is needed to develop the knowledge base in this field (WHO, 2011b).

Community-based interventions encompass a diverse range of interventions accessible to the whole community. Pedometer-based programmes have become popular in recent years due to the low cost of the devices and the advantage of an objective measure of activity levels, and have been shown to be effective in children and adults in the short term (Lubans, Morgan & Tudor-Locke, 2009; Bravata et al., 2007). Providing step-based goals (e.g. 10 000 steps per day) rather than time-based goals (e.g. walk for 30 minutes) has been shown to be more effective, and effectiveness is increased when efforts are combined with behaviour change support and goal setting (Williams et al., 2008a; Ogilvie et al., 2007). Pedometers have been modelled to be cost-effective in an Australian context (Vos et al., 2010). Also, walking groups and remote mediated interventions, such as telephone or web-based support and print materials, have also been found to be potentially effective. Though no comprehensive assessment of the cost–effectiveness of community-based interventions has been carried out (WHO, 2011c), community-based interventions would have a cost–effectiveness ratio that ranges from a few thousand dollars to about \$70 000 per DALY/QALY (Sassi et al., 2009). For children specifically, there is only mixed evidence on the cost–effectiveness of walking buses (NICE, 2009a; Moodie et al., 2009; Fordham, 2008).

It is difficult to change people’s attitudes and behaviours but collected evidence clearly demonstrates that tackling physical inactivity is an affordable and efficient means of increasing the health of a population. A number of challenges may hinder the success of translating what we know works into suitable policies and actions. Consistent monitoring systems, closer cooperation between all the relevant actors, as well as inclusion of multiple, coherent, long-lasting and large-scale strategies are identified as key factors in creating national policies.

4 Unhealthy diets

Unhealthy diets, particularly those involving an excessive consumption of salt, sugar and fat, energy-dense, nutrient-poor foods and limited intake of fruit and vegetables and whole-grains contribute to a range of chronic, non-communicable diseases. These diseases are increasingly prevalent in the European region, and impose a substantial burden on health, the economy and society as a whole. Moreover, there has been a greater than three-fold rise in overweight/obesity prevalence since the 1980s in the WHO European Region, even in countries with traditionally low rates (Branca, Nikogosian & Lobstein, 2007).

Obesity alone is estimated to account for approximately 1% to 3% of total health expenditure in most countries (Tsai, Williamson & Glick, 2011). An obese person incurs health care expenditures at least 25% higher than those of a normal weight person (Withrow & Alter, 2011). Combined, the leading behavioural and metabolic risk factors associated with nutrition (high blood pressure, high blood glucose, overweight and obesity, high cholesterol, low fruit and vegetable intake) plus physical inactivity are estimated to be responsible for almost 80 DALYs per 1000 population over age 30 in the WHO European Region, which is more than any other world region (WHO, 2009).

Table 3 highlights the economic case for population-based policies to change food environments, targeting information and aspects of the marketplace, as a means of preventing and controlling diet-related chronic non-communicable diseases (Hawkes & Sassi, forthcoming). Some policies may be best targeted at whole food groups, with others taking a nutrient-based approach. The effectiveness of policies may vary across population groups, and different policy actions can be combined.

Starting with the *food information environment*, the evidence from economic studies of *information campaigns* is rather mixed. Some studies conclude that information campaigns can be cost-effective but this is based on the low cost of these actions, with actual effectiveness being limited largely to impacts on knowledge and specific populations. For example, the effects of a mass media campaign aimed at increasing fruit and vegetable intake, as well as physical activity, were assessed in a multi-country study based on a microsimulation approach (Sassi, 2010; Sassi et al., 2009). The study found that the campaign would have a favourable cost-effectiveness ratio starting from about ten years from its initial implementation, but its health effects would be smaller than those of any of the other strategies examined. Worksite information campaigns often accompanied by changes in catering are not effective (Cobiac, Vos & Veerman, 2010b; Engbers et al., 2006). In developing country settings, model-based studies found that mass media campaigns for salt, saturated fat and

cholesterol reduction had a more favourable cost-effectiveness profile (Ha & Chisholm, 2011; Willett et al., 2006).

Nutrient lists and labels on food packages and menus as well as rules on nutrient and health claims fall under the category of labelling. In Europe, nutrient labelling will become mandatory in December 2016 (European Commission, 2011). The existing studies show there is convincing evidence that consumers use nutrient lists, but lower socioeconomic status (SES) groups lag behind in label use. *Food labelling schemes* were found to perform better than information campaigns in terms of cost-effectiveness, especially when implemented on a mandatory basis, but the studies available to support this claim are few and vary in the types of schemes assessed and methods applied. One multi-country modelling study found that mandatory labelling would have a favourable cost-effectiveness ratio in the EUR-A sub-section of the WHO European Region, as well in a number of non-European countries at different levels of income (Sassi et al., 2009). Although cost-effective, nutrient lists were estimated to have smaller health effects than fiscal measures. Evidence from Australia on interpretative labels is consistent with these findings. Traffic light labelling was shown to be cost-effective (Sacks et al., 2011) and using a mandatory “tick” symbol to indicate products low in salt, with the expected effect of food companies significantly reducing salt content, was shown to be effective and cost-saving (Cobiac, Vos & Veerman, 2010a).

Restrictions in the commercial promotion of food, was shown to be cost-effective in a small number of model-based economic studies focusing on *restricting food advertising to children*. One of these studies compared the cost-effectiveness of restricting commercial promotion through mandatory and self-regulatory approaches in five countries (Sassi, 2010; Sassi et al., 2009; Cecchini et al., 2010). Restrictions were highly cost-effective in the 20 years after implementation, especially in low- and middle-income countries, where they may even be cost-saving in some instances. Self-regulation (assuming half the effectiveness, compared with statutory regulation, at the individual level) had significantly lower costs but also limited effectiveness. Also, the extension of existing regulations in Australia to include food advertising during specified children’s TV viewing hours was highly cost-effective (Magnus et al., 2009).

The economic evidence available on policies aimed at affecting the *marketing environment for food choices* appears more solid and broadly based. Policies aimed at *making fruit and vegetables more available in schools* were found to have positive, albeit modest, effects on dietary intake. Evidence from the Netherlands found these initiatives to be cost-effective, although the finding was sensitive to assumptions regarding the sustainability of dietary changes in the long term (te Velde et al., 2011). When comparing two school-based interventions, the dominant intervention entailed multiple components,

including provision of free fruit and vegetables twice weekly, delivery of health education as part of the school curriculum, with feedback and parental involvement, and assumed 30% of the effect to be permanent. In the less effective intervention, the latter components were absent and schools were encouraged, but not mandated, to provide health education.

Policies aimed at altering the prices of less healthy foods through the use of taxes were more thoroughly investigated by means of economic models. Existing studies show that *taxes on foods high in salt, sugar and fat*, and on “junk food” are consistently cost-saving, that is, they cost less to implement than they save in terms of reduced health care expenditures, and they have a favourable health impact at the population level (Smith-Spangler et al., 2010; Sacks et al., 2011). Food taxes are likely to be regressive, although the less well off also benefit disproportionately from their effects, and need to be designed carefully in order to avoid undesirable substitution effects in food consumption, and minimise administrative and compliance costs. Both the effectiveness and the distributional impact of taxes may be improved by coupling them with subsidies targeting healthy foods or disadvantaged consumers (Sassi, 2010; Sassi et al., 2009; Cecchini et al., 2010). In contrast, studies in France and Australia suggest that the use of discounts, reductions in VAT, or provision of food stamps for fruit and vegetables are not cost-effective (Dallongeville et al., 2011; Cobiac, Vos & Veerman, 2010b).

Product reformulation policies aimed at reducing the salt content of processed foods were found to be cost-saving or to have a favourable cost-effectiveness ratio in several economic evaluations (Wang & Labarthe, 2011; Barton et al., 2011; Eatwell, 2012). Reductions in salt from both voluntary and legislative measures were found to be cost-effective, but legislation more so (Murray et al., 2003). In Norway, the effect of industry reformulation combined with an information campaign was modelled; these actions would be cost-saving (Selmer et al., 2000). For the United Kingdom, the estimate was made (using actual data) for both voluntary salt reduction by industry and an information campaign. On the basis that the salt reduction initiative saved 44 000 QALYs, it was found to be cost-effective and when savings to the National Health Service are included (\$116 million), it was found to be dominant (Eatwell, 2012). In Argentina, reducing salt in bread was found to be cost-saving, and more cost-effective than any of the other interventions analysed (Rubinstein et al., 2010). A study focused on developing countries found a legislated reduction in salt content of manufactured foods and an accompanying public education campaign would be cost-effective (Willett et al., 2006). The economic evidence on other instances of reformulation (e.g. to reduce transfat content) is very limited.

No cost–effectiveness studies were found to include interventions to change the “architecture” of food choices, and which impose restrictions on the availability of snacks and drinks in schools (Gittelsohn, Rowan & Gadhoke, 2012; Chriqui, 2012; Jaime & Lock, 2009). Many also lack substantial effectiveness evidence. Particularly critical gaps in the effectiveness evidence are those regarding agricultural and food-chain incentives, and more generally the effects of supply-side changes triggered by government policies, such as regulation of labelling and health claims. A further important gap is that concerning the broader effects of interventions on people’s and populations’ overall dietary behaviours. Even where evidence is available, this is often unsatisfactory owing to its limited generalizability, its reliance on relatively weak investigation approaches and/or its use of outcome measures only loosely linked with changes in dietary behaviours and health.

Thus, the evidence reviewed here provides initial support for a set of policy actions aimed at improving the quality of people’s diets, and a useful starting point for setting a detailed research agenda, which will enable policy-makers to consider a broader range of actions in the future, with a better knowledge than we have at present of the full range of consequences those actions may produce.

5 Alcohol

Economic efficiency can be improved in the alcohol market when market failures are addressed, negative externalities due to alcohol are reduced and a socially optimum level of alcohol is consumed. Market failures include the involvement of children and adolescents as consumers, a built-in neurobiological reaction of the brain which overestimates advantages of consuming alcohol, irrespective of harm, and a failure of price to reflect alcohol’s negative impact on health (Anderson & Baumberg, 2006).

Negative externalities include the health and social costs of alcohol. Alcohol, and more so sustained heavy drinking, impairs personal security, health, educational attainment and productive employment. For example, among those aged 15–64 years living in the EU in 2004, 138 000 died of an alcohol-related cause, of which 7700 (5.6%) were deaths in people other than the drinker (Rehm et al., 2012). Alcohol costs societies some 2–3% of GDP, mostly from lost productivity (Rehm et al., 2009a), a figure likely to double if the costs to people other than the drinker are included (Laslett et al., 2010). At any given level of alcohol consumption, poorer people can be as much as three or four times as likely to die from an alcohol-related condition as richer people (Rehm et al., 2009b).

An optimum level of societal consumption can be one where the level of harm is minimized. Taking into account that alcohol can reduce the risk of ischaemic diseases, including heart disease, it has been estimated that the optimum level of consumption in the United Kingdom for the adult population as a whole is 3 g of alcohol per day, about 50 ml of 5% beer (Nichols et al., 2012).

Collated evidence on the cost-effectiveness of alcohol policies is shown in Table 4 (Anderson, forthcoming). The three most cost-effective alcohol policies for reducing alcohol-related harm, and ones which correct alcohol's market failures, are price increases, restrictions on availability and bans on advertising (World Economic Forum & WHO, 2011). As Table 4 indicates, not all interventions are cost-effective: there is insufficient evidence on the effectiveness of school-based and mass media campaigns (Anderson, Chisholm & Fuhr, 2009).

Price increases represent the most cost-effective response throughout the world in reducing the harm done by alcohol, including heavy drinking, alcohol-related deaths, costs to health and criminal justice systems, and lost productivity (Österberg, 2012b; Lai et al., 2007; Anderson, Chisholm & Fuhr, 2009; Chisholm et al., 2004, 2006). Increasing prices through alcohol tax increases can be mitigated by illegal production, tax evasion and illegal trading in some jurisdictions. Reducing this unrecorded consumption via concerted tax enforcement strategies by law enforcement and excise officers is estimated to cost more than a tax increase but produces similar levels of effect (Anderson, Chisholm & Fuhr, 2009).

To be effective, tax increases need to accommodate changes in the affordability of alcohol compared with other goods (Rabinovich et al., 2009); targeted taxes on specific types of alcohol do not necessarily work (Anderson, Suhrcke & Brookes, 2012); tax regimes can be used in differing jurisdictions to support the maintenance of non-drinking behaviour or to favour products containing lower alcohol levels.

Setting a minimum price per gram of alcohol sold is one form of price policy that is particularly effective in reducing alcohol-related harm, and one that prevents markets being flooded with particularly cheap alcohol that fuels heavy drinking occasions and heavy drinkers (Purshouse et al., 2010; Stockwell et al., 2012).

Restricting availability of alcohol increases the time costs and inconvenience in obtaining alcohol and leads to reduced harm (Österberg, 2012a). It is also cost-effective (Anderson, 2009; Anderson, Chisholm & Fuhr, 2009; Chisholm et al., 2004, 2006). Increasing the time alcohol is on sale by as little as two hours, and increasing the number of places where alcohol can be bought in any given location are linked to increases in alcohol consumption and harms, including injury, violence, crime and medical harm. In contrast, reducing the number of

hours alcohol is on sale reduces violence and damage, assaults and murders. In many countries governments own retail outlets. These government monopolies, which limit outlet density and the hours and days alcohol is on sale, as well as removing the private profit motive for increasing sales, result in reduced alcohol consumption and alcohol-related harm (Österberg, 2012a).

Banning the advertising of alcohol, as is the case for tobacco, is estimated to be a very cost-effective measure if fully enforced (Anderson, 2009; Anderson, Chisholm & Fuhr, 2009; Chisholm et al., 2004, 2006). Econometric studies find positive relationships between expenditure on alcohol advertising and alcohol consumption (Anderson, 2009). A wealth of evidence from longitudinal observational studies shows that commercial communications, particularly through social media and electronic communication outlets, encourages young non-drinkers to start drinking and existing young drinkers to drink more (De Bruijn, 2012). Even simply watching a one-hour movie with a greater number of drinking scenes or viewing simple advertisements can double the amount drunk during the hour-long viewing period (Engels et al., 2009). In many jurisdictions, much store is put on self-regulation of the content and volume of commercial communications, and withdrawal of communications that are found to breach self-regulatory codes. However, these approaches are found not to work, with codes poorly interpreted and extensively violated (Anderson et al., 2013). Further, evidence shows that withdrawn commercial communications simply live on, accessible to all, in social media, which are, in any case, heavily financed by global alcohol producers (Anderson, Suhrcke & Brookes, 2012). Partial bans of advertising also do not work, with advertising companies simply finding creative ways to get around them (Nelson, 2010).

Brief interventions within the health system have also been shown to be cost-effective, but they are much less cost-effective than population-wide strategies (Anderson, 2009; Anderson, Chisholm & Fuhr, 2009; Chisholm et al., 2004, 2006; Vos et al., 2010). Good enforcement of *drink-driving legislation and countermeasures* such as random breath-testing campaigns have also been shown in a number of modelling studies in different country settings to be cost-effective (Anderson, 2009; Anderson, Chisholm & Fuhr, 2009; Chisholm et al., 2004, 2006, 2012; Vos et al., 2010).

A public health alcohol strategy that *combines a number of effective interventions* generates additional health benefits while still remaining cost-effective (Anderson, 2009; Anderson, Chisholm & Fuhr, 2009; Chisholm et al., 2004, 2006). Impediments to implementing effective policy include failure to regulate the alcohol industry and engage it in reducing harm in any meaningful way. The alcohol industry could remove alcohol from the market by producing and selling products with a lower alcohol concentration, incentivized by government taxes (Anderson et al., 2013).

6 Environmental hazards to children's health

Children are uniquely vulnerable to many common exposures in the environment (Trasande & Thurston, 2005; Thurlbeck, 1982). While environmental hazards can be broadly defined, exposure to mercury, lead, air pollutants and many synthetic chemicals can be modified through changes in anthropogenic activities.

The health burden of *mercury emissions* from coal burning, which remains a dominant source of electricity, has been estimated to be substantial. Children may suffer decrements in IQ ranging from 0.2 to 5.1 points, with a resultant \$11.3 billion loss in economic productivity of the United States (Trasande, Landrigan & Schechter, 2005). Abating emissions at coal-fuelled power plants by burning less/cleaner coal or by capturing mercury during combustion (with activated carbon injection filters) can reduce mercury hazards. The large uncertainty in the economic costs of mercury abatement reflects a short history and lack of experience with direct regulation. In general, establishing a tax/tradable permit system for mercury emissions from power plants would provide an economic mechanism by which to drive down the costs of abatement.

A number of actions that generate a positive return on investment can be seen in Table 5 (Trasande & Brown, forthcoming). The United States Environmental Protection Agency's (EPA) Mercury and Air Toxics Standards (which enter into force in 2016) set the first-ever limits on mercury emissions from electricity generation. The initial annualized compliance costs are estimated at \$10.4 billion in 2015, whereas the predicted health benefits are forecast to exceed \$40 billion per year, including benefits from reduced fine particulate matter pollution (EPA, 2011). Internationally, the United Nations Environment Programme (UNEP) coordinates negotiations towards a legally binding global mercury treaty due to be completed in 2013, which would include standards for abatement from coal combustion (UNEP, 2011).

Lead is similar to methylmercury in that it can impair neurological and cognitive function. Removing lead from petrol signifies one of the landmark successes in children's environmental health (Grosse et al., 2002; Nichols, 1997); however, currently lead paint in homes is the major source of childhood lead exposure globally, including in high-income countries. In the European region, estimates from various sources show that 17% of children under 15 in low- and middle-income countries had blood lead levels (BLLs) above 5 µg/dL, with cognitive impairment documented at BLLs between 2 and 10 µg/dL (Bellinger, 2008; Binns, Campbell & Brown, 2007). In terms of mortality and morbidity effects, 34 000 DALYs were lost in 2004 among low- and middle-income countries of the European region due to lead exposure among children under the age of 5 (WHO, 2012).

In France, the average costs of lead decontamination were calculated as \$4136–10 642 per home (Pichery et al., 2011). On a per home basis, the estimated present value benefits of lead abatement in United States homes is around \$212 000–295 000 (Gould, 2009). In France benefits of around \$10 500–58 000 per decontaminated home, have been reported, while the total monetized benefits in 2008 of lead abatement in homes was estimated to be in excess of \$26.40 billion. For France, the total monetized benefits in 2008 of lead abatement in homes is estimated to be in excess of \$26.40 billion (Pichery et al., 2011). For both studies, these benefits are calculated as avoided cost of illness (COI) owing to lead exposure in children under the age of 6.

The biological basis of children's unique vulnerability to *outdoor air pollution* (e.g. ozone and fine particulate matter) is well documented (National Research Council, 1993). The Clean Air Act has been shown to have a positive net return on investment over 20 years, taking account of health, productivity and ecological impacts (EPA, 2011). Across the European region, 8.7 million DALYs were lost in children under 5 due to outdoor air pollution. Furthermore, despite progressively stricter vehicle emissions standards and higher motor fuel taxes in the last several decades, ground-level ozone is expected to increase by 35% in large cities throughout Organisation for Economic Co-operation and Development (OECD) countries between 2010 and 2050, assuming no new policies are introduced to control this pollution (OECD, 2012).

Taxes on vehicles to reduce economic externalities associated with traffic congestion, so-called congestion-charging schemes, have also been shown to have positive health impacts. In London, bronchiolitis hospitalizations decreased 9% compared with two years prior (Tonne et al., 2010), with costs for the scheme estimated at \$228 million per year (Prud'homme & Bocarejo, 2005). Ongoing study of the low-emission zone requirements that have been implemented over a broader geographic region may identify similar economic rewards (Woodcock et al., 2009). In Stockholm, emissions of major pollutants were reduced by over 10%, which translates into 27 avoided deaths per year (Johansson, Burman & Forsberg, 2009), with costs for the scheme estimated at \$48.4 million per year (Eliasson, 2009).

Many *commercial chemical ingredients* in pesticides, flame retardants and plastics are known to cause chronic and acute diseases in children (and adults) under certain exposure scenarios. Pruss-Ustun et al. estimate that the global burden of disease attributable to unintentional acute chemical poisoning and preventable through improved safety standards in 2004 was 5.2 million DALYs, with 19% of this total being concentrated in children (Pruss-Ustun et al., 2011). They conclude that over three-quarters of this burden could have been avoided through improved chemicals safety standards. Moreover, emerging laboratory and modest epidemiological evidence raise cause for concern about the role of

endocrine-disrupting chemicals in obesity (Trasande et al., 2009), while epidemiological studies have associated exposure to benzene, certain pesticides, biphenyls and 1,3-butadiene with increases in childhood malignancies.

The EU is best positioned to obtain childhood health benefits from improved regulation of chemicals through its implementation of “Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals” (REACH), beginning in 2007. REACH supersedes the US’s Toxic Substances Control Act (TSCA) in that it requires pre-market testing of chemicals and substitution with safer alternatives when less toxic alternatives exist. A European Commission extended impact assessment estimated the costs of implementing REACH to be between \$3.7 and \$6.9 billion (European Commission, 2003), with economic benefits of \$35–71 billion over the next 30 years (Risk and Policy Analysts Ltd., 2003; Pickvance et al., 2005). The economic benefits stream described, however, is for adult disease prevention, especially for those consequences of adult occupational exposures that are likely to be prevented.

As a regulation whose full impacts have yet to be seen, REACH should be closely monitored in order to see how efficiently it can achieve its intended objectives. The evidence reviewed here suggests large future economic benefits to be gained through relatively modest investments which give children healthy environments.

7 Road-related injuries

While much of this policy summary concentrates on addressing non-communicable disease, injuries remain a significant contributor to the overall burden of death and disability in Europe. Here we focus on road injuries as they account for a large proportion of the burden of fatal and disabling unintentional injuries in European countries; there is a wide gap in injury rates and deaths between countries; and road injuries disproportionately affect vulnerable road users.

Over the last 20 years, road safety has improved tremendously, but in the WHO European Region 120 000 people still die each year. Road-related injuries are the leading cause of death in children and young adults aged 5 to 29 years, and a further 2.4 million people are estimated to be so seriously injured as to require hospital admission each year. In fact, 39% of injuries are to pedestrians, cyclists and motorcycle riders (Zambon, Sethi & Racioppi, 2009). The estimated annual costs, both direct and indirect, of these injuries in Europe have been conservatively estimated to be as much as 3% of GDP. Even in the best-performing countries in Europe there is scope to improve safety.

Many of these injuries and deaths are potentially avoidable through investment in cost-effective road safety policies as highlighted in Table 6. Many of these

injuries and deaths are potentially avoidable through investment in cost-effective road safety policies. There is good evidence indicating that a complex interaction of vehicular/equipment, human and environmental factors influence the likelihood of collisions, serious injuries and deaths (Anderson, McDaid & Park, forthcoming). Many interventions are not only cost-effective but likely to be cost-saving from a societal perspective. They include road environmental modifications, police/technological enforcement of traffic regulations, investment in vehicle safety features and special targeted actions for high-risk drivers.

Traffic-calming measures, which include road closures, traffic islands, central refuges, additional pedestrian crossings and turning restrictions, generated average net first year rates of return (FYRR) on investment of between 30% to 40% (Mackie, Ward & Walker, 1990), and the net FYRR was even greater for schemes for area-wide traffic calming, introducing pedestrian facilities and crossings (Gorell & Tootill, 2001).

Speed limit zones, sometimes in conjunction with physical measures to enforce slower speed (e.g. chicanes or speed humps) are probably cost-effective, especially in high-risk areas. Benefits will exceed costs over five to ten years in many locations (Peters & Anderson, 2012; Steinbach et al., 2012; Grundy et al., 2008). Other cost-effective speed management mechanisms include roundabouts at hazardous junctions in Sweden (Elvik et al., 2009; European Transport Safety Council, 2003) and removal of roadside obstacles in Norway (European Transport Safety Council, 2003). There was an 80% reduction in casualty crashes at 13 blackspots in Australia, with net lifetime benefits of \$22 million following the introduction of rumble strips, crash barriers and sealed shoulders (Meuleners, Hendrie & Lee, 2011).

Speed enforcement programmes using automated speed monitoring devices, such as cameras and radar guns, generate net benefits in the short to medium term, especially if placed on road sections of known higher accident risk. Evidence from Canada (Chen, 2005), Spain (Mendivil et al., 2012) and the United Kingdom demonstrate net benefits: the latter programme, costing \$179 million but generating benefits of \$481 million by preventing 4230 collisions resulting in personal injury (PA Consulting & UCL, 2005). Evidence from Norway and Sweden shows the potential of better prioritization of *police enforcement of traffic regulations* and also generates positive net benefits that could reduce the number of fatalities without requiring any additional resources (Elvik et al., 2009, 2012; Elvik, 2010).

Seat belts are another effective measure in reducing the risk of mortality and serious injury, but there is only 70% usage in some western European contexts; their overall rate of effectiveness and cost-effectiveness can be improved through behaviour change to encourage routine use for all journeys (Cummins et al., 2008, 2011), including increased police enforcement, which has been

shown to have net benefits in different settings (Elvik, 2010; Conner, Xiang & Smith, 2010; Stevenson et al., 2008).

A number of studies suggest that special *safety restraints for children in cars* is efficient. Estimates for Sweden show a benefit–cost ratio of 3.23:1 for families buying seats (Elvik et al., 2009). One of the barriers to using car restraints is the high costs associated with the purchase. A model-based study looked at a scheme in a Greek hospital to allow new parents to borrow child seats through a low-cost loan scheme. Compared to no intervention, from a societal perspective the estimated incremental cost per life-year saved was \$5550 (Kedikoglou et al., 2005), while four-fifths of families went on to purchase new child seats as their infants grew.

Mass media campaigns to reduce the rate of alcohol impaired driving have been shown to generate positive returns on investment due to accidents avoided in studies in the United States (Elder et al., 2004), Australia (Miller, Blewden & Zhang, 2004) and New Zealand (Miller, Blewden & Zhang, 2004). Raising the *minimum legal drinking age* from 18 to 21 has been modelled as being more cost-effective than random breath-tests or mass media campaigns in Australia, with both better outcomes and reduced costs (Cobiac et al., 2009). There is increasing evidence that *alcohol ignition interlocks* can be cost-effective, as shown in mandatory use in commercial vehicles in Sweden (Magnusson, Jakobsson & Hultman, 2011) and all new cars in Australia (Lahousse & Fildes, 2009).

Vehicle modifications, including ultraviolet headlights to increase visibility at night (Lestina et al., 2002) and daytime running lights (European Transport Safety Council, 2003), have shown positive economic impacts. Modest economic benefits have been estimated in studies looking at the use of airbags in cars (Graham et al., 1997) (Thompson, Segui-Gomez & Graham, 2002) (Williams et al., 2008b), but their cost–effectiveness is much lower than that of the use of seat belts or motorcycle helmets (Kent, Viano & Crandall, 2005). Models suggest that intelligent speed adaptation systems, if implemented, have the potential to be cost-effective (Lai, Carsten & Tate, 2012).

Some economic analysis has looked at *licensing and driver education*. For instance, imposing various restrictions on very late-night driving for those under 19 was estimated to have a benefit–cost ratio of at least 4:1 (Miller, Lestina & Spicer, 1998); exposing learner drivers to additional supervised practice from lay drivers reported benefits outweighing costs by a factor of 30 (Gregersen, Nyberg & Berg, 2003); and providing all older drivers with speed-of-cognitive-processing interventions suggests that this is a less costly way of reducing the risk of collisions in older drivers compared to screening strategies (Viamonte, Ball & Kilgore, 2006).

There is inconsistent evidence from studies in New Zealand and the United States that national *compulsory bicycle helmet laws* would be cost-effective from a societal perspective. However, from a *public sector* perspective – critically, omitting the cost to individuals or families of purchasing bicycle helmets – the measure is likely to be highly cost-effective (Taylor & Scuffham, 2002; Hansen & Scuffham, 1995; Hatzianandreu et al., 1995).

Motorcycle helmet legislation is already implemented in most European countries, although helmet wearing behaviour varies. Cost-benefit analyses for mandatory motorcycle helmet laws in the United States have shown positive economic gains, for instance benefit to cost ratios were 1.33:1 including helmet costs only (Rice, Mackenzie & Jones, 1989), 2.3:1 assuming a 100% compliance rate of wearing helmet (Muller, 1980), and 17:1 (Miller and Levy, 2000).

The development of any road safety strategy needs to be informed by evidence on both effectiveness and cost-effectiveness. As shown, there are reasonable clusters of good-quality economic evaluations for some interventions, sometimes in a range of different countries, but for some other aspects of road safety the pattern of economic evidence on preventing road injuries is dogged by a paucity of recent studies and extensive heterogeneity. Additionally, there is a scarcity of evaluative and economic evidence generated in low- and middle-income countries (Hyder & Aggarwal, 2009). This raises challenges in the potential transferability of cost-effective interventions across the European region. Another complication is that effective road safety policies will need to combine a range of actions at different levels – vehicle modification, legislation, enforcement, media campaigns and road design. Therefore, there remains a need to further develop methods to estimate the effectiveness and cost-effectiveness of different packages of road safety interventions that could be included in a national road safety policy.

8 Protecting mental health, preventing depression

Poor mental health can have long-lasting impacts across the life course. Globally, major depressive disorders are the second leading cause of years lived with disability (Vos et al., 2012). They affect about 150 million people worldwide at any moment in time, including about 33.4 million people in the WHO European Region. The costs are substantial, with costs for major depression in 30 European countries estimated to be \$113 billion in 2010, while costs for all anxiety disorders accounted for a further \$91 billion (Olesen et al., 2012). All-cause mortality rates are higher by a factor of 1.65 in people with depression (de Hert et al., 2011). People with depression make more frequent use of health services and stay absent from their work more often, which has significant economic ramifications; at least 60% of all suicides are in people who are depressed (Marquet et al., 2005).

Effective and cost-effective relatively simple and feasible actions that are potentially scalable to promote mental health and prevent the onset of mental health problems, across the life course and in different settings, are available (Smit et al., forthcoming). As Table 7 indicates, *actions in childhood* to both promote emotional health and well-being and address those behavioural problems that increase the risk of mental health problems in adulthood can be cost-effective (McDaid & Park, 2011; Mihalopoulos et al., 2012). For younger children at risk of developing conduct disorders, interventions targeting parents (Edwards et al., 2007), parents and children (Mihalopoulos et al., 2011) as well as those including *parents, child-based training and teacher training* (Foster, 2010) can be cost-effective. Interventions to prevent depression in adolescents through after school screening and subsequent psychological intervention (Mihalopoulos et al., 2012) and targeting at-risk teenagers whose parents have depressive disorders (Lynch et al., 2005) would be considered cost-effective in most high-income country settings.

New mothers are another important target group for action. One in every seven new mothers is affected by *post-partum depression* (Wisner, Chambers & Sit, 2006), which may lead to increased risks of hospitalization, marital stress and divorce, child abuse and neglect, and maternal suicide and infanticide. Health visitor-led identification of new mothers at risk of post-natal depression, coupled with subsequent therapy appears cost-effective (Bauer, Knapp & McDaid, 2011).

For *workplace interventions* at an organizational level, potential economic benefits have been reported from investment in stress and well-being audits, better integration of occupational and primary health care systems, and an extension in flexible working hours arrangements (Foresight Mental Capital and Wellbeing Project, 2008; Corbiere et al., 2009). There is also some workplace-specific evidence on the economic benefits of mental health promoting actions targeted at individuals. Potentially, interventions that can prevent depression and anxiety can be cost-saving from a business perspective for white-collar employment (McDaid et al., 2011; Matrix Insight, 2012); however, additional evidence on different workplace settings, for example where staff turnover is high and skill requirements low, would help strengthen the case for companies to invest.

For *older people*, better mental health from regular participation in group-based activities, such as *exercise classes and psychosocial group therapy* for those who are identified as lonely have the potential to be cost-effective (McDaid & Park, 2011; Munro et al., 2004). A *stepped care* approach for the prevention of depression in older people, identified as being at risk through primary care, has been shown to be more cost-effective than routine primary care in the Netherlands (Van't Veer-Tazelaar et al., 2010).

Economic evidence also indicates that depression prevention in adults is potentially cost-effective (Zechmeister, Kilian & McDaid, 2008), especially when offered in a self-help format with minimal guidance from a therapist. It may even be cost-saving when cost offsets due to changes in productivity are accounted for (van den Berg et al., 2011). *E-health delivered interventions* do not rely on scarce resources such as therapists' time, thus bringing down marginal costs significantly (Warmerdam et al., 2010). They are scalable and potentially reach groups, such as young men, who may be unwilling to engage with face-to-face support.

Most of the evidence has been demonstrated in high-income country contexts; more is needed on cost-effective interventions in low- and middle-income countries, and on the long-term benefits of better psychological well-being. Nonetheless, the evidence indicates that the promotion of mental well-being to reduce the risk of becoming vulnerable to poor mental health, and strategies to protect the mental health of the population who are at risk of developing depression constitute a critical element of any mental health strategy. There is a case for careful investment in many actions, but these need to be sensitive to local conditions, culture, infrastructure and resources.

9 Investing in health promotion and disease prevention: there is an economic case

A large burden of disease, particularly from chronic non-communicable diseases, in the WHO European Region impacts heavily on labour markets and productivity. Diseases fuel disparities in employment opportunities and wages. They affect productivity at work, increase sick leave and the demand for welfare benefits. Poor health in childhood can have adverse consequences well into adulthood, limiting educational attainment and career opportunities, as well as affecting health. Health expenditure has grown at a pace exceeding economic growth in many European countries, resulting in increased financial pressures which threaten the long-term sustainability of health care systems. Expensive medical treatments can generate important improvements in quality of life to populations, but they also drive up the cost of managing often multiple chronic diseases. It is therefore important to consider population-wide interventions that can help reduce the risks of poor health from occurring.

We have seen from the areas covered in this policy summary that there are strong economic, as well as health, reasons for investing in health promotion and disease prevention. Societies do not perfectly allocate information on which the population can best make decisions about the way in which they maintain their health. Individuals can also be myopic about the benefits of healthy lifestyles in protecting their health; choosing instead to "enjoy" the

benefits of an unhealthy lifestyle today, intending at some future point in time to change their health behaviour, but often never succeeding in doing this. They may also have unrealistic views of their own risks of poor health, failing to comprehend their much increased chances of having poor health in later life. Moreover, there are externalities associated with the adverse impacts of avoidable poor health that go beyond the individual; they affect families and can put a strain on public services.

Income and educational inequalities have an impact on an individual's stock of healthy human capital; health-related choices will also be constrained by income. Individuals do not choose where they are born, the socioeconomic environment in which we all live also has an impact on our lives; this can, for instance, limit our access to activities to promote or protect our physical health. Higher levels of environmental pollution in urban conurbations, for instance from car exhaust emissions or contaminated water supplies, can have profound long-term consequences for city dwellers, especially children. There may also be greater risks of injury and death in road environments as a result of the process of creeping urbanization and economic development bringing more and more suburban areas into contact with major road systems.

We have also seen major changes in the world of work away from manual to service sector oriented activities. There has been a blurring of the distinction between our private lives and work, coupled with constant short work deadlines and much less job security. All of these factors have been associated with greater risks of developing poor mental health, with depression and anxiety projected to be the leading contributor to the global burden of disease by 2030.

Thus a strong economic case for action to promote health and prevent disease can be made. Effective measures both within and beyond the health system are available. The rationale for government action to promote healthy behaviours is particularly strong given the presence of negative externalities from unhealthy behaviours and the inadequacy of information. As we have seen in this summary, a growing body of evidence from economic studies shows areas where appropriate policies can generate health and other benefits at an affordable cost, sometimes reducing health expenditure and helping to redress health inequalities at the same time. For instance, the victims of second-hand smoke and drunk drivers provide dramatic examples of negative additional consequences or externalities that can be corrected either by excise taxes on tobacco and alcohol, or other policies such as public smoking bans and drink-driving laws. Inadequate consumer information justifies interventions to promote healthier behaviours by informing people about the risks of smoking, obesity and other causes of disease, and providing them with more information on the food and drink that they consume. These externalities also provide a

justification for the use of fiscal measures to influence the price of food and drink and change overall patterns of consumption.

9.1 Is the evidence base strong enough?

The areas for action examined in this policy summary have deliberately moved beyond what is known about the economic benefits of specific actions within health care systems, such as vaccinations and screening, to look at research endeavours to make the economic case for investing upstream – that is prior to the onset of non-communicable diseases, and before health care services are required. The work highlights actions that can be supported by sound cost-effectiveness or cost-benefit analyses, including actions to limit risky behaviours such as tobacco use and alcohol consumption, to promote physical and mental health through diet, exercise and prevention of mental disorders, and to decrease preventable injuries, for example from road traffic accidents and exposure to environmental hazards. We have also looked separately at the evidence base for investment in early childhood development and the benefits to health that may be seen from education.

The majority of studies that we have identified rely on different types of modelling analyses in order to synthesize evidence on effectiveness and costs. In particular, models have been used to estimate some of the very long-term benefits of better health that are not usually possible to monitor in controlled trials and other observational studies. There are limitations in models and caution must be used in their interpretation, although some of these limitations can be addressed by adjusting the values and assumptions in models to see what difference this makes to findings. Where economic data are linked to actual implemented health promoting actions, there are still limitations to be mindful of, as the effectiveness of any intervention may differ depending on local context.

Notwithstanding these limitations, it is clear that there is strong evidence of cost-effective actions in many of these areas, for example for tobacco control programmes, many of which are inexpensive to implement and have cost-saving effects. Such programmes include raising taxes in a coordinated way with high minimum tax (which is the single most cost-effective action), encouraging smoke-free environments, banning advertising and promotion, and deploying media campaigns. Adequate implementation and monitoring, government policies independent of the tobacco industry, and action against corruption are needed to support effective policies.

The cost-effectiveness of alcohol policies is supported by a substantive evidence base of systematic reviews and meta-analyses. Very cost-effective interventions include: restricting access to retail alcohol; enforcing bans on alcohol advertising, including in social media; raising taxes on alcohol and instituting a minimum price per gram of alcohol. Less, but still somewhat

cost-effective measures include: enforcing drink-driving laws through breath-testing; delivering brief advice for higher-risk drinking and providing treatment for alcohol-related disorders. Media campaigns on their own and school-based health promotion programmes do not appear to be cost-effective.

Actions to promote healthy eating are especially cost-effective when carried out at the population rather than health care service level. Reformulation of processed food to decrease salt and saturated fat (trans fat, in particular) is a low-cost intervention which may be pursued through multi-stakeholder agreements. Fiscal measures (including taxes and subsidies) and regulation of food advertising to children also have a low cost and a favourable cost-effectiveness. However, feasibility could be hindered by conflicting interests. Programmes to increase awareness and information, such as mass media campaigns and food labelling schemes, are also efficient investments but with poorer effectiveness, particularly in lower socioeconomic groups.

The promotion of physical activity through mass media campaigns is a very cost-effective action, and relatively inexpensive. However, returns in terms of health outcomes may be lower than those provided by more targeted interventions, for instance, those set in the workplace. Changes in the transport system and increased access to opportunities for physical activity in the wider environment, such as the provision of bicycle trails, also have potential economic benefits, but require careful evaluation to ascertain affordability and feasibility. Actions targeting the adult population and individuals at higher risk tend to produce larger effects in a shorter time-frame compared with actions targeted at children and young people.

Robust evidence indicates that the prevention of depression, the single leading cause of disability worldwide, is feasible and cost-effective. Depression is associated with premature death and reduced family functioning, and it entails staggering economic costs due to health care and productivity losses, which can be partly avoided through appropriate forms of prevention and early detection. Evidence supports actions across the life course, starting from early actions in childhood to strengthen social and emotional learning, coping skills and improved bonds between parents and children, which can generate benefits lasting into adulthood. There are also cost-effective programmes targeted at high-risk groups such as isolated older people and new mothers.

Actions to prevent road traffic accidents, such as those through road design modification, urban traffic calming (e.g. mandatory speed limits with physical measures), and camera and radar speed enforcement programmes, are supported by sound economic evidence, especially when applied in higher-risk areas. Active enforcement of legislation to promote good road safety behaviours, including measures to reduce drink-driving, can also be highly cost-effective.

Evidence from economic studies supports actions to tackle environmental chemical hazards. Examples include comprehensive chemical regulatory reform such as that implemented in 2007 under the REACH in Europe; the removal of lead-based paint hazards; the abatement of mercury pollution from coal-fired power plants; and the abatement of vehicle emissions in high-traffic areas, for example, through congestion charging schemes used in many metropolitan areas, which may produce savings in health care and other costs associated with childhood asthma, bronchiolitis and other early life respiratory illnesses.

In addition to the thematic areas discussed earlier it is also important to look at other factors that influence our health and well-being. Investments in education are also investments in health: a growing body of empirical research suggests that when countries adopt policies to increase education, the investments also pay off in healthier behaviours and longer and healthier lives. For example, studies of compulsory schooling reforms adopted in a number of European countries conclude that the reforms not only lead to additional years of completed schooling, but also that this additional schooling reduces population rates of smoking and obesity (McDaid, Sassi & Merkur, forthcoming). When countries consider the return on investment in education and other social determinants of health, the analysis should also factor in the potential health gains.

9.2 What does this evidence tell us about impacts on inequalities?

Much of the evidence base we have discussed in this policy summary does not explicitly consider the impacts of health promoting actions on inequalities in health status and/or use of health care services. Yet central to most, if not all, health promotion and disease prevention programmes is the aim of reducing health inequality. Some prevention programmes, once implemented, do not rely on individuals to engage with the programme for a long period of time in order to reap the benefits. For instance, a one-off decision to be screened or to give up smoking for a short period of time (e.g. during pregnancy) is likely to be more effective than those that require sustained behaviour change.

Many prevention programmes require regular levels of participation in a health promoting activity. There is therefore a danger that investment in health promotion could widen health inequalities if these disadvantaged groups do not participate. Across the general population, access and take-up tends to be lowest in more disadvantaged groups.

Actions may need to be tailored so they are attractive to many social groups; cultural and religious sensitivities can also be accounted for. This might involve targeting disadvantaged individuals to improve their health relative to more advantaged individuals, or delivering programmes to all to raise the health of all, including those who are most disadvantaged. Investing in community engagement measures, including peer delivered programmes, to increase the

uptake of disease prevention and health promoting interventions can also be cost-effective (O'Mara-Eves et al., 2013).

Policy-makers should therefore be cautious in designing and implementing prevention programmes to ensure that they do not increase health inequalities or discriminate among groups of the population by demographic (e.g. age, gender, ethnicity) and/or socioeconomic variables (e.g. income, education). There is still relatively little evaluation to assess the effectiveness of prevention programmes and the impact of these programmes on health inequality (O'Mara-Eves et al., 2013). As improvement in health inequalities is of such importance within the public health arena, continuous, ongoing evaluation of health promotion and disease prevention programmes is required to monitor them and mitigate any unintended consequences, including through the possible re-design of programmes.

9.3 How can we facilitate implementation and promote uptake?

Of course, it is insufficient either simply to identify that there is an economic case for action or even to identify cost-effective interventions. It is important to consider the challenges of implementation and ways in which to promote the uptake and continued use of health promoting interventions when they are in place. We look at each of these issues in turn and at how knowledge on cost-effective actions may be translated into actions that help improve population health.

One challenge concerns the different economic incentives that are faced by different stakeholders. Ministries of health that wish to promote health by tackling the social determinants of health (SDH) face a fundamental difficulty: other ministries jointly and indirectly shape these determinants with their policies and programmes, through often tangential or unrelated objectives. Indeed, lifestyles; social and community networks; living and working conditions; and general socioeconomic, cultural and environmental conditions are all multifaceted determinants of health which cannot easily be tackled by direct ministry action or be attributed to a single policy or sectoral activity outside of health.

For instance, take the area of alcohol control. This will require actions in respect of taxation, retail, transport, education, economic development, criminal justice and social welfare. These will be the responsibility of different stakeholders, who will have different policy goals, such as stimulating economic activity, which may or may not be conducive to health. Implementing health promoting actions within different departmental fiefdoms and budgetary silos can therefore be challenging. Education budget holders, for instance, are more likely to be concerned with how their funds might affect average examination grade scores on national tests or the level of truancy in schools, rather than the social and emotional well-being of children. That is not to say

that health concerns are completely off the radar: for instance, ministries of transport usually have dedicated budgets and plans to promote safety on the road. Nonetheless, if the predominance of vertical policy structures and funding silos remains unchallenged, many health concerns that potentially could be addressed through actions outside the health care system remain of low concern to these policy-makers

Take, for instance, action to improve the health and well-being of children at school, one of the few places where public health interventions can easily reach most children. We have noted that there is an evidence base for early childhood development and school-based measures including parenting programmes. However, the education sector may be reluctant to invest its limited resources in school-based mental health promotion programmes rather than core education-related activities. This reluctance may be even more pronounced in times of constrained economic circumstances, when all public services are under heightened pressure to demonstrate their efficiency and added value.

One way round this issue may be to identify benefits of direct interest to the sector in question *in addition* to health sector benefits; some studies of social and emotional well-being actions for children have demonstrated that they reduce the need for special education classes and make classroom disruption rarer; in Canada one such programme has been shown to reduce the risk that children have to repeat a whole school year (Peters, Bradshaw & Petrunka, 2010). Similar approaches have been used when looking at the economic benefits of investing in workplace health promotion programmes, where benefits to business in terms of better performance by workers when at work, and greater levels of employee retention and creativity have been cited, alongside some of the benefits of reduced levels of time off work due to depression and anxiety problems (Matrix Insight, 2012).

Another way in which to encourage implementation of health promoting activities across sectors is to engage at a very early stage in the evidence-informed policy-making process with these stakeholders. This has been the case for public health evaluation for England undertaken by NICE. Since 2005 NICE has assessed the effectiveness and cost-effectiveness of a very broad range of public health interventions, all of which are implemented within public health programmes or in other sectors, such as schools, workplaces, on the roads and in people's homes. This process does not simply involve synthesizing evidence and constructing cost-effectiveness models. It involves much stakeholder consultation, including the co-opting of different topic-specific experts onto committees assessing the evidence. Unlike assessment of health care technologies at NICE, a broader perspective on costs is often presented, looking at the impacts outside the health sector. This can be helpful in encouraging the adoption of guidance: for instance, in one of its first pieces

of guidance on public health interventions, arguments on reduced time out of the workplace if a ban on smoking at work could be initiated were helpful in getting employers on side.

Another way in which cross-sectoral actions may be facilitated is to look at ways of changing funding arrangements to overcome narrow sector-specific interests. For example, cross-sectoral collaboration could be fostered through establishing one single budget for the provision of school-based health promotion (McDaid, 2012). Creating a dedicated budget for a non-health sector health promoting activity, bringing together resources from the health sector and beyond, provides health policy-makers with a direct means of influencing policy in other sectors. For instance, the approach might be used to ensure adequate funding and priority is given to road safety measures by ministries of transport, or to address health concerns in new urban housing developments. Such a pooling of budgets might be done on a mandatory or voluntary basis. Approaches whereby different sectors come together voluntarily to pool funds will take more time to establish. They rely more heavily on securing the buy-in of different stakeholders by demonstrating the potential added value of collaboration, both in terms of health and regarding objectives of importance to other sectors. They also rely more heavily on trust and open discussion; in turn, mutual learning and innovation is enhanced by the development of trusting relationships. Voluntary pooling of resources may thus be more sustainable in the long term as long as all partners have a sense of ownership over collaboration, making them more willing to continue to make a contribution towards the pooled budget.

10 Conclusions

Reducing the risk of chronic diseases and injury through interventions aimed at modifying lifestyle risk factors is possible and cost-effective, and potentially could reduce health inequalities within countries. However, turning the tide of chronic health problems that have assumed epidemic proportions during the course of the twentieth century requires fundamental changes in the social norms that regulate individual and collective behaviours. Such changes can only be triggered by wide-ranging prevention strategies addressing multiple determinants of health across social groups.

Most countries are putting efforts into improving health education and information. The evidence in this summary suggests, however, that these measures alone are not sufficient, nor are they always cost-effective. More stringent measures, such as regulation of advertising or fiscal measures, are more intrusive on individual choices and more likely to generate conflict among relevant stakeholders, but are also likely to weigh less on public finances and to produce health returns more promptly.

A wide range of regulatory and fiscal measures have been put in place in many countries, for instance to curb consumption of tobacco and alcohol. A minimum age has been set for purchasing cigarettes and alcoholic drinks, which often carry health warnings printed on their labels. Advertising has been severely restricted and hefty taxes have been imposed on the consumption of both commodities. All of these measures have contributed to containing consumption and modelling studies have shown that most have very favourable cost-effectiveness profiles. However, fiscal measures are complex to design and enforce; their impact may be unpredictable; and they can bear more heavily on low-income groups than on those with higher incomes.

The complex nature of chronic diseases, their multiple determinants and causal pathways suggest that pervasive and sustained efforts and comprehensive strategies involving a variety of actions and actors are required for successful prevention. Governments still spend only a fraction of their health budgets on prevention (on average around 3% of total health expenditure, in OECD countries), although some activities will be funded from other budgets. In any case, providing economic incentives or changing financing arrangements within countries to foster cross-sectoral activity may help to increase the overall level of resources invested in health promotion and disease prevention.

It is also crucial that expectations concerning the benefits of health promotion and disease prevention remain realistic. Prevention can improve health and well-being, with a cost-effectiveness that is as good as, or better than, that of many accepted forms of health care. However, reducing health expenditure should not be regarded as the sole goal of prevention, because many programmes will not have this effect. In saying this, low-cost population-wide strategies can have substantial capacity to generate economic returns if they only improve the health of a very small fraction of the population.

It is also important to recognize the differing contexts in which health promotion and disease prevention programmes are implemented; they require adaptation to different infrastructures and cultures and we are mindful of the concentration of evidence on what works within North America, Australasia and western Europe. This issue of equity is a particularly important consideration. If the uptake of a public health intervention is higher in more affluent groups in society then one unintended consequence of investment in a public health programme could be to inadvertently widen health inequalities.

Notwithstanding these caveats, it is clear that there is an economics evidence base for health promotion and disease prevention. The challenge now is to strengthen this evidence base further and look at ways in which it may be used to translate evidence-based knowledge into routine everyday practice across all of the WHO European Region.

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Health promotion and disease prevention programmes – Summary tables of economic evidence

The subsequent tables provide summaries of the existing evidence of the economic impact of a range of health promotion and disease prevention programmes, discussed in the policy summary document. The tables, organized by risk factor area, are not meant to provide an exhaustive account of all economic studies undertaken in each area. Rather, they are designed to provide an interpretation and brief assessment of evidence related to relevant chapters of the book “Promoting health, preventing disease: the economic case” (McDaid, Sassi & Merkur, forthcoming).

As readers who are familiar with the economic evidence base for public health action will know all too well, the available evidence is extremely heterogeneous. The programmes assessed are very diverse, as are the evaluation approaches applied, the countries where studies were undertaken, the outcome measures, the time-frames, the perspectives adopted in the studies, and, not least, the generalizability of the findings. Moreover, findings are often nuanced, and may vary in the same study depending on the way programmes are designed or implemented. The imperative of synthesizing their direction in a table cell may not do justice to the authors’ efforts to ascertain what factors may be associated with better or worse economic outcomes. In this context, summarizing the evidence base in concise tables is a challenge, and no doubt the tables included in this section, as well as the whole body of evidence discussed in this document, are only a starting point for policy-makers wishing to use the existing evidence base in support of their policy decisions. Assessing whether the findings of individual studies are relevant in a specific policy setting requires a detailed analysis of the design, assumptions, data and inferences made in those studies. What the tables do provide, however, is a broad-brush overview of areas and programmes that are more, or less, strongly supported by existing evidence, offering initial guidance to decision-makers towards an evidence-based approach to public health policy.

The tables contain the following elements:

1. *Programme description*. Short description of the intervention(s) assessed in the referenced studies. Descriptions may contain details that help to distinguish the intervention from similar ones listed in the same section of the table.
2. *Economic impact*. Summary assessment of the economic studies’ conclusions. It is important to note that studies may have been undertaken using different approaches. The assessment is on three levels, as follows:
 - (i) Cost saving. A lower cost and better health outcomes than a situation in which the programme were not available.

- (ii) *Efficient*. A favourable cost–effectiveness ratio (lower than accepted thresholds in the relevant countries); a positive net present value, a cost–benefit ratio greater than 1, or a favourable internal rate of return (for cost-benefit analyses). Good value for the money invested.
 - (iii) *Borderline*. Close to the relevant cost–effectiveness or cost–benefit thresholds.
 - (iv) *Inefficient*. High costs relative to the health outcomes generated by the programme. Poor value for the money invested.
3. *Strength of economic evidence*. Summary assessment based on the size and consistency of the evidence base for the specific programme. The assessment is on five levels, as follows:
- (i) *Single study*. Only one study is available on the specific programme.
 - (ii) *Two or three studies with inconsistent findings*. Two or three studies are available, but their conclusions do not consistently point to the programme being efficient or inefficient. More information may be provided in the “Comments” column.
 - (iii) *Two or three studies with consistent findings*. Two or three studies are available whose conclusions consistently point in the direction indicated in the “Economic impact” column.
 - (iv) *Multiple studies with inconsistent findings*. More than three studies are available, but their conclusions do not consistently point to the programme being efficient or inefficient. More information may be provided in the “Comments” column.
 - (v) *Multiple studies with consistent findings*. More than three studies are available, whose conclusions consistently point in the direction indicated in the “Economic impact” column.
4. *Cross-national assessment*. Two-part assessment reflecting the country coverage of studies available on a specific programme, including breadth of coverage and levels of income of the countries concerned. Breadth of coverage is assessed in three levels, as follows:
- (i) *Single country*. Evidence from studies based in, or covering, only one country.
 - (ii) *Few countries*. Evidence from studies based in, or covering, no more than three countries. More information may be provided in the “Comments” column.
 - (iii) *Multiple countries*. Evidence from studies based in, or covering, a larger number of countries.
5. *Comments*. This section has relevant additional information about the evidence available on a specific programme. This may include details of study design, an assessment of the overall quality of the studies, and other relevant information.

Table 1: Tobacco

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Fiscal measures					
(Jha & Chaloupka, 1999; Ranson et al., 2002; Ortego et al., 2012; Chisholm et al., 2006; Vos et al., 2010)	Various increases in taxes on tobacco	Efficient	Multiple studies with consistent findings	Multiple countries with different levels of income	Economic modelling and econometric analyses. Some studies suggest actions are cost-saving.
Smoking cessation measures					
(Vos et al., 2010; Ranson et al., 2002; Parrott, Godfrey & Kind, 2006; Chisholm et al., 2006; Public Health Research Consortium, 2010)	Cessation support including NRT	Efficient	Multiple studies with consistent findings	Multiple countries with different levels of income	Economic modelling and econometric analyses.
(Parrott, Godfrey & Kind, 2006)	Brief GP advice plus with and without self-help advice	Efficient	Single study	One high-income country	Economic modelling.
Advertising bans					
(Chisholm et al., 2006; Lai et al., 2007)	Comprehensive advertising ban	Efficient	Multiple studies with consistent findings	Multiple countries with different levels of income	Economic modelling and econometric analyses.
Mass media campaigns					
(Hurley & Matthews, 2008; Ratcliffe, Cairns & Platt, 1997; Secker-Walker et al., 1997; Ha & Chisholm, 2011)	Intensive mass media campaigns	Efficient	Multiple studies with consistent findings	Multiple countries with different levels of income	Modelling used to project long-term benefits of quitting smoking. Some observational studies. Some studies cost-saving.

Table 1: Tobacco (continued)

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Environmental measures					
(Chisholm et al., 2006)	Clean air legislation	Efficient	Single study	Multiple countries with different levels of income	Modelling used to project long-term costs and benefits.
Combinations of interventions					
(Lai et al., 2007; Ortegon et al., 2012; Chisholm et al., 2006)	Taxation and clean air legislation, tobacco advertising ban, information and labelling, brief advice and counselling, NRT	Efficient	Two studies with consistent findings	Multiple countries with different levels of income	Economic modelling analysis. Inefficient compared to taxation alone.

Key: Economic Impact: Defined as efficient (inefficient) intervention has an incremental cost-effectiveness ratio of less (more) than \$50 000 per QALY gained or DALY averted. Also defined as efficient if intervention has a positive net benefit-cost ratio. Defined as cost-saving if reported to have better health outcomes and lower costs in a cost-effectiveness study. Defined as borderline action where inconsistent findings on cost-effectiveness in reported studies. World Bank classification of high-, middle- and low-income countries used.

Table 2: Physical inactivity

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Mass media campaigns					
(Lewis et al., 2010; WHO, 2011c; Sassi et al., 2009; Cobiac et al., 2009; Vos et al., 2010; Cecchini et al., 2010)	Mass media campaigns to encourage physical activity	Efficient	Multiple studies with consistent findings	Multiple high-income countries	Largely modelling based studies, some of which are cost-saving.
School-based interventions					
(Wang et al., 2003; Sassi et al., 2009)	Curriculum-based intervention including physical activity aimed at reduction of obesity	Efficient	Multiple studies with consistent findings	Multiple high-income countries	Cluster randomized controlled trial with modelling used to extrapolate lifetime costs and benefits. One study only effective in girls.
(Fordham, 2008; Moodie et al., 2009)	School "walking buses"	Borderline	Multiple studies with inconsistent findings	Two high-income countries	Shown effective in one study but very inefficient in the other.
Primary-care interventions					
(Sassi et al., 2009)	Counselling in primary care for physical activity and dietary advice	Efficient	Multiple studies with consistent findings	Multiple high-income countries	Simulation modelling synthesizing effectiveness and epidemiological data with long-term cost impacts. Some empirical studies as well.
(NICE, 2008c)	Brief interventions	Efficient	Single study	Multiple high-income countries	

Table 2: Physical inactivity (continued)

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Worksite-based interventions					
(Cecchini et al., 2010; Sassi et al., 2009)	Workplace health promotion programmes that focus on physical activity and diet	Efficient	Single study	Multiple countries; predominantly low and middle-income	Simulation modelling synthesizing data on effectiveness, epidemiology and costs. Only cost-effective in all countries after 50 years; not efficient after 20 years in some countries.
(Bending, Beale & Hutton, 2008)	Physical activity counselling in the workplace and/or workplace physical activity programmes including walking	Efficient	Multiple studies with consistent findings	Multiple high-income countries	Effectiveness data taken from randomized controlled trials and observational studies with economic costs then added.
Travel/transport-related interventions					
(Sassi et al., 2009)	Developing and managing cycle trails	Cost-saving	Multiple studies with consistent findings	Multiple high-income countries	Mostly cost-benefit analyses without comparators.
(Sassi et al., 2009)	Bike paths and access to fitness facilities	Efficient	Single study	One high-income country	
Community-based interventions					
(Vos et al., 2010)	Pedometers	Cost-saving	Single study	One high-income country	Simulation modelling analysis.
(Sassi et al., 2009)	Community-based group counselling interventions targeted at working-age adults	Borderline	Multiple studies with inconsistent findings	Two high-income countries	Wide range of cost-effectiveness ratios from very efficient to inefficient.

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
(Sassi et al., 2009)	Health education through media	Inefficient	Single study	One high-income country	

Key: Economic Impact: Defined as efficient (inefficient) intervention has an incremental cost-effectiveness ratio of less (more) than \$50 000 per QALY gained or DALY averted. Also defined as efficient if intervention has a positive net benefit-cost ratio. Defined as cost-saving if reported to have better health outcomes and lower costs in a cost-effectiveness study. Defined as borderline action where inconsistent findings on cost-effectiveness in reported studies. World Bank classification of high-, middle- and low-income countries used.

Table 3: Unhealthy diets

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Public awareness campaigns					
(Cecchini et al., 2010; Dallongeville et al., 2011)	Mass media campaigns to promote fruit and vegetable intake	Mixed results	Multiple studies with inconsistent findings	Multiple countries with mixed income levels	Simulation modelling synthesizing data on effectiveness and costs. Efficient in two high-income countries and four middle-income countries after 20 and 50 years; inefficient in two other low/middle-income countries.
(Cobiac, Vos & Veerman, 2010b)	Two-year workplace-based nutrition intervention including classes, mailed self-help materials and dietary feedback	Inefficient	Single study	One high-income country	28-site controlled study in car industry workers in the US. Simulation modelling used to adapt to Australian context. Effectiveness evidence noted to be limited.
(Cobiac, Vos & Veerman, 2010b)	Information seminars, promotion materials and changes in cafeterias	Inefficient	Multiple studies with consistent findings	One high-income country	Simulation modelling used to adapt to Australian context. Effectiveness evidence noted to be limited.
(Cobiac, Vos & Veerman, 2010b)	Targeted dietary information mail-out versus no intervention	Efficient	Single study	One high-income country	Empirical evidence from targeted mail-out on fruit and vegetable consumption to callers to a cancer information service in US. Simulation modelling study for Australian context. Median cost per DALY range between \$7700 and \$24 200. Effectiveness evidence noted to be limited.

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
(Cobiac, Vos & Veerman, 2010b)	Multiple-component local community awareness-raising initiatives and networking with retailers, farmers, etc. versus no intervention	Cost-saving	Single study	One high-income country	Empirical evidence from evaluation of local community initiative "Five a Day" fruit and vegetable consumption pilot studies across England; involved a range of awareness initiatives, each different in each local area. Simulation modelling study for Australian context. Effectiveness evidence noted to be limited.
(Ha & Chisholm, 2011)	Mass media health education campaign to reduce consumption of salt, cholesterol levels (also tobacco)	Efficient	Single study	One low-income country	Simulation modelling synthesizing data on effectiveness from a range of studies with local cost data.
(Sassi, 2010)	Mass media campaign using TV, radio and print over two years	Efficient	Single study	Multiple countries; predominantly high-income	Simulation modelling synthesizing data on effectiveness and costs. Becomes efficient after 10 years.
(Willett et al., 2006)	Media campaigns for reduction in saturated fat consumption, and 2% substitution of trans fat with polyunsaturated fat	Efficient	Single study	Multiple countries with different levels of income	Simulation modelling synthesizing data on effectiveness and costs.
(Willett et al., 2006)	Public education campaign and legislation to reduce salt content	Efficient	Single study	Multiple countries with different levels of income	Simulation modelling synthesizing data on effectiveness and costs.

Table 3: Unhealthy diets (continued)

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Public awareness campaigns (continued)					
(Wootan et al., 2005)	6–8 week intensive population-wide information campaigns using paid advertising, media events, educational activities	Unclear	Single study	One high-income country	Quasi-experimental study seeking to get population to switch to 1% or less fat milk; four locations; four different campaigns; professional advertising and media events lowest cost per individual at \$0.57 to \$11.85 for educational activities plus media events. Unclear whether this will ultimately be cost-effective.
Labelling					
(Cobiac, Vos & Veerman, 2010a)	Voluntary or mandatory use of a “tick” to indicate low salt content bread, margarine or cereal	Cost-saving	Single study	One high-income country	Simulation modelling used to adapt effectiveness evidence to Australian context and synthesis with costs.
(Sassi et al., 2009)	Nutrient labelling	Efficient	Single study	Multiple countries with different levels of income	Simulation modelling synthesizing data on effectiveness and costs. Efficient after 10 years.
Labelling and public awareness campaign					
(Sacks et al., 2011)	Front-of-pack “traffic light” nutrition labelling and one-year national social marketing campaign on these labels	Cost-saving	Single study	One high-income country	Simulation modelling using threshold analysis. Compared to back-of-pack nutritional information. Equivocal evidence from other studies on effectiveness of labelling.

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Advertising regulation					
(Cecchini et al., 2010)	Food advertising regulation to children	Efficient	Single study	Multiple countries with different levels of income	Simulation modelling synthesizing data on effectiveness, epidemiology and costs. In six of seven countries efficient or cost-saving in 20 years; efficient in all in 50 years.
(Sassi et al., 2009)	Mandatory and voluntary industry regulation for food advertising to children	Efficient	Single study	Multiple countries with different levels of income	Simulation modelling synthesizing data on effectiveness and costs. Becomes efficient after 20 years; self-regulation can be cost-saving.
(Sassi, 2010)	Mandatory and voluntary industry regulation for food advertising to children	Efficient	Single study	Multiple countries; predominantly high-income	Simulation modelling synthesizing data on effectiveness and costs. Becomes efficient after 20 years; self-regulation can be cost-saving.
(Magnus et al., 2009)	Banning TV adverts for energy-dense nutrient-poor food and drink during children's peak viewing times	Cost-saving	Single study	One high-income country	Simulation modelling used to adapt effectiveness evidence to Australian context and synthesis with costs.
Fruit and vegetable initiatives in schools					
(te Velde et al., 2011)	Two school schemes: (1) provision of and better access to fresh fruit and vegetables, plus mandatory curriculum activities and feedback in schools; (2) free fruit and vegetable scheme, voluntary curriculum activities, no feedback	Efficient	Single study	One high-income country	Empirical controlled trial supplemented by epidemiological modelling. Both interventions cost-effective compared to no action. First more comprehensive intervention dominates second scheme.

Table 3: Unhealthy diets (continued)

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Pricing mechanisms					
(Cecchini et al., 2010)	10% tax on foods with high fat content and subsidy for 10% reduction in price of fruit and vegetables	Cost-saving	Single study	Multiple countries with different levels of income	Simulation modelling synthesizing data on effectiveness, epidemiology and costs.
(Cobiac, Vos & Veerman, 2010b)	Farmers market vouchers or supermarket vouchers	Inefficient	Single study	One high-income country	Simulation modelling used to adapt effectiveness evidence to Australian context and synthesis with costs.
(Cobiac, Vos & Veerman, 2010b)	Supermarket displays, flyers and discount coupons	Inefficient	Single study	One high-income country	Simulation modelling used to adapt effectiveness evidence to Australian context and synthesis with costs.
(Dallongeville et al., 2011)	3.4% VAT decrease on fruit and vegetables	Inefficient	Single study	One high-income country	Simulation modelling for synthesis of effectiveness, epidemiological and cost data. Life years saved and deaths averted estimated.
(Dallongeville et al., 2011)	Food stamps for fruit and vegetables targeted at low-income population	Inefficient	Single study	One high-income country	Simulation modelling for synthesis of effectiveness, epidemiological and cost data. Life years saved and deaths averted estimated.
(Sacks et al., 2011)	10% "junk food" tax	Cost-saving	Single study	One high-income country	Simulation modelling synthesizing data on effectiveness, epidemiology and costs.
(Sassi et al., 2009)	10% tax on foods with high fat content and subsidy for 10% reduction in price of fruit and vegetables	Cost-saving	Single study	Multiple countries with different levels of income	Simulation modelling synthesizing data on effectiveness, epidemiology and costs.

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
(Sassi, 2010)	10% tax on foods with high fat content and subsidy for 10% reduction in price of fruit and vegetables	Cost-saving	Single study	Multiple countries; predominantly high-income	Simulation modelling synthesizing data on effectiveness, epidemiology and costs.
(Smith-Spangler et al., 2010)	Voluntary maximum targets for sodium in processed foods	Cost-saving	Single study	One high-income country	Markov modelling synthesizing data on effectiveness and costs.
(Smith-Spangler et al., 2010)	Sodium tax on food production that would increase price of salty foods by 40%	Cost-saving	Single study	One high-income country	Markov modelling synthesizing data on effectiveness and costs.
Food product reformulation					
(Barton et al., 2011; Eatwell, 2012)	Social marketing campaign on risks of high salt diet and product reformulation	Cost-saving	Single study	One high-income country	Salt consumption data from observational data of national programme. Existing model used to estimate longer-term benefits. Assumes gains sustained for 10 years.
(Bibbins-Domingo et al., 2010)	Population-wide regulatory approach to salt reduction	Cost-saving	Single study	One high-income country	Simulation modelling for synthesis of effectiveness, epidemiological and cost data.
(Murray et al., 2003)	Mandatory or voluntary agreements with food industry to reduce salt content of processed foods and appropriate labelling	Efficient	Single study	Multiple countries with different levels of income	Simulation modelling synthesizing data on effectiveness, epidemiology and costs.

Table 3: Unhealthy diets (continued)

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Food product reformulation (continued)					
(Rubinstein et al., 2010)	Reducing 1 gram of salt per 100 grams bread	Cost-saving	Single study	One middle-income country	Simulation modelling for synthesis of effectiveness, epidemiological and cost data.
(Selmer et al., 2000)	To reduce salt consumption through combination of health promotion campaign, product reformulation, taxes on salty foods and subsidies on less salty foods	Cost-saving	Single study	One high-income country	Markov model synthesizing data on effectiveness, epidemiology and costs.

Key: Economic Impact: Defined as efficient (inefficient) intervention has an incremental cost-effectiveness ratio of less (more) than \$50 000 per QALY gained or DALY averted. Also defined as efficient if intervention has a positive net benefit-cost ratio. Defined as cost-saving if reported to have better health outcomes and lower costs in a cost-effectiveness study. Defined as borderline action where inconsistent findings on cost-effectiveness in reported studies. World Bank classification of high-, middle- and low-income countries used.

Table 4: Alcohol

References	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Raising awareness and political commitment					
(Anderson, Chisholm & Fuhr, 2009)	School-based education	Inefficient	Multiple studies with consistent findings	Multiple countries with different levels of income	Systematic reviews demonstrate lack of effectiveness of school-based education.
Health sector response					
(Chisholm et al., 2004, 2006; Lai et al., 2007; Anderson, Chisholm & Fuhr, 2009; Vos et al., 2010)	Brief interventions	Efficient	Multiple studies with consistent findings	Multiple countries with different levels of income	Simulation modelling synthesis of evidence on effect, epidemiology and costs. While efficient and cost-effective, it is dominated by population-level alcohol public health policies.
Community action					
(Anderson, Chisholm & Fuhr, 2009)	Mass media campaigns	Inefficient	Multiple studies with consistent findings	Multiple countries with different levels of income	Systematic reviews demonstrate lack of effectiveness of mass media campaigns.
Drink-driving policy and countermeasures					
(Chisholm et al., 2004, 2006, 2012; Lai et al., 2007; Anderson, Chisholm & Fuhr, 2009; Vos et al., 2010)	Drink-driving legislation and enforcement (via random breath-testing campaigns)	Efficient	Multiple studies with consistent findings	Multiple countries with different levels of income	Simulation modelling synthesis of evidence on effect, epidemiology and costs.
Addressing the availability of alcohol					
(Chisholm et al., 2004, 2006; Lai et al., 2007; Anderson, Chisholm & Fuhr, 2009)	Reduced access to retail outlets by reducing opening hours	Efficient	Multiple studies with consistent findings	Multiple countries with different levels of income	Simulation modelling synthesis of evidence on effect, epidemiology and costs.

Table 4: Alcohol (continued)

References	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Addressing the marketing of alcohol beverages					
(Chisholm et al., 2004, 2006; Lai et al., 2007; Anderson, Chisholm & Fuhr, 2009)	Comprehensive advertising bans	Efficient	Multiple studies with consistent findings	Multiple countries with different levels of income	Simulation modelling synthesis of evidence on effect, epidemiology and costs.
Pricing policies					
(Chisholm et al., 2004, 2006; Lai et al., 2007; Anderson, Chisholm & Fuhr, 2009)	Increased excise taxes (20–50%)	Efficient	Multiple studies with consistent findings	Multiple countries with different levels of income	Simulation modelling synthesis of evidence on effect, epidemiology and costs.
(Chisholm et al., 2004, 2006; Lai et al., 2007; Anderson, Chisholm & Fuhr, 2009)	Improved tax enforcement (20–50% less unrecorded)	Efficient	Single study	Multiple countries with different levels of income	Simulation modelling synthesis of evidence on effect, epidemiology and costs. Not as efficient as increased excise taxes.
Combination strategy					
(Chisholm et al., 2004, 2006; Lai et al., 2007; Anderson, Chisholm & Fuhr, 2009)	Strategy combining many cost-effective measures: e.g. brief advice, random breath-testing, reduced access, advertising ban, plus increased tax (by 50%) and its enforcement (50% less unrecorded consumption)	Efficient	Multiple studies with consistent findings	Multiple countries with different levels of income	Simulation modelling synthesis of evidence on effect, epidemiology and costs.

Key: Economic Impact: Defined as efficient (inefficient) intervention has an incremental cost–effectiveness ratio of less (more) than \$50 000 per QALY gained or DALY averted. Also defined as efficient if intervention has a positive net benefit–cost ratio. Defined as cost-saving if reported to have better health outcomes and lower costs in a cost–effectiveness study. Defined as borderline action where inconsistent findings on cost–effectiveness in reported studies. World Bank classification of high-, middle- and low-income countries used.

Table 5: Environmental hazards

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Childhood lead exposure abatement measures					
(Pichery et al., 2011)	Lead-based paint decontamination, industrial emission abatement, lead pipe removal	Efficient	Single study	One high-income country	Modelling analysis synthesizing data on effectiveness, impact of lead exposure and costs. Positive net benefits; but only a partial cost-benefit analysis as not all costs of abatement measures included. Lifetime perspective adopted with broad range of costs and benefits included: health benefits, juvenile delinquency, productivity losses, special education needs.
(Gould, 2009)	Household lead paint hazard control	Efficient	Single study	One high-income country	Modelling analysis synthesizing data on effectiveness, impact of lead exposure and costs. Positive net benefits; but only a partial cost-benefit analysis. Author notes magnitude of benefits overinflated as only costs of lead paint hazard included in analysis. Lifetime perspective adopted with broad range of costs and benefits included: health benefits, IQ and lifetime earnings, special education, behaviour and crime.
(Grosse et al., 2002; Nichols, 1997)	Regulations banning lead in petrol	Efficient	Single study	One high-income country	Observational study following introduction of regulations in 1970. Costs of regulations compared with estimated economic benefits in better IQ and earnings.

Table 5: Environmental hazards (continued)

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Mercury abatement					
(EPA, 2011)	Implementation of national mercury and air toxics standards	Efficient	Single study	One high-income country	Modelling analysis synthesizing data on effectiveness, impact of mercury and other toxic exposure and costs. Even though not all costs and benefits could be monetized economic benefits of standards considerable. Much of the economic benefits due to reducing direct fine particles and sulphur dioxide. Lifetime impacts on health and productivity included in analysis.
Reducing outdoor air pollution					
(EPA, 1999)	Clean Air Act to reduce pollutants including nitrogen oxide and carbon monoxide	Efficient	Single study	One high-income country	Observation of changes in emissions over 9-year period following introduction of Act. Modelled longer-term impacts to 20 years, including health, productivity and ecological impacts.
Improved chemical safety regulations					
(Risk and Policy Analysts Ltd, 2003; Pickvance et al., 2005)	Multinational regulation on registration, evaluation, authorization and restriction of chemicals. Includes substitution of chemicals with less toxic alternatives if possible	Efficient	Single study	Multiple countries; predominantly high-income	Modelling analysis synthesizing data on effectiveness, impact of reduction in toxic exposures in workplaces and costs of implementing reach. Impacts on respiratory diseases and skin disorders over a 30-year time period modelled.

Key: Economic Impact: Defined as efficient (inefficient) intervention has an incremental cost-effectiveness ratio of less (more) than \$50 000 per QALY gained or DALY averted. Also defined as efficient if intervention has a positive net benefit-cost ratio. Defined as cost-saving if reported to have better health outcomes and lower costs in a cost-effectiveness study. Defined as borderline action where inconsistent findings on cost-effectiveness in reported studies. World Bank classification of high-, middle- and low-income countries used.

Table 6: Road-related injuries

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Traffic-calming measures					
(Gorell & Tootill, 2001)	Range of traffic-calming schemes including separate pedestrian schemes, roundabouts, cycleways and priority junctions	Efficient	4225 sites evaluated with consistent findings	One high-income country	Costs of implementation of schemes and change in accidents taken from national database recording information for each locality. This was compared with the average cost of accidents averted to estimate rate of return on investment.
(Burns, Johnstone & Macdonald, 2001)	Advisory 20 mph speed limits	Efficient	75 sites evaluated with consistent findings	One high-income country	Costs of implementation and health care costs avoided calculated alongside observational study.
(Grundy et al., 2008; Peters & Anderson, 2012; Steinbach et al., 2012)	Mandatory 20 mph speed limits	Borderline	144 sites evaluated with inconsistent findings	One high-income country	Costs of implementation and health care costs avoided calculated alongside observational study. Subsequently re-analysed using cost-benefit analysis and QALYs as outcomes. Cost-saving in high-risk settings using cost-benefit analysis but not efficient if cost per QALY used.
(Elvik et al., 2009)	Use of roundabouts to restrict speed	Efficient	Multiple sites with consistent findings	One high-income country	Costs of implementation and health care costs avoided calculated. Benefits assumed to last for 20 years.
(Meuleners, Hendrie & Lee, 2011)	Use of sealed road shoulders and audible edge lines	Efficient	Multiple sites with consistent findings	One high-income country	Quasi-experimental before-and-after study design over four years. Costs of implementation and health care costs avoided calculated.

Table 6: Road-related injuries (continued)

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Traffic-calming measures (continued)					
(Meuleners et al., 2008)	Various calming measures adopted at accident blackspots e.g. roundabouts, traffic islands, better signage	Efficient	Multiple sites with consistent findings	One high-income country	Before-and-after study design over two years. Costs of implementation and health care costs avoided calculated.
Enforcement of speed limits					
(Chen, 2005; PA Consulting & UCL, 2005; Mendivil et al., 2012)	Speed cameras and photo radar devices	Efficient	Multiple studies with consistent findings	Three high-income countries	Before-and-after study designs. Costs of implementation, health care and other costs avoided calculated.
(Elvik, 2010; Elvik et al., 2009)	Increased police enforcement of traffic regulations	Efficient	Multiple studies with consistent findings	Two high-income countries	Before-and-after study designs. Costs of implementation, health care and other costs avoided calculated.
Enforcement of seat belts and car restraints for children					
(Conner, Xiang & Smith, 2010; Harris & Olukoga, 2005; Stevenson et al., 2008; Chisholm et al., 2012)	Increased enforcement legislation for front seatbelts	Efficient	Multiple studies with consistent findings	Multiple countries with different levels of income	Mainly modelling-based studies analysing previous patterns of seat belt use in accidents.
(Fildes et al., 2003; European Transport Safety Council, 2003)	Automated reminder systems for front seat belts	Efficient	Multiple studies with consistent findings	Multiple countries; predominantly high-income	Modelling-based studies analysing previous patterns of seat belt use in accidents.
(Fildes et al., 2003)	Automated reminder systems for back seat belts	Inefficient	Single study	One high-income country	Modelling-based studies analysing previous patterns of seat belt use in accidents.

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
(Elvik et al., 2009; Miller, Zaloshnja & Hendrie, 2006)	Use of car booster seats for young children	Efficient	Multiple studies with consistent findings	Two high-income countries	Modelling-based studies analysing previous patterns of car booster seats in accidents.
Tackling alcohol impaired driving					
(Chisholm et al., 2004, 2006, 2012; Lai et al., 2007; Anderson, Chisholm & Fuhr, 2009; Vos et al., 2010)	Drink-driving legislation and enforcement (via random breath-testing campaigns)	Efficient	Multiple studies with consistent findings	Multiple countries with different levels of income	Simulation modelling synthesis of evidence on effect, epidemiology and costs.
(Eider et al., 2004)	Mass media campaigns to reduce alcohol impaired driving	Efficient	Two studies with consistent findings	Two high-income countries	Before-and-after study designs. Costs of implementation and broad range of cost, including health care costs and productivity avoided calculated.
(Miller, Blewden & Zhang, 2004)	Mass media campaigns to reduce alcohol impaired driving plus compulsory breath-testing and "booze buses"	Efficient	Single study	One high-income country	Before-and-after study designs. Costs of implementation and broad range of costs, including health care costs and productivity avoided calculated.
(Cobiac et al., 2009)	Raising legal age of drinking from 18 to 21	Efficient	Single study	One high-income country	Modelling-based synthesizing available data on effectiveness and costs and adapting to local context.
(Lahaussie & Fildes, 2009)	Installation of alcohol ignition locks in all new cars	Borderline	Single study	One high-income country	Modelling study. Whether or not intervention will be effective depends on assumptions made in model: ranges from inefficient to cost-saving.

Table 6: Road-related injuries (continued)

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Vehicle modification					
(European Transport Safety Council, 2003; Lestina et al., 2002)	Car lights come on automatically when engine started/ fluorescent lights on cars	Efficient	Two studies with consistent findings	Multiple high-income countries	Modelling analysis look at use and impact of lamps/lights on crashes.
(Lai, Carsten & Tate, 2012)	Intelligent Speed Adaptation systems in cars	Efficient	Single study	One high-income country	Exploratory modelling study.
Licensing and driver education					
(Miller, Lestina & Spicer, 1998)	Night-time driving curfews on drivers aged 19 or less	Efficient	Single study	One high-income country	Before-and-after study design with range of costs and benefits included.
(Gregersen, Nyberg & Berg, 2003)	Additional supervised practice from lay drivers for learner drivers	Efficient	Single study	One high-income country	Economic analysis linked to analysis of national accident data over seven years.
Helmets					
(Taylor & Scuffham, 2002; Hansen & Scuffham, 1995; Hatzianreou et al., 1995; Thompson et al., 1993)	Mandatory use of bicycle helmets	Borderline	Multiple studies with inconsistent results	Multiple high-income countries	Economic analyses linked to observational data. More likely to be efficient if targeted at young children rather than adults.
(Rice, Mackenzie & Jones, 1989; Chisholm et al., 2012)	Mandatory use of motorcycle helmets	Efficient	Multiple studies with consistent results	Multiple countries with different levels of income	More efficient interventions identified in low- and middle-income country contexts.

Key: Economic Impact: Defined as efficient (inefficient) intervention has an incremental cost–effectiveness ratio of less (more) than \$50 000 per QALY gained or DALY averted. Also defined as efficient if intervention has a positive net benefit–cost ratio. Defined as cost-saving if reported to have better health outcomes and lower costs in a cost–effectiveness study. Defined as borderline action where inconsistent findings on cost–effectiveness in reported studies. World Bank classification of high-, middle- and low-income countries used.

Table 7: Promoting mental health, preventing depression

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Parenting and teacher support programmes for mental and emotional well-being					
(Edwards et al., 2007)	Manualized parenting programme (Incredible Years)	Efficient	Single study	One high-income country	Economic evaluation conducted prospectively alongside randomized controlled trial.
(Foster, 2010)	Manualized parenting programme (Incredible Years) plus child-based training and teacher training	Efficient	Multiple studies with consistent findings	One high-income country	Economic evaluation alongside six randomized controlled trials looking at impacts on health and education.
(Mihalopoulos et al., 2011; Foster, Olchowski & Webster-Stratton, 2007; Vos et al., 2010)	Manualized children and parenting programme (Triple P)	Efficient	Multiple studies with consistent findings	Two high-income countries	Modelling based studies in part extrapolating from ongoing randomized controlled trials.
Children and adolescent depression prevention programmes					
(Mihalopoulos et al., 2012)	Screening children and adolescents for symptoms of depression and psychological intervention	Efficient	Single study	One high-income country	Modelling study synthesizing data on effectiveness from multiple trials and costs and adapted to the Australian context.
(Lynch et al., 2005)	Provision of cognitive behavioural therapy for adolescents with depressed parents	Efficient	Single study	One high-income country	Economic evaluation conducted retrospectively following randomized controlled trial.

Table 7: Promoting mental health, preventing depression (continued)

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Prevention of post-partum depression					
(Bauer, Knapp & McDavid, 2011)	Health visitors assessing risk of post-partum depression routinely for new mothers	Efficient	Single study	One high-income country	Modelling study synthesizing data on effectiveness from multiple trials and costs and adapted to the Australian context. Targeted approach has better cost-effectiveness.
(Morrell et al., 2009)	Health visitor delivered psychological therapies plus drug therapy if needed	Efficient	Single study	One high-income country	Economic evaluation conducted prospectively alongside randomized controlled trial.
(Petrou et al., 2006)	Health visitor delivered counselling and support for mother–infant relationship	Efficient	Single study	One high-income country	Economic evaluation conducted prospectively alongside randomized controlled trial.
Workplace mental health promotion programmes					
(Matrix Insight, 2012)	Workplace mental health improvement programme	Cost-saving	Single study	Multiple countries predominantly high-income	Modelling study synthesizing data on effectiveness from multiple trials and costs and adapted to the EU context.
(Matrix Insight, 2012)	Acceptance and commitment therapy	Cost-saving	Single study	Multiple countries predominantly high-income	Modelling study synthesizing data on effectiveness from multiple trials and costs and adapted to the EU context.
(Matrix Insight, 2012)	Stress management	Cost-saving	Single study	Multiple countries predominantly high-income	Modelling study synthesizing data on effectiveness from multiple trials and costs and adapted to the EU context.
(Matrix Insight, 2012)	E-mail cognitive behavioural therapy	Cost-saving	Single study	Multiple countries predominantly high-income	Modelling study synthesizing data on effectiveness from multiple trials and costs and adapted to the EU context.

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
(Matrix Insight, 2012)	Workplace exercise programmes	Cost-saving	Single study	Multiple countries predominantly high-income	Modelling study synthesizing data on effectiveness from multiple trials and costs and adapted to the EU context.
(Matrix Insight, 2012)	Cognitive behavioural therapy	Cost-saving	Single study	Multiple countries predominantly high-income	Modelling study synthesizing data on effectiveness from multiple trials and costs and adapted to the EU context.
(McDaid et al., 2011; NICE, 2009b; Mills et al., 2007)	Multi-component workplace health promotion programme	Cost-saving	Multiple studies with consistent findings	Two high-income countries	Modelling studies building on data collected from one randomized controlled trial at headquarters of multinational company.
	Stress management risk reduction programme for high-risk workers	Efficient	Single study	One high-income country	Economic evaluation conducted prospectively alongside randomized controlled trial.
Prevention of depression in people with physical health problems					
(Smit et al., 2006)	Minimal contact psychotherapy plus usual care	Cost-saving	Single study	One high-income country	Economic evaluation conducted prospectively alongside randomized controlled trial.
Mental health promotion and prevention of depression in older people					
(Munro et al., 2004)	Regular group exercise classes	Efficient	Single study	One high-income country	Economic evaluation conducted alongside randomized controlled trial.
(Pitkala et al., 2009)	Psychosocial group rehabilitation for lonely people	Cost-saving	Single study	One high-income country	Impacts on health care costs assessed prospectively alongside randomized controlled trial.
(Van't Veer-Tazelaar et al., 2010)	Stepped care programme	Efficient	Single study	One high-income country	Economic evaluation conducted alongside randomized controlled trial.

Table 7: Promoting mental health, preventing depression (continued)

Studies	Description	Economic impact	Strength of economic evidence	Cross-national application	Comments
Mental health promotion and prevention of depression in older people (continued)					
(Cohen et al., 2006)	Participation in choral singing programmes	Cost-saving	Single study	One high-income country	Impacts on health care costs assessed prospectively alongside randomized controlled trial; cost of choir not included.
(Markle-Reid et al., 2006)	Nursing health promotion services to bolster personal resilience	Efficient	Single study	One high-income country	Randomized control trial versus usual home care services; costs stated not to be different but better outcomes.
(Onrust et al., 2008)	Volunteer visiting services for bereaved widows	Efficient	Single study	One high-income country	Economic evaluation conducted alongside randomized controlled trial.
E-health interventions for the prevention of depression					
(Warmerdam et al., 2010)	Use of internet-based cognitive behavioural therapy or problem solving therapy for people at high risk of depression	Equivocal	Single study	One high-income country	Economic evaluation conducted alongside randomized controlled trial. Between 50% and 60% chance of either therapy being cost-effective versus waiting list when cost per QALY of \$30 000.

Key: Economic Impact: Defined as efficient (inefficient) intervention has an incremental cost-effectiveness ratio of less (more) than \$50 000 per QALY gained or DALY averted. Also defined as efficient if intervention has a positive net benefit-cost ratio. Defined as cost-saving if reported to have better health outcomes and lower costs in a cost-effectiveness study. Defined as borderline action where inconsistent findings on cost-effectiveness in reported studies. World Bank classification of high-, middle- and low-income countries used.

Joint policy summaries

1. Addressing financial sustainability in health systems
Sarah Thomson, Tom Foubister, Josep Figueras, Joseph Kutzin, Govin Permanand, Lucie Bryndová
2. Assessing future health workforce needs
Gilles Dussault, James Buchan, Walter Sermeus, Zilvinas Padaiga
3. Using audit and feedback to health professionals to improve the quality and safety of health care
Signe Agnes Flottorp, Gro Jamtvedt, Bernhard Gibis, Martin McKee
4. Health system performance comparison: an agenda for policy, information and research
Peter C. Smith, Irene Papanicolas
5. Health policy responses to the financial crisis in Europe
Philippa Mladovsky, Divya Srivastava, Jonathan Cylus, Marina Karanikolos, Tamás Evetovits, Sarah Thomson, Martin McKee

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