



FORESIGHT AND MODELLING FOR EUROPEAN HEALTH POLICY AND REGULATION

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# D 6.2 Review on the evidence on public health impact of existing policies

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In the last two decades, chronic non-communicable diseases (NCDs), mainly cardiovascular diseases, cancers, diabetes, chronic lung disease, depression, musculoskeletal and neurological diseases, are the leading cause of death, disease and disability in the WHO European Region. In Europe, NCDs account for nearly 86% of deaths and 77% of the disease burden, putting increasing strain on health systems, economic development and the well-being of large parts of the population, in particular people aged 50 years and older. At the same time, NCDs are responsible for many of the growing health inequalities that have been observed in many countries, showing a strong socioeconomic gradient and important gender differences (1).

Globally, there has been in recent years, a growing awareness of and mandate for action on NCDs (2). In 2008, the World Health Assembly endorsed the Action Plan for Implementation of the Global Strategy for the Prevention and Control of Non communicable Diseases (2008–2013) updated in 2012 (3), with its comprehensive plan for mapping emerging epidemics, reducing exposure to risk factors and strengthening health care for people with NCDs.

NCDs are linked by common risk factors, underlying determinants and opportunities for intervention. After the identification in the 1950s of tobacco smoking as the principal cause of lung cancer, other major risk factors for NCDs became known, mainly in the 1960s and the early 1970s. The evidence that epidemiologists generated on the role of risk factors influencing health problems and their magnitude was impressive.

At a WHO meeting in 1981, the concept of an integrated approach to the prevention and control of NCD was formulated, based on growing evidence that major NCDs, such as heart disease, stroke, cancer, chronic respiratory disease and diabetes, shared common risk factors such as tobacco use, unhealthy diet, physical inactivity and harmful use of alcohol.

Political awareness and commitment are important for the success of many of the policy interventions aimed at reducing the major risk factors for NCDs.

It is indeed difficult to determine the direct effect of policy interventions on NCDs risk factors and on health outcomes; unless these specific outcomes are measured, doubt about an intervention's effectiveness often persists.

In evaluating interventions aimed at tackling the main NCDs and their main underlying risk factors, 4 criteria must be considered:

- Health impact
- Cost-effectiveness
- Cost of implementation
- Feasibility of scale-up





The interventions with a significant public health impact that are highly cost-effective, inexpensive and feasible to implement are defined as "best buys".

Risk factor/disease	Interventions				
Tobacco use	- Raise taxes on tobacco				
	- Protect people from tobacco smoke				
	- Warn about the dangers of tobacco				
	- Enforce bans on tobacco advertising				
Harmful use of alcohol	- Raise taxes on alcohol				
	- Restrict access to retailed alcohol - Enforce bans on alcohol advertising				
Unhealthy diet and physical	- Reduce salt intake in food				
inactivity	- Replace trans fat with polyunsaturated fat				
	- Promote public awareness about diet and physical activity (via mass media)				
Cardiovascular disease (CVD)	- Provide counselling and multi-drug therapy (including blood sugar control for				
and diabetes	diabetes mellitus) for people with medium-high risk of developing heart				
	attacks and strokes (including those who have established CVD)				
	- Treat heart attacks (myocardial infarction) with aspirin				
Cancer	- Hepatitis B immunization beginning at birth to prevent liver cancer				
	- Screening and treatment of pre-cancerous lesions to prevent cervical cancer				

Table1: Recommended 'best buys'

Since all countries have to make choices on how to allocate resources for health and health care, policy makers have to be guided on where to focus attention in elaborating new policies to tackle NCDs. Of course preventive intervention and improved access to health care do reduce mortality, disability and premature mortality (4), but policy makers also need evidence showing if an intervention is a cost-effective use of resources in a specific resources settings and if scaling up of these interventions is appropriate, affordable and feasible.

Cost-effectiveness summarizes the efficiency with which an intervention produces health outcomes. An intervention is defined "highly cost-effective" when generating an extra year of healthy life (or avoiding one disability-adjusted life year) for a cost that falls below the average annual income or gross domestic product [GDP] per person.

Table 2 summarizes interventions on risk factors for NCDs, for countries of all income levels in terms of their ability to reduce disease burden and the cost, cost-effectiveness, feasibility and timeliness of their implementation.





Risk factor (DALYs, in millions; % global	Interventions / actions (*core set of 'best buys')	Avoidable burden (DALYs averted, millions)	Cost-effectiveness (US\$ per DALY prevented) [Very= < GDP per person; Quite= <3*GDP per person	Implementation cost (US\$ per capita) [Very low= <us\$0.50 Quite low= <us\$ 1<="" th=""><th><b>Feasibility</b> (health system constraints)</th></us\$></us\$0.50 	<b>Feasibility</b> (health system constraints)
Tobacco use (> 50m DALYs; 3.7% global burden)	Protect people from tobacco smoke * Warn about the dangers of tobacco * Enforce bans on tobacco advertising * Raise taxes on tobacco *	Combined effect: 25-30 m DALYs averted (>50% tobacco	Very cost-effective	Very low cost	Highly feasible; strong framework (FCTC)
	Offer counselling to smokers	burden)	Quite cost-effective	Quite low cost	Feasible (primary care)
Harmful use of alcohol (> 50m DALYs;	Restrict access to retailed alcohol * Enforce bans on alcohol advertising * Raise taxes on alcohol *	Combined effect: 5-10 m DALYs averted	Very cost-effective	Very low cost	Highly feasible
4.5% global burden)	Enforce drink driving laws (breath-testing) Offer brief advice for hazardous drinking	(10-20% alcohol burden)	Quite cost-effective	Quite low cost	Intersectorial action Feasible (primary care)
Unhealthy diet (15-30m DALYs; 1-2% global	Reduce salt intake * Replace trans fat with polyunsaturated fat * Promote public awareness about diet *	Effect of salt reduction: 5 m DALYs averted	Very cost-effective	Very low cost	Highly feasible
burden) <sup>b</sup>	Restrict marketing of food and beverages to children Replace saturated fat with unsaturated fat Manage food taxes and subsidies Offer counselling in primary care Provide health education in worksites Promote healthy eating in schools	Other interventions: Not yet assessed globally	Very cost-effective? (more studies needed)	Very low cost	Highly feasible
			Ouite cost-effective	Higher cost	Feasible (primary care)
			Less cost-effective		Highly feasible
Physical inactivity	Promote physical activity (mass media) *	Not yet assessed	Very cost-effective	Very low cost	Highly feasible
(> 30m DALYs; 2.1% global burden)	Promote physical activity (communities) Support active transport strategies Offer counselling in primary care	globally	Not assessed globally	Not assessed globally	Intersectoral action
	Promote physical activity in worksites		Quite cost-effective	Higher cost	Feasible (primary care)
	Promote physical activity in schools		Less cost-effective		Highly feasible

Table 2. <sup>a</sup>DALYs (or disability-adjusted life years) are widely used as a measure of premature mortality and ill-health - one DALY can be thought of as one lost year of healthy life. b This estimate is based on the combined burden of low fruit and vegetable intake, high cholesterol, overweight and obesity, high blood glucose, high blood pressure - all diet related - and low physical activity. From: First Global Ministerial Conference on Healthy Lifestyles and Non Communicable Disease Control - DISCUSSION PAPER <a href="http://www.who.int/nmh/publications/who">http://www.who.int/nmh/publications/who bestbuys to prevent ncds.pdf</a>





# Intervention on risk factors

Preventive strategies focus on the key underlying risk factors for NCDs: tobacco, harmful alcohol use, physical inactivity and unhealthy diet, and sequelae such as raised blood pressure, blood sugar and cholesterol. We will now consider the main policies addressing NCDs and their underlying risk factors, evaluating, where possible, their impact, cost-effectiveness, cost of implementation and feasibility of scale-up.

# **Tobacco**

Tobacco is the most widely available harmful product on the market. Smoking has been directly linked to cancer, cardiovascular disease and respiratory disease, among others (5). A vast literature exists on the relationship between smoking and mortality (6-8). These studies estimate about 4 million deaths per year worldwide attributable to smoking. By 2030, the annual death toll could reach 10 million if no tobacco control measures are taken. To reduce its arm, the WHO Framework Convention on Tobacco Control (FCTC) has proposed a set of policies to reduce demand for tobacco through evidence-based intervention (9,10).

The WHO FCTC includes measures on prices and taxes, exposure to tobacco smoke, the contents of tobacco products, product disclosures, packaging and labelling, education, communication, training and public awareness, tobacco advertising, promotion and sponsorship and reducing tobacco dependence. It also includes sales to and by minors, measures to reduce illicit trade, and support for economically viable alternative activities. It addresses liability, protecting public health policies from the tobacco industry, protecting the environment, national coordinating mechanisms, international cooperation, reporting and exchange of information and institutional arrangements.

Worldwide millions of euros are now spent on tobacco-control policy and it is essential to understand how effective these policies are overall, and which elements of them appear to have most impact. There is robust evidence that tobacco control is cost-effective compared to other health interventions, but measuring the impact of tobacco-control policies is complex and difficult. Single policies can rarely be evaluated in the absence of other policy changes crucial to success in reducing prevalence so that we can normally only speculate on the exact impact of a specific policy element.

International experience strongly suggests that the best results are achieved when a comprehensive set of measures are implemented together and this seems to be borne out by observing that many countries have succeeded in reducing smoking prevalence dramatically.

Implementing key cost-effective interventions (including tax increases, comprehensive legislation creating smoke-free indoor workplaces and public places, health information and warnings about the effects of tobacco, and bans on advertising, promotion and sponsorship) would save more than 5 million deaths in 23 large low- and middle-income countries alone during the period 2006-2015. All four key elements are each considered "best buys", in reducing tobacco use and preventing NCDs. All







of these interventions reduce social acceptance of tobacco use, thereby increasing demand for cessation therapies. In this context, it is a "good buy" to provide smokers in particular, and tobacco users in general, with treatment for tobacco dependence (11). Most deaths averted would be from cardiovascular diseases (75.6%), followed by deaths from respiratory diseases (15.4%) and cancer (8.7%) (12). Available evidence from the same analysis indicates that the cost of implementing all four interventions would cost less than USD 0.40 per person per year in low-income and lower-middle income countries (in other upper-middle income countries the cost is USD 0.5-1.0 per person per year).

#### **Pricing policies**

Increases in taxes on and prices of tobacco products are the most effective and cost-effective tobacco-control strategy according to the World Bank, especially for young people and others on low incomes, who must, of necessity, be highly price responsive. Tobacco use among young people is very price sensitive, with reductions in tobacco use in this group two to three times larger with a given price increase than among adults (13). With larger reductions in tobacco use by young people than older tobacco users, the societal benefits of higher tobacco taxes are predicted to grow over time as future generations quit at younger ages or never start in the first place (13).

Given the well-documented health and economic benefits of cessation, reduced adult smoking prevalence resulting from tax and price increases lead to substantial improvements in public health as well as reduced economic costs (14). The impact of tobacco taxation on the reduction of mortality depends on the magnitude of the price increase resulting from a tobacco tax increase, the magnitude of the price elasticity (the negative relationship between price and consumption), which includes smoking behavior (quitting or initiating) in relation to the price increase, and the relationship between mortality and quitting smoking. For example, if the price elasticity of demand for cigarettes is -0.5%, a 10% price increase will reduce consumption by 5% (15). Empirical literature indicates that about one third to one half of the 5% reduction in cigarette consumption is the result of people quitting or not initiating smoking (5). The literature suggests that about one quarter to one half of those who quit smoking will avoid a smoking-related premature death (16,17).

Experiences from around the word show that tobacco taxes and consumption are strongly inversely related. Well over 100 studies worldwide demonstrate that increases in taxes on cigarettes and other tobacco products lead to significant reductions in use. Before 2000, nearly all of this research was conducted in high-income countries (12). Research from high-income countries generally finds that a 10% price increase will reduce overall tobacco use by between 2.5% and 5% (4% on average) in the medium term (within a few years), and perhaps twice this in the longer-term (5 years or longer) (13). Estimates of the effect of price increases in low- and middle-income countries are more variable, but





often point to larger reductions in overall consumption than those reported in high-income countries (13). Most estimates from low- and middle-income countries show that a 10% price increase will reduce tobacco use by between 2% and 8% (5% on average) (13).

Asaria et al, (12) estimated the effects of successful implementation of price tobacco control strategies, using methods from the WHO Comparative Risk Assessment project. With the assumption of price elasticities ranging between -0.40 and -1.20 for 23 low income and middle-income countries, an increased real price of cigarettes to reduce smoking prevalence by 10% in combination with midrange estimates of non-price interventions would reduce the smoking prevalence rate by 20%, and 2.19 million deaths from cardiovascular disease would be averted, as well as 2.12 million from respiratory disease, and 1.20 million from cancer, for a total of 5.5 million deaths averted.

In France, large price increases were followed by declines in smoking prevalence and lung cancer deaths (Fig.1) (18). France took only 15 years to halve consumption. France's uptake of smoking was chiefly after the Second World War and its prevalence rose until the mid-1980s. From 1990 to 2005, cigarette consumption fell from about six cigarettes per adult per day to three cigarettes per adult per day. This sharp decline was mostly due to a sharp increase in tobacco taxation starting in 1990 under the then president Jacques Chirac. These price increases raised the inflation-adjusted price threefold. Among men, the corresponding lung cancer rates at ages 35-44, which is a good measure of recent smoking in the population, fell sharply from 1997 onward. Tax levels stagnated from 2004 onward when Nicolas Sarkozy became finance minister as has the declines in per capita cigarette consumption. The decline in lung cancer was also due, more controversially, to replacement of high-tar with lower-tar cigarettes (19).

Similar results on reductions in lung cancer risk among ex-smokers are seen in Poland. In Germany and Italy, the excess lung cancer mortality avoided among men who quit smoking by age 40 was 91%, and 80%, respectively (20).









Figure 1. Declines in smoking prevalence and lung cancer deaths accompany large price increases in France (data 1974-2009)

#### **Non-price policies**

There is some evidence from European countries of the impact of various specific policy elements, including emerging evidence from Belgium, the Netherlands, Poland and the UK that larger more prominent health warnings have measurably, and considerably greater impact. On advertising bans, the World Bank concluded that the most comprehensive restrictions would reduce consumption by >6% in high income countries. This estimate suggests that the EU's ban on advertising would reduce cigarette consumption by nearly 7% (21).

Emerging evidence from the UK indicates that the enhancement of the health warnings substantially increased their salience: smokers thinking about warning labels, reports of smokers forgoing a cigarette because of the labels, perceived effectiveness of the warning labels, and smokers considering warning labels as a motivation to quit compared with reactions to warnings in countries outside Europe. Large health warnings on cigarette packs were introduced in the UK from 1 January 2003 .The percentage of respondents noticing the warning labels increased from just over 40% in 2002 to just over 80% in 2003.

In November 2002, a Dutch tobacco-control organization, Defacto, presented the results of studies on the effects of the new health warnings. These studies indicated that some adult smokers said that they smoked less and were more motivated to quit by the new health warnings. They found an even stronger effect among those aged 13-18 years: 28% said that they smoked less because of the new health warnings.

A Belgian study released in May 2004 confirmed the Dutch findings and found that bigger, clearer warnings motivated smokers to stop smoking and made cigarette packs less attractive to youngsters





(22). Warnings on cigarettes have been compulsory in Belgium since 30 September 2003, and cover an average of 55% of the front and back of the package, making them the largest in the world. The Flemish Institute of Public Health, in collaboration with the Belgian Federation against Cancer has conducted research among 608 smokers over 15 years of age in Belgium in December 2003 and January 2004 regarding the effects of the health warnings. Amongst the findings were the following:

• Warnings were particularly effective amongst young people between 15-24 years of age and amongst those who wished to stop smoking within the year.

• Young people found it easier to remember the messages than other age groups. Fifty-six per cent of the age group 15-24 years agreed with the statement that they had discussed the new health warnings with family or friends. Forty per cent of all smokers felt the packaging was becoming less attractive to youngsters.

• Twenty-nine per cent of all smokers felt that warnings were an additional motivation to stop smoking. Amongst those who declared that they wished to stop smoking within a year, the percentage was even 46%.

• As a result of the new warnings 8% of those questioned smoked less, 2% more and 88% as much as before.

In Poland, large health warnings have been found to be strongly linked with smokers' decisions to stop or reduce their smoking. Among Polish male smokers, 3% said they had quit following the introduction of new very large warnings, an additional 16% said they had tried quitting, and a further 14% said they understood the health effects of smoking better because of the warnings (13).

#### Cost and cost-effectiveness analysis

One of the immediate impacts of the tobacco control policies is that some smokers quit smoking. Quitting smoking reduces the incidence of smoking-related illness, thus saving healthcare costs. The potential impact of health cost savings can be documented by numerous studies of the cost of smoking around the world. There are two approaches to estimating the cost of smoking: one is based on the incidence rate, and the other is based on the prevalence rate. The incidence-based approach estimates the lifetime cost of smoking (23,24) while the prevalence-based studies estimate the cost of smoking in a given year for a given country (25). The incidence approach requires extensive sources and numerous lifetime epidemiological and economic assumptions. Thus, most cost of smoking studies are estimated by the prevalence-based approach.

The key assumption used in the prevalence approach is to estimate the smoking-attributable fraction (SAF) for comparing the healthcare cost of current smokers, former smokers and never smokers, mainly for three disease categories: cancer, vascular disease and respiratory diseases. Using healthcare expenditures surveys and associating with these disease categories, the SAF is calculated by disease category and relevant socio-demographic distinctions (rural/urban, gender, age). The





estimated SAF is then multiplied by each cost estimate of interest to obtain smoking attributable cost. For example, the product of SAF and total inpatient hospitalization expenditure is smoking-attributable hospitalization costs; the product of SAF and total morbidity cost is smokingattributable morbidity costs (25).

An alternative method of cost estimation is to use a regression model comparing the overall healthcare expenditures between smokers (former and current) and never smokers. This method requires extensive data to compare various smoking states as well as a set of socio-demographic variables. The magnitude of smoking costs is influenced by method of estimation, cost data source, assumption of SAF, and time period of the study. Even for the same country and the same year, costs could vary by these factors (25).

One approach for assessing the impact of tobacco taxation on healthcare cost savings is to first estimate the amount of healthcare services (inpatient, outpatient, medication) prevented or averted due to quitting smoking, and then to estimate the unit cost of these healthcare services.

A Netherland study (26), compared healthcare costs among smokers and nonsmokers to estimate the effect of smoking cessation on healthcare costs over time. They found that the healthcare costs for smokers at any given age are as much as 40% higher than those for nonsmokers, but only in the short run. In the long run, the study compared the healthcare costs incurred by smokers and lifetime healthcare cost incurred by non-smokers; with the additional years gained, the total lifetime healthcare costs for non-smokers are higher than smokers. If these costs are converted into present value (with a discount rate of 3% to 5%), smoking cessation would not lead to increased healthcare cost. A study of the United Kingdom prepared for Action on Smoking and Health (27) provided an economic analysis of the impact of increasing tobacco tax on net benefits to the United Kingdom economy as a whole. Assuming -0.35 as prevalence elasticity, they estimate that an increase of 5% in tobacco prices would cause 190000 smokers to quit smoking, a total cost savings of 10.2 billion. These cost savings consist of £1.97 billion for National Health Services, £1.36 billion for reduced absenteeism, £1.15 billion for output from extra working life, and £5.74 billion for values of extra life years.

#### Conclusion

Price increases have the greatest impact on future tobacco mortality; a 70 percent higher price would prevent more than 110 million deaths, or one-quarter of all expected premature deaths from tobacco worldwide. Of avoided deaths, about 25 million would be from cancer and 50 million would be from vascular disease. Nonprice interventions would prevent 35 million deaths. The greatest impact of these tobacco control interventions would occur after 2015, but a substantial number of deaths could be avoided even prior to then. By 2030 to 2035, the expected annual toll of ten million deaths could be reduced to about seven million.





On current smoking patterns, about one billion people will be killed in the 21st century by smoking. Without widespread cessation, about 400 million people alive today will be killed by smoking between 2010 and 2050.

Smoking-attributable cancer and total deaths have fallen sharply in high-income countries but will rise globally unless today's smokers, most of whom live in low- and middle-income countries, quit smoking before or during middle age.





# <u>Alcohol</u>

Around 4.6% of all ill health and premature death worldwide is due to alcohol, with poorer populations and lower-income countries having a greater disease burden per litre of alcohol than higher-income populations and countries (28).

Reduction in the harmful use of alcohol is important in preventing and tackling cancers and cardiovascular disease. Harmful use of alcohol is also a preventable cause of other burdensome non communicable and injury conditions, including liver cirrhosis, depression and road traffic injury. Enhanced taxation of alcoholic beverages and comprehensive bans on their advertising/marketing are recommended "best buys", based on their favourable cost-effectiveness, low cost and feasibility.

Alcohol policies have been defined as sets of measures aimed at keeping the health and social harms from the use of alcohol to a minimum (29). Much of the published work to establish the effectiveness of alcohol policies has been done in high-income societies, although some policies have been assessed in low-income countries (30).

## Information and Education

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Provision of information and education is important to raise awareness and impart knowledge; however, in an environment in which many competing messages are received in the form of marketing and social norms supporting drinking, and in which alcohol is readily accessible, it does not lead to sustained changes in behaviour. Many systematic reviews have assessed school-based education and concluded that classroom based education is not an effective intervention to reduce alcohol-related harm (31). Although some evidence suggests a positive effect on increased knowledge about alcohol and on improved alcohol-related attitudes, evidence for a sustained effect on behaviour is scarce. Parenting (32) and social marketing (33) programmes have mixed effects. The little research that is available has shown that industry-funded educational programmes tend to lead to positive views about alcohol and the alcohol industry (34). Generally, public information campaigns are ineffective in reducing alcohol-related harm (35). The effects of counter advertising-a variant of public information campaigns that provides information about a product, its effects, and the industry that promotes it, to decrease its appeal and use-are inconclusive. No rigorous assessments of whether or not publicising drinking guidelines have any effect on alcohol-related harm have been done. Assessment of the effect of mandated health warnings on alcohol product containers does not show that exposure produces a change in drinking behaviour, although some intervening variables are affected, such as intention to change drinking patterns. These results contrast with those for tobacco, for which evidence does suggest an effect. However, this evidence could be an indicator of the nature of the warning labels, since the introduction of more graphic and larger warnings for cigarettes, with alternating messages, has affected behavior (36). Nevertheless, warning labels are important to help establish a social understanding that alcohol is a hazardous commodity.







#### Restriction on the availability of alcohol

Although total bans on the sale of alcohol exist in several countries with large Muslim populations, there are also other widely dispersed bans for the use of alcohol in particular locations, circumstances, or statuses, eg. drinking in parks or streets, hospitals, or at the workplace. Government monopolies for the sale of alcohol can reduce alcohol-related harm (37); such systems tend to have fewer stores, which are open for shorter hours than systems of private sellers. Without government monopolies, having a licensing system for the sale of alcohol allows for control, since infringement of laws can be met by licence revocation; however, an introduction of a licensing system, with fees generated from licences, can lead to a proliferation of licensed establishments as a mechanism to generate income for jurisdictions.

Implementation of laws that set a minimum age for the purchase of alcohol show clear reductions in drink-driving casualties and other alcohol-related harms (38); the most effective means of enforcement is on sellers, who have a vested interest in retaining the right to sell alcohol.

Urban settings can also be risk factors for harmful alcohol use and harmful patterns of drinking, especially in areas of low social capital (39). An increased density of alcohol outlets is associated with increased amounts of alcohol consumption among young people (40), with increased numbers of assault, and with other harms such as homicide, child abuse and neglect, self-inflicted injury, and, with less consistent evidence, road traffic accidents. Although extending times of sale can redistribute the times when many alcohol-related incidents occur, such extensions generally do not reduce rates of violent incidents and often lead to an overall increase in consumption and problems (41). A reduction of the hours or days of sale of alcoholic beverages leads to fewer alcohol-related problems, including homicides and assaults. Strict restrictions on availability can create an opportunity for an illicit market; but, in the absence of substantial home or illicit production, in most circumstances such restrictions can be managed with enforcement.

#### Marketing

Alcohol is marketed through increasingly sophisticated advertising in mainstream media, and through linking alcohol brands to sports and cultural activities, through sponsorships and product placements, and through direct marketing such as the internet, podcasting, and mobile telephones. Econometric studies of the link between alcohol advertising and consumption have noted only weak interactions (42), largely because of methodological difficulties. The strongest evidence, however, comes from longitudinal studies that have shown an effect of various forms of alcohol marketing—including exposure to alcohol advertising in traditional media and promotion in the form of movie content and of alcohol-branded merchandise, on initiation of youth drinking, and on riskier patterns of youth drinking (43). These findings are supported by those from experimental studies (44). The effects of exposure seem cumulative and, in markets with greater availability of alcohol advertising, young





people are likely to continue to increase their drinking as they move into their mid-20s, whereas drinking decreases at an earlier age in people who are less exposed to it. In some jurisdictions, alcohol marketing relies on self-regulation implemented by economic operators, including advertising, media, and alcohol producers. However, evidence from several studies shows that these voluntary systems do not prevent marketing content that affect young people (45).

## **Pricing Policies**

Drinkers respond to changes in the price of alcohol as they do to changes in the price of other consumer products. When other factors are held constant, such as income and the price of other goods, a rise in alcohol prices leads to less alcohol consumption and less alcohol-related harm (and vice versa) in both high income (42) and low-income countries (46,47). Demand for alcohol is fairly inelastic to price, such that an increase in price results in a drop in consumption that is smaller than the price increase. Thus, increasing alcohol taxes not only reduces alcohol consumption and related harm, but also increases government revenue at the same time (48). The existence of a substantial illicit market for alcohol complicates policy considerations for alcohol taxes (47); in such circumstances, tax changes are needed to bring the illicit market under effective government control, eg, taxation policies that increase the attractiveness of lower alcohol-content forms of culturally preferred beverages, such as decreased rates of taxation on low-strength beer.

Beverage elasticities are generally lower for the preferred beverage (beer, spirits, or wine) in a particular market than for the less-preferred beverages, and tend to decrease with increased levels of consumption (49). Controlling for overall consumption, beverage preferences, and time period, consumer responses to changes in the price of alcoholic beverages do not vary by country (49). If prices are raised, consumers reduce overall consumption and tend to change to cheaper beverages, with heavier drinkers tending to buy the cheaper products within their preferred beverage category. The effect of an increase in alcohol price tends to be stronger in the long rather than the short term, which is important from a public health perspective (42). Policies that increase alcohol prices delay the start of drinking, slow young people's progression towards drinking large amounts, and reduce young people's heavy drinking and the volume of alcohol consumed per occasion (50). Price increases reduce the harms caused by alcohol (51) and alcohol dependence (52). Setting a minimum price per unit gram of alcohol is modelled to reduce consumption and alcohol-related harm (53). Price increases and a set minimum price are both estimated to have a much greater effect on heavier than on lighter drinkers, with modest or only small extra financial cost to lighter drinkers. Natural experiments in Europe consequent to economic treaties have shown that as alcohol taxes and prices were lowered, so sales, alcohol consumption, and alcohol-related harm have usually increased.







#### Cost and cost-effectiveness of alcohol policies

The effect of harmful use of alcohol extends beyond the direct health-related consequences to drinkers (mortality and morbidity effects) to a broader set of social costs, including criminal damage, violence, and lost productivity in the workplace. Documentation of these social costs is important in itself, because the negative spill over effects (or so-called externalities) imposed on society as a result of the private consumption of alcohol represent instances of market failure, which is a central justification for government intervention and action. Studies of social costs have been done in many countries (28), and the proportion of these costs that are avoidable via the implementation of cost-effective and effective policy measures has been estimated for a small subset. Improved understanding of which measures or strategies represent best use of society's resources, and by how much they can reduce the harmful consequences of alcohol use, is directly relevant to an evidence-based approach to alcohol policy, planning, and assessment.

Action area	Coverage	Yearly cost per head	Cost per DALY
		(1\$)*	saved (15)*
Action Area 1 - Raising awareness and political			
commitment			
School based education	80%	0,34	NA‡
Action Area 2 - Health sector response			
Brief interventions for heavy drinkers	30%	1,78	2671
Action Area 3 - Community action			
Mass media campaign	80%	0,79	NA‡
Action Area 4 - Addressing the availability of alcohol			
Reduced access to retail outlets	80%	0,47	567
Action Area 5 - Addressing marketing of alcohol			
beverages			
Comprehensive advertising ban	95%	0,47	961
Action Area 6 – pricing Policies			
-increased excise taxation (by 20%)	95%	0,67	380
- increased excise taxation (by 50%)	95%	0,67	335
-tax enforcement (20% less unrecorded)	95%	0,87	498
-tax enforcement (50% less unrecorded)	95%	0,93	480
Combination strategy			
Brief advice, random breath-testing,		4,10	754
reduced access, advertising ban, plus			
increased tax (by 50%) and its			
enforcement (50% less unrecorded			
consumption)			
*Implementation cost in 2005 international dollars (IC)	+Cost off optimerous re	tio overaccod in interna	tional dollars nor

\*Implementation cost in 2005 international dollars (I\$). †Cost-eff ectiveness ratio, expressed in international dollars per disability-adjusted life-year (DALY) saved for the year 2005. ‡Not applicable (NA) because eff ect size not signifi cantly diff erent from zero (cost-eff ectiveness ratio would therefore approach infi nity).

Table 3. Cost and cost-effectiveness of interventions relating to different target areas for alcohol public health policy





The results in table 3 shows the estimated costs of school-based education and mass-media awareness campaigns (action area 1 and 3 respectively). Although these interventions are not expensive, they do not notably affect consumption levels or health outcomes. Such interventions are therefore not effective or cost-effective strategies to pursue to reduce health-related harm due to alcohol use (especially since other actionable strategies exist that are very cost effective).

For the second action area, the health-sector response, brief interventions for hazardous alcohol use have been greatly studied. Compared with the situation of no alcohol control policies, the costeffectiveness of such interventions (in the range of I\$2000–4000 per DALY saved) is not as favourable as is the population-level policy instruments because they involve direct contact with health-care professionals and services. For alcohol dependence, a disease entity in its own right, the relative costeffectiveness of pharmacological agents (such as acamprosate and naltrexone) has yet to be assessed. The effect of reducing access to retail outlets for specified periods of the week and implementation of a comprehensive advertising ban (which are specific interventions relating to action area 5 and 6, addressing the availability and marketing of alcoholic beverages, respectively) have the potential to be very cost-effective countermeasures, but only if they are fully enforced (every healthy year of life restored costs between I\$500 and I\$1000). Within the category of pricing policies (action area 7), consistent evidence shows that the consumption of alcohol is responsive to an increase in final price, which can be effectuated via higher excise taxes on alcoholic beverages. Tax increases (of 20% or even 50%) represent a highly cost-effective response in countries with a high prevalence of heavy drinking (eg, every DALY saved costs less than I\$500 in European settings). In lower-prevalence contexts, population-level effects fall and cost-effectiveness ratios rise accordingly. The effect of increases in alcohol tax stands to be mitigated by illegal production, tax evasion, and illegal trading, which accounts for roughly a third of all consumption. Reduction of this unrecorded consumption (by 20-50%) via concerted tax-enforcement strategies is estimated to cost 50–100% more than a tax increase but produces similar levels of effect. Specific intervention strategies are not implemented in isolation, but should be combined to maximize possible health gains up to the point at which it remains affordable to do so. The best possible mix of interventions at different spending limits will depend on the relative cost and cost-effectiveness of the individual components, and on the interactions that exist between them. Table 3 includes an example of a wide-ranging combination strategy, showing that although cost-effectiveness is maintained, implementation costs naturally rise.

#### Conclusions

A substantial evidence base exists for the effectiveness of different policies in reducing the harm caused by alcohol. Essentially, policies that regulate the environment in which alcohol is marketed (economic and physical availability and commercial communications) are effective in reducing alcohol-related harm. Enforced legislative measures to reduce drink-driving are effective, as are





individually-directed interventions to drinkers already at risk. However, the evidence shows that information and education type programmes do not reduce alcohol-related harm; nevertheless, they have an important role in providing information, and in increasing attention and acceptance to alcohol on the political and public agendas. Addition of a cost component to health impact assessment allows the opportunity to identify alcohol prevention and control strategies that offer greatest (or worst) value for money. For example, devotion of scarce resources to interventions that do not discernibly reduce the harm caused by alcohol, as seen for information and education, is not economically rational and serves only to divert resources away from efficient prevention or control strategies. Conversely, taxation policies cost fairly little to implement but reap substantial health returns. All the population-based interventions represent a cost-effective use of resources (against the international benchmark of per head income), and compare favourably with treatment strategies for disease and injury that could in fact result from harmful alcohol use (eg, cirrhosis of the liver, depression, trauma care for people injured by alcohol-impaired drivers). Brief interventions for the treatment of individual high-risk drinkers also compare favourably with such treatment strategies, but are evidently harder to scale-up because of their associated training and manpower needs. The presence of an evidenced-based alcohol policy, although important, is not enough. Policy needs to be implemented, assessed, and refined. Furthermore, alcohol is the only major dependence-producing psychoactive substance causing substantial harm to health, and globally it is the most often used psychoactive substance. However, at present alcohol is not covered by an international treaty.





# **Physical inactivity**

It is widely recognised that regular physical activity is beneficial to both physical and mental health (54). It is associated with reduced risk of chronic diseases, including coronary heart disease (55), stroke and diabetes and has been shown to be positively linked to mental health (56), including depression (57). The evidence further highlights that 5% of the burden of disease from coronary heart disease, 7% from type 2 diabetes, 9% from breast cancer and 10% from colon cancer are estimated to be a consequence of physical inactivity, resulting in 1 million deaths (about 10% of all deaths) and 8.3 million disability-adjusted life years lost per year in the WHO European Region (58).

The Global Strategy on Diet, Physical Activity and Health endorsed by the World Health Assembly in 2004, and the Action Plan for the Global Strategy for the Prevention and Control of Non communicable Diseases 2008–2013 (59,60) urge Member States to implement the outlined programmes and actions to increase levels of physical activity among their populations. A wide range of interventions have been shown to increase physical activity, and a number of them constitute a good buy.

Raising levels of physical activity require countries to develop and implement a combination of policies aimed at informing, motivating and supporting individuals and communities to be active. Multi-targeted approaches to encourage walking and cycling to school, and create healthier commuting and leisure activities, showed moderate effectiveness (61).

#### School-based and workplace interventions

School-based physical activity interventions show consistent improvements in knowledge, attitudes, behaviour and, when tested, physical and clinical outcomes. Schools should include a physical activity component taught by trained teachers in a supportive environment, and also include parental involvement. Benefits include mental health and behavioural improvements, and the physical activity habits developed appear to carry on into later years. Findings from a WHO review showed that school-based interventions are most often assessed, whereas few studies focused on other public health interventions and hardly any were from low-income countries (61). However, there is still a scarcity of cost-effectiveness research in this area.

Multi-component programmes promoting physical activity in the workplace are shown to be effective when they a) provide space for fitness and signs to encourage the use of stairs; b) involve workers in programme planning and implementation; c) involve families through self-learning programmes, newsletters, festivals, etc.; d) provide individual behaviour change strategies and self-monitoring.





## Community and primary health care interventions

Community based physical activity interventions have been shown to be effective in increasing population physical activity levels. The most effective physical activity interventions at the community level include community development campaigns with multisectoral cooperation that focus on a common goal, such as reduction in CVD risk, as well as group-based physical activity programmes or classes for homogenous groups. Community interventions that provide advice on lifestyle modifications of moderate physical activity and diet advice have been shown to prevent diabetes in people who have impaired glucose tolerance. The effect of participation in physical activity and improving diet is about equal to that of drug therapy.

Interventions to increase physical activity at the population level are effective and must be integrated into strategies to prevent and control NCDs. Mass media interventions can be considered a best buy for physical activity promotion (62). Promoting physical activity (in combination with a healthy diet) through the media has been estimated to be a cost-effective, low-cost and highly feasible option.

Exercise-referral schemes have been introduced in UK to encourage exercise participation in sedentary adults, particularly those with chronic ill-health. Exercise-referral schemes resulted in a statistically significant increase in the numbers of sedentary people becoming moderately active. However, the absolute risk reduction was small, with 17 sedentary people needing to be referred for one to become moderately active. This was most likely due to poor participation and compliance rates. The qualitative studies identified barriers to participation, which included personal barriers such as lack of self-efficacy, poor body image, poor time management, and lack of social support, as well as exercise scheme barriers such as intimidating environments, inadequate supervision, and inconvenient opening hours (63).

Walking, exercise groups or brief exercise advice on prescription, delivered in person or by phone or mail, appeared to be more cost-effective than supervised gym-based exercise classes or instructor-led walking programmes. Based on the higher-quality studies, it is possible to deliver a physical activity intervention for between €1120 and €15.860 per quality-adjusted life-year gained, which is more cost-effective than many other currently-funded pharmaceutical interventions (63).

Physical activity counselling in primary health care has been recommended (64). In some countries at least 80% of the population visit primary health care annually (65,66) making this an ideal setting for intervening to increase physical activity. Furthermore, patients expect to receive health-related messages in this context and may therefore be more receptive to brief advice or referral to community-based interventions. Physical activity interventions based in primary health care, such as exercise on prescription, have been shown to be effective (67-70) and cost-effective (71,72) with a cost-utility ratio comparable to many currently-funded pharmaceutical therapies.





## Cost and cost-effectiveness analysis

Physical inactivity has a broad impact on societal costs: it contributes to between 1.5% and 3.0% of direct health care costs in developed counties (73) and also results indirectly in higher costs owing to increased periods of sick leave, work disabilities and premature deaths.

For a population of 10 million people, of which half the population are insufficiently active, the overall cost is estimated to be €910 million per year. There is a dose-response relationship for cardiovascular disease and diabetes with risk reduction routinely occurring at levels of 150 minutes of activity per week. Evidence also shows that participation in 30 to 60 minutes of physical activity per day significantly reduces risk of breast and colon cancer (58).

It is difficult to determine the total cost of physical inactivity on society, especially since only a fraction of the costs can be estimated. In a British calculation (74), the societal costs were estimated to be 8.2 billion pounds. For a population of 9 million people, such as in Sweden, these costs correspond to 18 billion SKr. Diseases included were angina pectoris, myocardial infarction, stroke, colon cancer, type 2 diabetes, hypertension, osteoarthritis, depression and back pain. In a Swedish report (75), the costs of physical inactivity were calculated at 0.4% of the health care costs, and 3% of losses in production due to illness.

A systematic review of the cost-effectiveness of physical activity interventions within primary health care was completed in 2002, in which eight studies were identified, published between 1996 and 2002 (76). The review found that there was a trend towards favourable cost-effectiveness of physical activity promotion through primary health care but there were few trials available of mixed study quality. The cost-effectiveness of community-based physical activity promotion in general was assessed by another systematic review which also showed favourable results, but included modelling studies and evaluations of workplace or infrastructural innovations in the community, as well as individual based interventions to promote physical activity (77).

In a British study (78) it was determined that there are strong economic arguments in favor of the value of exercise in adults aged 45 years and more, but not in younger adults. Indirect effects of physical activity, such as obesity, have not been considered in these calculations. In 1983, a British study found that sedentary people were shown to consume more benefits from collectively financed programs such as sick leave and health, disability, and group life insurance than moderately active people. Because they on average die 10 month earlier, they pay lower lifetime taxes on earnings, and collect less in public and private pensions. As a result of these differences, the sedentary person imposes US\$9,300 in lifetime external costs and US\$1,650 in discounted lifetime external costs (79). The investigation was controlled for physical disability (not able to exercise) and for heavy drinkers, but not for other lifestyles that may correlate to a sedentary lifestyle. Smokers were also studied as the previous study and the costs of a sedentary lifestyle were larger than for smoking.





A Danish analysis from 2005 (80) reported that if an 30-year old physically inactive person became moderately active, the expected gains in production were an estimated 65,000-78,000 Danish crowns (80,000-100,000 SKr), calculated using the human capital method and discounted by 5%. When the friction method was used, savings were estimated to be 9,000-15,000 Danish crowns (11,000-19,000 SKr). The costs of health care would decrease by 27,000-29,000 Danish crowns (34,000-36,000 SKr) and the increased lifespan was estimated to limit the reduction of health care costs to 18,000-24,000 Danish crowns (22,000-30,000 SKr). The analysis was controlled for smoking, alcoholic consumption, socioeconomic factors, BMI, increased blood pressure and cholesterol.

## Conclusion

In general, the promotion of physical activity among patients with increased risk or manifest poor health associated with physical inactivity seems to be cost-effective compared to standard care. There is still little evidence of what the best design of an intervention might be. Different groups of patients need different methods of promoting physical activity.

An important aspect of sustainable increase of physical activity and cost-effectiveness is the ability of the intervention to create enjoyable physical activity. This emphasizes the need for health care to be involved in the design of the performance of physical activity.

Interventions to increase physical activity at the population level are effective and must be integrated into strategies to prevent and control NCDs. Multiple intervention strategies including physical activity have been shown to have favorable cost-effectiveness profiles, and there is an emerging body of evidence which shows promise of cost-effectiveness for physical activity interventions alone, however these have not yet been assessed for their global applicability.





# **Unhealthy diet**

The burden of disease associated with poor nutrition continues to grow in the European Region, particularly as a result of the obesity epidemic, and unhealthy diet is one of the major risk factors for chronic diseases. Obesity has important consequences for morbidity, disability and quality of life, and obese adults are especially likely to develop type 2 diabetes, cardiovascular diseases, several common forms of cancer, osteoarthritis and other health problems (81). The trend in obesity is especially alarming in children and adolescents with an annual rate of increase in the prevalence of childhood obesity that has been growing steadily, being the current rate 10 times that in the 1970s. This contributes to the obesity epidemic in adults and creates a growing health challenge for the next generation.

For diet, recommendations for populations and individuals should include the achievement of an energy balance and a healthy weight by the limitation of salt consumption, free sugars and total fats (possibly shifting fat consumption away from saturated fats to unsaturated fats and towards the elimination of trans-fatty acids), and a parallel increase in consumption of fruits, vegetable, and legumes, whole grains and nuts.

The World Health Organization (WHO) has recommended the use of fiscal policy to influence food prices "in ways that encourage healthy eating" (59,60). Although this is consistent with growing worldwide interest in the effect of fiscal policy on diet (82-84), evidence supporting the use of taxes is weak.

Currently, financial incentives favour the consumption of highly processed, energy-dense foods since it is consistently cheaper, in terms of energy content for a given price, than less energy-dense and often more nutrient-rich foods (85,86). Taxing less healthy foods could create a financial incentive for consumers to avoid them. Many studies on the effect of manipulating food prices show that both individual consumers (87,88) and population groups (89,90) do respond as predicted.

Very little evidence about the use of food taxes as a public health strategy is available. Cash & Lacanilao (91) examined pricing and taxation studies on food and concluded that more evidence is needed on the efficacy of taxation as a health intervention to support taking action.

Most of the evidence available comes from the grey literature or from modelling studies (91,92). They show that taxes and subsidies on food have the potential to influence consumption considerably and improve health, particularly when they are large (92). Taxes may also reinforce efforts to educate consumers. Being aware that a product has been taxed because it is unhealthy may discourage purchases. Cash & Lacanilao (93) observed this effect when warning labels were placed on products that were taxed because of their high fat content.

One argument against fat taxes is their potential regressivity: they impose a larger burden on the poor than the rich.





Most of the available literature although, highlights the inadequate evidence available for policymakers. In particular, the review's findings are limited by the high proportion of modelling studies, which are based on assumptions and subject to data limitations. Moreover, many modelling studies analyse only target food consumption and overlook shifts in consumption within or across food categories. No experimental studies are available, which probably reflects the difficulty of designing such studies of interventions at a population level. Wide variations in data sources and analytical methods also make it difficult to compare the effectiveness of the taxes assessed.

#### Salt

The sodium risk factor was ranked 11<sup>th</sup> globally out of all risk factors considered for disease burden identified in the Global Burden of Disease Study 2010 (93). A direct correlation between blood pressure and dietary salt intake is now well established and it is consolidated that sodium reduction also reduces long term risk of cardiovascular events. Current estimates indicate that a 15 percent reduction in salt intake could prevent 8.5 million deaths worldwide from cardiovascular disease over 10 years. Salt reduction is therefore to be considered a public health priority, and in 2012 the WHO recommended a "reduction to <2 g/day sodium (5 g/day salt) in adults (*strong recommendation*)" (94).

Focusing on individual behavior change is not enough to make an impact on cardiovascular disease because most salt is added to food during manufacturing, rather than at the table. Therefore, a three-pronged approach should form the foundation for comprehensive salt reduction policy:

-Communication: Create and evaluate public awareness campaigns to educate consumers about salt and its health effects, by media campaign and food labelling.

-Reformulation: Set progressive targets for lowering sodium levels in existing processed food and partner with industry to set standards for new food products. This process must include voluntary or mandatory salt standards or market pressure from consumers for lower-sodium products.

-Regulation: Connect with the food industry, including regulatory agencies, to create a "level playing field" of lower sodium products.

Health and Economic Impacts of Eight Different Dietary Salt Reduction Interventions Nhung Nghiem, Tony Blakely, (95), and Nick Wilson, have compared 8 sodium reduction interventions, using epidemiological modelling and cost-utility analysis. Although the setting was New Zealand, this work is of interest for the interventions considered, some of them already performed in UK:

- 1. mandatory 25% reduction in sodium levels in all processed foods;
- 2. a package of interventions performed in the UK (media campaign, voluntary food reformulation and food labelling changes) (96);
- 3. mandatory 25% reduction in sodium levels in bread, processed meats and sauces;
- 4. the media campaign part of the UK package alone;







- 5. voluntary food labelling as currently used in NZ;
- 6. dietary counselling as currently used in NZ;
- the theoretical options of a "sinking lid" on the amount of food salt released to the national market to achieve an average adult intake of 2300 mg sodium/day;
- 8. an hypothetical excise salt tax, to be applied and increased up to the point where the recommended level of sodium intake is achieved.

All the interventions produced net cost savings (except counselling – albeit still cost-effective) (Fig 2). The largest health gain was from the potential intervention of a Sinking Lid in food salt released to the market to achieve an average adult intake of 2300 mg sodium/day It achieved 211,000 QALYs gained (95% uncertainty interval [UI]: 170,000–255,000). This QALY benefit was followed in descending order by that from a: (i) Salt Tax (195,000 QALYs gained); (ii) mandatory 25% reduction of sodium levels in processed food ("Mandatory-All"), (110,000); (iii) the package of interventions performed in the UK (85,100); (iv) mandatory 25% reduction in sodium levels in bread, processed meats and sauces ("Mandatory-3G"); (v) Media Campaign as per the UK one (25,200); (vi) the voluntary Endorsement Label Programme as currently used in New Zealand (7900); and (vii) Dietary Counselling as currently used in New Zealand (200 QALYs gained).



Figure 2. Cost-effectiveness plane with the eight salt-reduction interventions for the New Zealand adult population. From PLoS One. 2015; 10(4): e0123915

In 2014 Marissa Collins et all (97), published a study on the cost-effectiveness of four population health policies to reduce dietary salt intake on an English population, to prevent coronary heart disease. They compare four policies, touching different approaches:

- 1) Change4Life health promotion campaign
- 2) Front-of-pack traffic light labeling to display salt content



3) Food Standards Agency working with the food industry to reduce salt (voluntary)

4) Mandatory reformulation to reduce salt in processed foods.

The effectiveness of these policies in reducing salt intake, and hence blood pressure, was determined by systematic literature review (Tab.4). The model calculated the reduction in mortality associated with each policy, quantified as life-years gained over 10 years (Tab. 5). Policy costs were calculated using evidence from published sources. All policies resulted in a life-year gain over the baseline. Change4life and labeling each gained approximately 1960 life-years, voluntary reformulation 14,560 life-years, and mandatory reformulation 19,320 life-years. Each policy appeared cost saving, with mandatory reformulation offering the largest cost saving, more than £660 million.

Policy	Estimated reduction by policy (%)	Estimated decrease in salt intake (g/d)		
		Best	Min	Max
Change4life	2	0.16	0.065	0.486
Labeling	2	0.16	0.065	0.486
Reformulation-voluntary	15	1.21	0.324	1.944
Reformulation-mandatory	20	1.62	0.648	3.110

Table 4- Estimated policy effects on decreases in salt intakes using best estimates (g/d)

Policy	Policy costs	Health care costs (£)	Total costs (£)
Baseline	0	15,008,250,131	15,008,250,131
Change4Life	41,605,237	14,574,001,919	14,615,607,156
Labeling	36,851,600	14,574,001,919	14,610,853,519
Reformulation—voluntary	17,527,929	14,406,406,793	14,423,934,722
Reformulation—mandatory (best case)	17,527,929	14,321,677,353	14,339,205,282
Reformulation-mandatory (worst case)	500,619,716	14,321,677,353	14,822,297,070

Table 5. Discounted costs of each policy over 10 y

#### Sugar

Globally, the number of people overweight or obese has reached epidemic proportions fueling the growing rates of non-communicable diseases, including at least ten cancers. Excessive sugar consumption is one factor promoting overweight and obesity. Sugar is widely available and cheap. Over the last decade, global sugar consumption has grown from about 130 to 178 million tonnes. The WHO's sugar guideline, issued in March 2015, recommends that adults and children restrict their sugar intake to less than 10% of total energy intake per day, which is the equivalent of around 12.5 teaspoons of sugar for adults, and suggests a further reduction to below 5% of total energy intake per day (98). Effective, feasible policy actions are available for governments to reduce the availability and

affordability of sugar and sugary products, influence the acceptability of alternatives and raise





awareness about the sugar contained in products in an effort to move towards meeting the WHO sugar guideline.

Examples of actions which have had these effects include school nutrition standards; vending machine ban; a front-of-package symbol; soda taxes; programme targeting retail environments; programme promoting increased water consumption in schools; school fruit and vegetable programmes; healthy marketing campaign and a comprehensive nutrition and health programme. Experience from officials implementing these policies and pilot programmes provides important insights for governments to help them design more effective policies to reduce sugar intake in the context of broader dietary improvements. Insights include the need for measurable indicators of change; engagement, incentives, and/or clear standards for entities involved in the manufacture and delivery of food; actions to inform stakeholders about the broader benefits of reduced sugar consumption; clear and understandable messages for consumers, and synergistic, complementary actions. A comprehensive approach is needed to reduce sugar consumption at a population level.

Sugar-sweetened beverages (SSBs) have been stressed as relevant targets of public health interventions considering the evidence supporting a cause-and-effect association of SSBs with obesity and other diseases. Considering the burden of disease and the financial constraints posed to healthcare systems derived by obesity globally, policy makers and governments around the world have widely supported and joined efforts in improving low- or non-caloric beverage consumption patterns. Actions taken have encompassed interventions to decrease consumption of SSBs or/and increase water intake at community levels, through school policies and media coverage (health campaigns). Political measures like taxation and marketing restrictions have also been implemented.

Little evidence is available though, on the effectiveness that different strategies and multi-component programmes, have had to influence this particular dietary behavior across all ages. Vargas-Garcia EJ et all (99) published in 2015 a protocol for a meta-analysis for the evaluation of the effect of public health interventions to reduce SSBs intake or increase water intake in children and adults, to guide the design of future programmes and inform policy making (Fig.3).

Randomized controlled trials and quasi-experimental interventions (with a control group) that have reported baseline and post-intervention intakes of SSBs or water, have been published from 1990 in any language.









Figure 3. Decreasing SSB and/or increasing water intake. Interventions and activities for decreasing SSB and/or increasing water intake in children and adults. SSB, sugar-sweetened beverage. From: Impact of interventions to reduce sugar-sweetened beverage intake in children and adults: a protocol for a systematic review and meta-analysis. EJ Vargas-Garcia et all. Syst Rev. 2015; 4: 17.

Policy can be used to help us reduce sugar intake by influencing: how available sugar and sugary products are, how affordable they are, how acceptable sugar and its alternatives are perceived to be and how aware we are of sugar in products.

The World Cancer Research Fund International, has implemented a policy database called NOURISHING (www.wcrf.org/NOURISHING), comprising policies that can affect the 4 A's that influence sugar consumption (availability, affordability, acceptability and awareness) used by many countries around the world to implement actions to promote healthier diets. It is an interactive tool designed to help policymakers, researchers and civil society organization worldwide take action to tackle unhealthy diets.

In 2015, the World Cancer Research Fund International published a report indicating some of the effective policies implemented in different countries (98). Some examples:

1. France's 2004 Public Health Law including a vending machine ban in schools. Comparing data from 1998 and 2006 (before and after the ban was implemented), a significant reduction in calories (between 90-115 calories), fat, sodium and, especially, free sugar intakes (10-12 grams) was observed during morning break after the ban came into force.







2. The Dutch School Gruiten Programme implemented in 2003 with a 3-year pilot, provided one serving of fruit or vegetables twice a week at no cost to school children. Children from schools with the intervention program brought in fruit and vegetables and fewer unhealthy snacks from home, significantly more often than children in schools without the intervention. Starting in 2006, the School Gruiten Programme was rolled out nationally with the costs of the fruit and vegetables passed onto schools, parents or third parties. The SchoolGruiten Programme ran until 2013 and the teaching materials were adapted and transitioned into the EU School Fruit Programme.

3. Norway's School Fruit Programmes initiated in 1996 and made nationwide in 2003, for students in grades 1-10. In 2007, a free school fruit program was also implemented nationwide in all secondary elementary schools (grades 8-10) and combined schools (grades 1-10). In both programmes, a piece of fruit or vegetable was provided every school day to students. Research shows that students enrolled in schools implementing the programme increased their overall fruit and vegetable intake and reduced the frequency of their unhealthy snack consumption (sugary drinks, candy and potato chips). In the free fruit program, the reduced frequency in consumption of unhealthy snacks was especially evident among students with parents with lower educational attainment. Norway's Free School Fruit Programme was replaced with a subscription program in 2014.

4. The Hungarian Aqua Promoting Program in the Young (HAPPY) was implemented initially as a two-month intervention programme in 2007. HAPPY aimed to increase the popularity of drinking water among primary school students aged 7 to 10. The program promoted water consumption by educating students about adequate fluid consumption and making free water available (in water coolers) on school premises. At the end of the intervention, there was a significant increase in the children's knowledge about fluid intake, a significant decrease in sugary drinks consumption, and an increase in water consumption (with almost two-thirds of students reducing the amount of sugary drinks they consumed). In addition, fewer students brought sugary drinks to school and more students brought water to school following the intervention. Based on the success of the pilot, in 2010 the National Institute for Food and Nutrition Science extended HAPPY nationwide for voluntary adoption by schools. In 2014, around 144 schools had implemented the program.

Other evidences and cost effectiveness of policies to reduce sugar intake can be found in the "CDC Guide to Strategies for Reducing the Consumption of Sugar-Sweetened Beverages" (100).

Different strategies are evaluated:

#### -Ensuring ready access to potable drinking water

A school-based environmental and educational intervention was conducted to promote water consumption among elementary school students in Germany. The intervention focused on the water needs of the body and the water circuit in nature. For the environmental intervention, water





fountains were installed in schools, and plastic water bottles were given to each child. Outcome measures were evaluated at baseline and 1 year after intervention. The results indicated that the risk of overweight was significantly decreased by 31% in the intervention group compared to the control group. Furthermore, water consumption was 1.1 glasses/day (about 7.4 ounces) higher in the intervention group (101).

<u>-Decrease the relative cost of more healthful beverage alternatives through differential pricing of SSBs</u> The impact of price interventions on soft drink consumption may vary substantially depending on baseline consumption status. On the basis of a paper prepared for the Congress of the European Association of Agricultural Economists, individuals who drink greater amounts of SSBs are more sensitive to price increases and less likely to drink SSBs as prices increase in Norway. In this study, increasing the price of soft drinks by 11% was estimated to decrease consumption by nearly 7% in the lowest consumers and 17% among highest consumers. Increasing the price by 27% was associated with a drop in consumption of 17% in the lowest use group, 44% in the highest use group, with an overall 24% reduction in consumption across the population. This larger increase would reduce consumption of sugar-sweetened sodas by 2 liters per year for the moderate consumers and by 74 liters per year for those in the top 5% in level of consumption (102).

#### Fat

Trans fatty acids (TFA) are unsaturated fatty acids with at least one double bond in a *trans* position, obtained from ruminants, such as dairy products and meat, and in industrially produced partially hydrogenated vegetable oils (103). Human consumption of naturally occurring TFAs from ruminants is generally low and there is evidence to suggest that it does not adversely affect health. In contrast, consumption of industrially produced partially hydrogenated vegetable oils has been associated with an increased risk of cardiovascular disease, infertility, endometriosis, gallstones, Alzheimer's disease, diabetes and some cancers (104). In the 1960s, following public health campaigns aimed at decreasing the use of animal fats, the food industry began using substantial amounts of partially hydrogenated vegetable oils in processed food. Their use is favored by industry – and their removal resisted – because: they are cheap; they are semisolid at room temperature, which makes them easier to use in baked products; they have a long shelf-life; and they can withstand repeated heating (105).

TFA have been shown to increase low density lipoprotein cholesterol concentrations, decrease high density lipoprotein cholesterol concentrations, and can cause systemic inflammation as well as endothelial dysfunction (104).

A meta-analysis of pooled prospective studies found that for every 2% of total energy (%E) that comes from trans fatty acids, there is a 23% increase (95% confidence interval 11% to 37%) in incidence of coronary heart disease (104). Higher intake is also associated with increased all cause mortality. This makes TFA more dangerous on a per gram basis than other types of fat (106).





Elimination of TFA is recommended by the UK Faculty of Public Health (107) and by the World Health Organization, which includes elimination in its global strategy on diet, physical activity and health (59). Currently in the UK, elimination of TFA is a component of the Department of Health's "public health responsibility deal" (59), which simply advocates voluntary reformulation. Internationally, however, several types of public health policies have been enacted to reduce consumption of TFA (1): total bans, mandatory labelling, restaurant bans, and voluntary reformulation. We evaluated three options for further restricting consumption in England: a ban of TFA in processed foods, improved labelling of trans fatty acids, and a restaurant ban.

Kirk Allen and collegues (108) analyzed health and equity benefits and cost effectiveness of policies to reduce or eliminate TFA from processed foods, for 2015-20 in England only. They considered as interventions: total ban on TFA in processed foods; improved labelling of trans fatty acids; bans on trans fatty acids in restaurants and takeaways.

Their work shows (Fig.4) that a total ban on TFA in processed foods might prevent or postpone about 7200 deaths (2.6%) from coronary heart disease from 2015-20 and reduce inequality in mortality from coronary heart disease by about 3000 deaths (15%). Policies to improve labelling or simply remove TFA from restaurants/fast food could save between 1800 (0.7%) and 3500 (1.3%) deaths from coronary heart disease and reduce inequalities by 600 (3%) to 1500 (7%) deaths, thus making them at best half as effective. A total ban would have the greatest net cost savings of about £265m (€361m, \$415m) excluding reformulation costs, or £64m if substantial reformulation costs are incurred outside the normal cycle. They showed that in England a regulatory policy to eliminate TFA from processed foods would be the most effective and equitable policy option. Intermediate policies would also be beneficial, but simply continuing to rely on industry to voluntary reformulate products, however, could have negative health and economic outcomes.







Figure.4. Contributions of each cost category for each policy option for reduction in trans fatty acids. Costs to government and industry are expressed as positive and savings from reductions in direct healthcare, productivity loss, and informal care are expressed as negative. From: Kirk Allen et all. Potential of trans fats policies to reduce socioeconomic inequalities in mortality from coronary heart disease in England: cost effectiveness modelling study BMJ 2015; 15 September 2015

The removal of partially hydrogenated vegetable oils containing industrially produced TFAs from the food supply has been described as one of the most straightforward public health interventions for improving diet and reducing the risk of non communicable disease (105).

Although the removal of TFAs from the food supply has been identified as a "best-buy" public health intervention for low- and middle-income countries (11), WHO Member States that took part in consultations indicated "low (no) support" for including the removal of TFAs as a global monitoring target because of concerns about the feasibility, achievability and public health effect of removing them from the food supply (100). However, both national and local bans of TFAs in foodstuffs have been implemented throughout the world (Fig.5), which demonstrates that the removal of TFAs is both feasible and achievable.







Figure. 5 Trans fat policies around the world, 2005-2012

Political awareness and commitment are important for the success of many of the policy interventions aimed at reducing TFAs in the food supply, and although bans proved to be most effective, many countries, states and cities lack the political will to introduce the necessary legislation. Even when the political commitment is there, the prospect of legislation often provokes resistance from food and agriculture industries.

When Denmark introduced its ban on TFAs, the country experienced resistance from the European Union, which regarded the legislation as creating a barrier to trade given that all food in the country, including imports, had to abide by the restriction on TFAs.

In conclusion, TFA policies are associated with significant reductions in TFA levels in the food supply: such policies are feasible, achievable and likely to have an effect on public health. Although product reformulation in high-income countries has improved the fatty acid profile of foods, further research is needed in low-resource settings to identify context-specific challenges and policy responses. Moreover, monitoring TFA levels in the food supply is important for ensuring that progress continues, particularly in low-income settings where little information on consumption is available. Encouraging the agriculture sector to increase the supply of suitable alternative oils may facilitate product reformulation. Finally, it is important to note that reducing the TFA content of food is only one component of a multipronged strategy to improve diet and reduce the risk of diet-related chronic disease.





#### Conclusions

Food taxes and subsidies can influence consumption in high-income countries and imposing substantial taxes on fattening foods may improve health outcomes such as body weight and chronic disease risk. Current recommendations state that taxes and subsidies should be included as part of a comprehensive strategy to prevent obesity.

Further research is recommended in four areas. First, experimental studies are needed to document actual responses of both prices and consumers to changes in food taxation. These will predominantly involve the evaluation of natural experiments. Second, future modelling studies should examine changes in the entire diet resulting from price changes rather than in single food items to take account of shifts in food consumption within or across food categories. These studies will require the standardization of models for converting energy imbalances to weight changes, thereby avoiding simple, arithmetic equations that imply that weight changes indefinitely. Third, there is a need for research into consumer responses to food taxes in developing countries where differential population effects may be greater. Finally, implementation and administrative costs need to be examined as they represent potential barriers to the feasibility of these interventions.





### Cost-effective individual health care interventions

Cardiovascular disease, diabetes, cancer and respiratory disease account for around 20% of the world's disease burden (over 300 million disability-adjusted life years lost annually). To address these major NCDs there are `best buy` interventions that can be implemented in primary care even in resource-constrained settings and a significant proportion of the burden caused by major NCDs can be reduced scaling-up these interventions (Table 6 summarizes interventions on chronic diseases for countries of all income levels in terms of their ability to reduce disease burden and the cost, cost-effectiveness, feasibility and timeliness of their implementation).

## Integrated care for prevention and control of cardiovascular disease and diabetes

People at risk of heart attacks and stroke usually have modest elevation of multiple risk factors, such as smoking, raised blood pressure, raised cholesterol and/or diabetes. Such people who have medium-high cardiovascular risk should be treated with a multidrug regimen and counseling to reduce the risk of developing heart attacks, strokes, cardiac failure and kidney failure. This intervention, which is based on the total cardiovascular risk, is more cost-effective and less expensive than conventional single risk factor interventions countries.

Other very cost effective for CVD and diabetes are: (i) providing aspirin to people with an acute heart attack, which can save the lives of 1 in 5 of those with a heart attack; (ii) providing multidrug treatment and counseling to people following a heart attack or stroke to prevent recurrent attacks, which buys a reduction of recurrent events up to 75% - and of course a decrease in mortality; and (iii) controlling glucose levels in people with diabetes by insulin, oral glucose-lowering medication, diet and exercise, which reduces levels of blindness and kidney failure.

#### Cancer

Many of the above interventions for reducing tobacco use, physical inactivity, the harmful use of alcohol and unhealthy diets also reduce the risk of certain cancers. Effective methods of prevention, early detection, diagnosis, treatment and palliative care are available for many types of cancer including cervical cancer, breast cancer, colorectal cancer and oral cancer.

There is evidence that population-based interventions are superior to individual-based approaches in terms of coverage, equity, quality control, and cost-effectiveness (109, 110)

Cancer-specific strategies include specific interventions aimed at avoidance or control of cancer associated infections.

Chronic Hepatitis B virus (HBV) infection is a major cause of liver cancer. The development of chronic HBV infection is inversely related to age of infection. Therefore, WHO recommends universal infant immunization including a birth dose by incorporating hepatitis B vaccination in national infant





immunization programmes, the most cost-effective strategy for preventing chronic HBV infection and primary liver cancer. Hepatitis B vaccine immunization is a best buy (111).

Human papillomavirus (HPV) infection is the main cause of cervical cancer. Currently available HPV vaccines can prevent up to 70% of incident cervical cancer. It is recommended to include HPV immunization into comprehensive cervical cancer prevention and control programmes where appropriate (i.e. in countries where cervical cancer represents a priority) and feasible (112).

Major challenges for the introduction of HPV vaccination are the high cost of the vaccine and the recommendation to target adolescent girls, for whom no efficient vaccination platform is in place.

Fortunately, the cost of the vaccine for the public sector is declining. It has been estimated that, with a good coverage of adolescent girls (70% at least) and at I\$ 10 per vaccinated girl (approximately I\$ 2.00 per dose, plus wastage, administration and programme support), HPV vaccination would be cost-effective in the 72 poorest countries – a cost of per DALY averted of less than I\$ 200 in most of these countries. A separate analysis for low- resource settings similarly found that HPV vaccination would be just as (highly) cost-effective as alternative screening and treatment strategies assuming that vaccine prices will fall to US\$ 2 or less (113). Both analyses also demonstrated that combining vaccination of adolescent girls and screening of adult women can reduce cervical cancer faster than programmes resorting to only one strategy.

Protection against environmental or occupational risk factors for cancer includes very effective prevention strategies, as low-cost interventions are often available. Although not always resulting in large numbers of prevented cases, such interventions often result in reduction of local occurrences of avoidable lethal cancers. Examples include: reduced exposure to solar radiation in susceptible populations; better food storage in countries with high humidity, to reduce aflatoxin-related hepatocellular cancers; bans on the use of asbestos to reduce mesothelioma and lung cancer; higher awareness and more strict regulation for occupational hygiene and worker protection; reduced indoor air pollution from cooking or heating from combustion of solid fuels; reduced contamination of drinking-water and soil by better regulations for the protection of the public and the environment.

In addition to primary prevention, secondary prevention can also be cost-effective. Population-based cancer screening is effective in reducing the cancer burden. It consists of the application of validated tests, examinations and other procedures that can be applied rapidly to the general population.

Over 50 years of experience in cancer screening in high-resource countries has demonstrated that population-based organized screening programmes can reduce cancer mortality in a cost-effective way (109,110).

Breast cancer is generally diagnosed at an advanced stage. While there is evidence from high-income countries that screening with mammography will reduce mortality from breast cancer, it is essential to ensure that the required capacity, funding and infrastructure for treatment exist before initiating such programmes. Available economic evidence indicates that treatment of early-stage breast cancer





is the most cost-effective and affordable option. A comprehensive mammographic screening and treatment programme is also cost-effective but is much less affordable in low-resource settings with low incidence (109).

Cervical cancer is the second most important cancer in women, and the first in many low-income countries. In too many countries, cervical cancer is generally diagnosed in an advanced stage. There is evidence that organized cytology screening has reduced cervical cancer mortality in many highincome countries (69). Screening of cervical cancer using HPV testing and, to a lesser extent, visual inspection with acetic acid, have been successfully implemented and evaluated in low-income settings and may be a first priority for cancer prevention and control in these countries (113). New, low-cost HPV screening tests, combined with HPV vaccination, have the potential for a major improvement in cervical cancer control worldwide, although the high vaccine price makes this option a less affordable option at the present time (114). Colorectal cancer is the most frequent cancer in nonsmokers worldwide. Different screening options (i.e. search for occult fecal blood, sigmoidoscopy, and colonoscopy) have been validated and included in organized screening programmes in highincome countries. Colorectal screening programmes have not yet been implemented in low-resource countries, due to the relatively lower incidence of the disease and the high cost and complications assessing pre-cancerous lesions (115). Prostate cancer is the second most frequent cancer in men worldwide. However more studies are needed to establish the merit of population screening with regard to reduction of prostate cancer-specific mortality and quality of life improvement (116).

#### Chronic respiratory disease

The main contributors to the global burden of chronic respiratory disease are asthma and chronic obstructive pulmonary disease. Standard treatment of asthma consists of inhaled salbutamol for intermittent asthma and inhaled salbutamol and inhaled corticosteroids for persistent asthma; these are very low cost and feasible to deliver in primary care, but their cost-effectiveness is limited by their modest impact on disease burden. For persons with chronic obstructive pulmonary disease , similar conclusions can be made concerning these drug treatments. As highlighted above, tobacco cessation and mitigation indoor air pollution are the key strategies for preventing chronic respiratory disease.





<b>Risk factor</b>	Interventions / actions	Avoidable burden	<b>Cost-effectiveness</b> (US\$ per DALY prevented)	Implementation cost (US\$ per capita)	Feasibility
(%global burden; DALYs <sup>ª</sup> )	(*core set of 'best buys')	(DALYs averted, millions)	[Very= < GDP per person; Quite= <3*GDP per person Less= >3* GDP per person]	[Very low= <us\$0.50 Quite low= <us\$ 1<br="">Higher = &gt;US\$ 1]</us\$></us\$0.50 	(health system constraints)
Cardiovascular disease (CVD) & diabetes (170m DALYs; 11.3% global burden)	Counselling & multi-drug therapy (including glycemic control for diabetes mellitus) for people (≥30 years), with 10- year risk of fatal or nonfatal cardiovascular events ≥ 30%c *	60 m DALYS averted (35% CVD burden)	Very cost-effective	Quite low cost	Feasible (primary care)
	Aspirin therapy for acute myocardial infarction*	4 m DALYs averted (2% CVD burden)	Very cost-effective	Quite low cost	
	Counselling & multi-drug therapy (including glycemic control for diabetes mellitus) for people ( $\geq$ 30 years), with a 10-year risk of fatal and nonfatal cardiovascular events $\geq$ 20%	70 m DALYS averted (40% CVD burden)	Quite cost-effective	Higher cost	
<b>Cancer</b> (78m DALYs; 5.1% global burden)	Cervical cancer - screening (VIA), and treatment of pre- cancerous lesions to prevent cervical cancer *	5 m DALYs averted (6% cancer burden)	Very cost- effective	Very low cost	Feasible (primary care)
	Breast cancer - treatment of stage I		Quite cost-effective	Higher cost	
	Breast cancer - early case finding through mammographic screening (50 - 70 years) and treatment of all stages	3 m DALYS averted (4% cancer burden) 15m DALYs averted (19% cancer burden)	Quite cost-effective	Higher cost	Not feasible in primary care (diagnosis and treatment
	Colorectal cancer - screening at age 50 and		Quite cost-effective	Quite low cost	requires
	treatment Oral cancer - early detection and treatment	7 m DALYs averted (9% cancer burden) Not assessed globally	Not assessed globally	Not assessed	secondary or tertiary care)
Respiratory disease (60m DALYs; 3.9% global burden)	Treatment of persistent asthma with inhaled corticosteroids & beta-2 agonists	Not assessed globally (expected to be small)	Quite cost-effective	Very low cost	Feasible (primary care)

Table 6. <sup>a</sup>DALYs (or disability-adjusted life years) are widely used as a measure of premature mortalityy and ill health - one DALY can be thought of as one lost year of healthy life. From: First Global Ministerial Conference on Healthy Lifestyles and Non Communicable Disease Control - DISCUSSION PAPER http://www.who.int/nmh/publications/who\_bestbuys\_to\_prevent\_ncds.pdf







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