

Chapter 4

Reducing risks and preventing disease: population-wide interventions

The global epidemic of NCDs can be reversed through modest investments in interventions. Some effective approaches are so low in cost that country income levels need not be a major barrier to successful prevention. What is needed are high levels of commitment, good planning, community mobilization and intense focus on a small range of critical actions. With these, quick gains will be achieved in reducing the major behavioural risk factors: tobacco use, harmful use of alcohol, unhealthy diet and physical inactivity, together with key risk factors for cancer, notably some chronic infections.

This chapter demonstrates that best practices exist in many countries with different income levels. It reviews affordable actions that are evidence-based and can be taken immediately to save lives and prevent disease. Further actions that can achieve even greater successes are also detailed.

This chapter introduces the concepts of ‘best buys’ and ‘good buys’, based on cost-effectiveness and other information. A **best buy** is an intervention that is not only highly cost-effective but also cheap, feasible and culturally acceptable to implement. **Good buys** are other interventions that may cost more or generate less health gain but still provide good value for money. A highly cost-effective intervention is one that, on average, provides an extra year of healthy life (equivalent to averting one DALY) for less than the average annual income per person. For example, in Eastern Europe, any intervention that produces a healthy year of life for less than US\$ 9972 (the average GDP per capita) is deemed to be highly cost-effective; an intervention that does so for less than three times GDP per capita is still considered reasonable value for money or quite cost-effective. These threshold values are based on a recommendation by the WHO Commission on Macroeconomics and Health (2001) and the work of the WHO cost-effectiveness CHOICE project.

Reducing tobacco use

Tobacco is the most widely available harmful product on the market. To reduce its harms, WHO sponsored the negotiations of the WHO Framework Convention on Tobacco Control (WHO FCTC), its first legally-binding international treaty. The treaty sets a framework for guidelines and protocols to reduce tobacco consumption and tobacco supply through evidence-based interventions (1).

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 (2).

There is robust evidence that tobacco control is cost-effective compared to other health interventions. The evidence base on what works to reduce harm from tobacco provided the foundation for the WHO FCTC (3). The 1998 book *Curbing the Epidemic* (4), a landmark World Bank publication, addressed the economic costs of tobacco and estimated the overall impact of tobacco control interventions.

Key cost-effective interventions include tobacco tax increases, timely dissemination of information about the health risks of smoking, restrictions on smoking in public places and workplaces, and comprehensive bans on advertising, promotion and sponsorship (5). These 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.

There is robust evidence that tobacco control is cost-effective compared to other health interventions

Increases in taxes on and prices of tobacco products are by far the **best buys** in tobacco control because they can significantly reduce tobacco use through lower initiation and increased cessation, especially among young people and the poor (6). Increases in tobacco excise taxes increase prices and reduce the prevalence of adult tobacco use. The effectiveness of tax and price policies in tobacco control has been recently documented in detail (7).

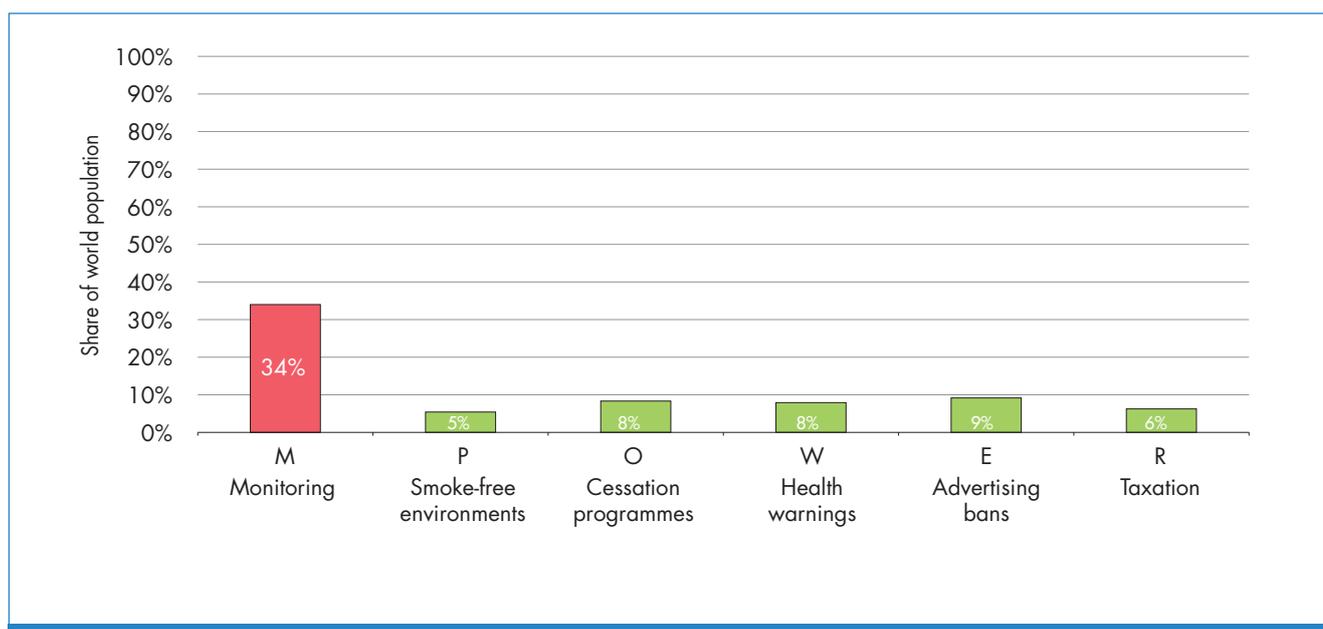
Smoke-free work and public places reduce second-hand smoke (8) and effectively help smokers cut down or quit, while reducing smoking initiation. Smoke-free policies reduce the opportunities to sustain nicotine addiction in individuals at early stages of dependence, youth in particular (9). Furthermore, smoke-free laws enjoy popular support and high levels of compliance when properly implemented, providing an additional message that smoking is not socially acceptable. For all these reasons, protection from second-hand tobacco smoke is a **best buy**.

Providing information to adults about tobacco-dependence and health impacts of tobacco can reduce consumption and is another **best buy**. Regular and creative mass media campaigns and graphic health warnings on tobacco packages have been shown to reduce demand (10, 11). Country-based experience suggests that despite tobacco companies' opposition and the resource constraints faced by health authorities, implementation of health warnings is generally powerful and successful (12). A comprehensive set of tobacco advertising, promotion and sponsorship bans is a **best buy** and can reduce tobacco consumption by up to 6.3%. However, limited advertising bans have little or no effect (13).

Cost-effective tobacco cessation assistance is a **good buy**. Treatment should be available at public health (including toll free 'quitlines' and awareness-raising campaigns) and primary care services. The most effective treatment modality is a combination of behavioural and pharmacological therapies (14).

Evidence shows that tobacco control interventions are affordable in all countries. One study (15) modelled price increases, workplace bans, health warnings and bans on advertising for 23 countries. This showed that 5.5 million deaths could be averted at a cost of less than US\$ 0.40 per person per year in low- and lower-middle-income countries, and US\$ 0.5–1.00 in upper-middle-income countries. Yet, less than 10% of the world's population in 2008 was fully covered by any of the tobacco control demand reduction measures in the WHO FCTC (16).

Figure 1. Share of the world population covered by selected tobacco control policies, 2008



Factors that hinder implementation of cost-effective measures can include the lack of resources and political will and competing priorities. To increase adoption and implementation of tobacco interventions, key approaches are needed:

Cooperation: Virtually all countries that have implemented successful tobacco control programmes – countries from all regions and income levels – have engaged diverse sectors such as finance, trade, customs, agriculture, industry affairs, labour, environment and education.

Comprehensiveness: Programmes should focus on multiple interventions (17), including preventing initiation, promoting cessation, reducing exposure to second-hand smoke, regulating tobacco products and eliminating disparities among population subgroups (18).

Capacity: A national plan of action and a national commission or steering committee is needed, along with high-level partnerships; human and financial resources; and the technical, managerial, and political processes necessary to implement policies.

Surveillance and monitoring: Comprehensive surveillance and monitoring of tobacco use and harms can provide decision-makers and civil society with a true picture of the tobacco epidemic (19). Monitoring the activities of the tobacco industry is also an essential component of tobacco control programmes (20).

Declines in tobacco use prevalence are apparent in high-income countries that conduct regular population-based surveys of tobacco use (e.g. Australia, Canada, Finland, the Netherlands and the United Kingdom). There are some low- and middle-income countries that also have a documented decline. Examples include Mexico, Uruguay and Turkey (21).

Box 1. Cost-effective policies: increasing taxes and prices on tobacco products

A number of low- and middle-income countries (e.g. Bangladesh, Egypt, Pakistan, Turkey and the Ukraine) have recently increased taxes on tobacco products, generating substantial revenues and saving lives. Between 2009 and 2010, Turkey became one of the 17 smoke-free countries in the world. It increased tobacco taxes by 77%, which led to a 62% price increase on cigarettes. Turkey also adopted and implemented comprehensive tobacco control measures, including pictorial health warnings on tobacco packaging, a comprehensive ban on tobacco advertising, promotion and sponsorship in all media, as well as a comprehensive smoke-free law for all public and work places. Egypt increased taxes by 87% for cigarettes and 100% for loose tobacco. This will lead to an estimated increase of 44% in average retail prices and a 21% reduction in cigarette consumption. The Ukraine elevated taxes by 127% on filtered cigarettes, leading to a 73% increase in retail prices between February 2009 and May 2010.

In conclusion, tobacco control programmes are an integral part of the public health agenda, with proven cost-effectiveness. **Best buys** in tobacco control include tax and price interventions; providing information about the dangers of using tobacco products (with packaging health warnings being a simple and cost-effective intervention); promoting smoke-free environments; and banning advertising, promotion and sponsorship. A **good buy** in tobacco control is treating tobacco dependence. Multisectoral action is essential, and a national coordination mechanism and the integration of tobacco control programmes in country health-care systems are key. Tobacco control interventions should be integrated into development programmes and related investment initiatives. The WHO FCTC provides a blueprint for international cooperation.

Promoting physical activity

There is a direct relationship between physical activity and risk reduction for coronary heart disease, stroke, and diabetes. There is a dose–response relationship for cardiovascular disease (CVD) and diabetes with risk reductions 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 (22, 23).

There are a number of interventions to promote physical activity that constitute a **good buy**. Promoting physical activity (in combination with a healthy diet) through the media has been

Promoting physical activity and healthy diet through the media is a cost-effective and highly feasible intervention

estimated to be a cost-effective, low-cost and highly feasible option. The cost-effectiveness of other potential strategies is being assessed.

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 Noncommunicable Diseases 2008–2013* (24, 25) urge Member States to implement the outlined programmes and actions to increase levels of physical activity among their populations.

Children and young people between 5 and 17 years of age should accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity every day. Adults over 18, including those 65 and older, should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week, or at least 75 minutes of vigorous-intensity aerobic physical activity, or an equivalent combination of the two. Adults aged 65 and above with poor mobility should perform physical activity to enhance balance and prevent falls on three or more days per week. When older adults cannot do the recommended amount of physical activity due to health conditions, they should be as physically active as their abilities and conditions allow (23).

National policies to ensure that walking, cycling, sports and other recreational activities are accessible and safe are required to promote physical activity. National physical activity guidelines are required in order to implement and guide national policies and programmes. Many types of public policies across sectors – which may include transport, education, sport and urban design – can encourage physical activity and reach large portions of the population (26).

The physical environment plays an important role in physical activity, ensuring that walking, cycling and other forms of activity are accessible and safe for all. The physical environment can also promote active and safe methods of travelling to and from schools and workplaces; provide adequate sports, recreation and leisure facilities; and ensure adequate safe spaces for active play, especially for children.

Raising levels of physical activity requires countries to develop and implement a combination of policies aimed at informing, motivating and supporting individuals and communities to be active (26). Multi-targeted approaches to encourage walking and cycling to school, and create healthier commuting and leisure activities, showed moderate effectiveness.

Schools: 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. However, there is a scarcity of cost-effectiveness research in this area.

Workplaces: Multi-component programmes promoting physical activity in the workplace are shown to be effective when they:

- Provide space for fitness and signs to encourage the use of stairs;
- Involve workers in programme planning and implementation;
- Involve families through self-learning programmes, newsletters, festivals, etc.;
- Provide individual behaviour change strategies and self-monitoring.

Community level: 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 diets is about equal to that of drug therapy (27).

In conclusion, 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 (28). Multiple intervention strategies including physical activity have been shown to have favourable cost-effectiveness profiles, and there is an emerging body of evidence which show promise of cost-effectiveness for physical activity interventions alone, however these have not yet been assessed for their global applicability.

Reducing harmful alcohol use

In relation to harmful use of alcohol, effective prevention strategies for certain cancers, liver cirrhosis and CVD should target both the levels and patterns of alcohol consumption. Established evidence for the effectiveness and cost-effectiveness of interventions to reduce the harmful use of alcohol (29-33) including examples from countries such as Brazil, China, Mexico, the Russian Federation and Viet Nam, supports implementation of the following effective measures:

- Increasing excise taxes on alcoholic beverages;
- Regulating availability of alcoholic beverages, including minimum legal purchase age, restrictions on outlet density and on time of sale, and, where appropriate, governmental monopoly of retail sales;
- Restricting exposure to marketing of alcoholic beverages through effective marketing regulations or comprehensive advertising bans;
- Drink-driving countermeasures including random breath testing, sobriety check points and blood alcohol concentration (BAC) limits for drivers at 0.5 g/l, with reduced limits or zero tolerance for young drivers;
- Treatment of alcohol use disorders and brief interventions for hazardous and harmful drinking.

Available evidence does not support isolated classroom-based education, public education and mass media campaigns, or consumer warning labels and messages. However, educational and information campaigns in support of the effective measures listed above can increase their acceptance in populations.

The cost-effectiveness of these policy measures may depend on their degree of acceptance in the population and their level of enforcement, in addition to the extent of harmful alcohol use in the society. In countries with low prevalence of drinking or with high proportion of consumed alcohol produced informally or illegally and, therefore, not covered by taxation, the cost-effectiveness of raising taxes on alcohol is far less favourable.

In May 2010, the Sixty-third World Health Assembly adopted resolution WHA63.13, which endorsed the *WHO Global Strategy to Reduce the Harmful Use of Alcohol* (34), and urged Member States to adopt and implement it. The strategy represents a global policy framework for reducing harmful use of alcohol. It advances guiding principles for development and implementation of alcohol policies and interventions at all levels, sets priorities for global action and urges a set of policy options for implementation at the national level. The strategy recommends 10 target areas for action in countries: leadership awareness and commitment; health services participation through counselling and treatment; community involvement in identifying needs and solutions; drink-driving control policies and countermeasures; reducing the availability of alcohol; regulating the marketing of alcoholic beverages; pricing policies; reducing the negative consequences of drinking and alcohol intoxication; reducing the public health impact of illicit and informally produced alcohol; and monitoring and surveillance.

In conclusion, the current available scientific evidence supports prioritization of multiple cost-effective policy actions (32), three of which are **best buys**: increasing alcohol beverage excise taxes, restricting access to retailed alcohol beverages and comprehensive advertising, promotion and sponsorship bans (Table 1).

Cost-effective measures for reducing harmful alcohol use include increasing alcoholic beverage taxes, regulating the availability of alcoholic beverages, restricting marketing of alcoholic beverages and drink-driving countermeasures

Promoting healthy diets

Unhealthy diets increase the risk of NCDs including CVD, some cancers and diabetes. An optimal diet (24) includes:

- Achieving a balance between energy intake from food and energy expenditure from physical activity to maintain a healthy weight;
- Limiting energy intake from total fats (not to exceed 30% of total energy intake), and shifting fat consumption away from saturated fats to unsaturated fats, and towards elimination of trans-fatty acids;
- Limiting intake of free sugars;
- Limiting sodium consumption from all sources and ensuring that salt is iodized;
- Increasing the consumption of fruits, legumes, whole grains and nuts.

There is evidence to suggest that multiple intervention strategies have the potential to achieve larger health gains than individual interventions, and often with greater cost-effectiveness (35). However, some interventions stand out as best buys in the prevention of NCDs. Enough evidence exists to make salt reduction strategies a **best buy** in the prevention of NCDs (36, 37). As mentioned, excessive salt intake is linked with raised blood pressure, which is a major cause of mortality (22, 38). In Europe and North America, approximately 75% of salt intake is from sodium added in manufactured foods and meals. In some African and Asian countries, most sodium consumption comes from salt added at home in cooking and at the table or through the use of sauces, such as soy sauce (39). It has been estimated that if salt consumption is reduced to the recommended level (40–42), up to 2.5 million deaths could be prevented each year (43). Of the countries with salt reduction initiatives, five – Finland, France, Ireland, Japan and the United Kingdom – have demonstrated some positive, measurable results (44).

Box 2. Cost-effective policy: United Kingdom salt reduction programme

The United Kingdom salt reduction programme, begun in 2003, has involved working with industry to reduce levels of salt in food, raise consumer awareness and improve food labelling. Average intake was 9.5g/day in 2000–2001, considerably above the recommended national level of no more than 6g/day for adults.

Voluntary salt reduction targets were set, and industry made public commitments to work to reduce the amount of salt in food products. Public awareness campaigns about health issues, recommended salt intakes and consumer advice took place between 2004 and 2010.

Levels of salt in foods have been reduced in some products by up to 55%, with significant reductions in those food categories contributing most salt to the diet. Consumer awareness of the 6g/day message increased tenfold, and the number of people who say they make a special effort to reduce their intake has doubled. By 2008, average intake declined by 0.9g to 8.6g/day, which is estimated to prevent more than 6000 premature deaths and save £1.5 billion every year in health care and other costs, dramatically more than the cost of running the salt reduction programme.

Industrially produced trans-fatty acids negatively affect blood lipids and fatty acid metabolism, endothelial function and inflammation, thus increasing the risk of type 2 diabetes and CVD (45). The Disease Control Priorities (DCP) project report indicates that substituting 2% energy from trans-fat with polyunsaturated fat will lead to a reduction of CVD risk ranging between 7–8% and 25–40%, and that these calculations do not consider the additional effects on type 2 diabetes (46). In order to achieve the reduction of industrially produced trans-fatty acids, government approaches have included mandatory regulation of food standards, nutritional recommendations, raising awareness about adverse effects of trans-fatty acids through nutrition and health claims, voluntary or mandatory labelling of trans-fatty acid content of foods, and voluntary reformulation by industry (47, 48). Bans are the most effective action. In 2003, Denmark introduced mandatory compositional restrictions of trans-fatty acids in fats and oils to less than 2% of total fatty acids. A 2006 survey indicated

that industrially produced trans-fatty acids in Denmark have been virtually eliminated from the food supply and that both the population average and the high-risk groups consume less than 1 g of industrially produced trans-fatty acids per day. Although more economic evidence is needed, the conservative assumptions used by the DCP project (46) indicate the high likelihood of this intervention being very cost-effective, cheap and feasible to implement, and therefore a **best buy**.

Sound communication and information strategies are **best buys** for healthy diet promotion campaigns. Food-based dietary guidelines should be developed and properly disseminated to consumers. However, this is not yet being done at a national scale in most countries (49). Adequate nutritional information through product labelling is also necessary to help consumers make the right food choices. Nutrition labels have been shown to encourage more healthy diets, among people who read the labels (50).

There is evidence linking nutrition during pregnancy and early life to the predisposition to NCDs later in life. Individuals who were breastfed experienced lower mean blood pressure and total cholesterol, higher performance in intelligence tests, and lower risk of overweight/obesity and type 2 diabetes (51). Children should be exclusively breastfed until six months and breastfeeding should continue until two years and beyond (52). Improvement of infant and young child feeding requires a combination of legislation, such as maternity protection at work; actions in the health system and improving health worker skills; and support for improving family and community practices through community channels, such as breastfeeding support groups (53).

There are, however, additional effective interventions that should be considered in a comprehensive strategy to promote healthy diets.

The replacement of saturated with unsaturated fat in the diet would lead to a decrease in LDL cholesterol concentration and the total/HDL cholesterol ratio and to a decreased risk of CVD (54). The DCP project report indicates that replacing part of the saturated fat with polyunsaturated fat could avert one DALY at a cost of US\$ 1865 in South Asia and US\$ 4012 in the Middle East and North Africa (46).

Lifestyle interventions addressing diet and physical activity are considered a first-line intervention for the prevention of type 2 diabetes (55). A combination of increase in dietary fibre (≥ 15 g/1000 kcal), reducing total fat ($< 30\%$ of energy consumed) and saturated fat ($< 10\%$ of energy consumed), combined with moderate physical activity (≥ 30 min/day) and weight reduction (5%) can reduce the risk of progression to type 2 diabetes in adults with impaired glucose regulation (also known as pre-diabetes) by around 50% (56).

The reduction in marketing of foods and non-alcoholic beverages high in salt, fats and sugar to children is also a cost-effective action to reduce NCDs (57). The marketing of such food to children is very potent, because children engage with and enjoy these advertisements and other promotions (58, 59). Strong evidence links television advertising to children's food knowledge, preferences, purchase requests and consumption patterns. Television advertising is associated with increased consumption of snacks and drinks high in sugar, consumption of nutrient-poor foods and increased caloric intake (60, 61). A recent review shows that since 2003, 20 countries have developed or are developing policies that include statutory mandates, official guidelines or approved forms of self-regulation (62). The United Kingdom evaluated the impact of restrictions on children's exposure to advertising (63), and found that children aged 4–15 years saw 32% less overall food advertising after restrictions were instituted. World Health Assembly Resolution WHA 63.14 urges Member States to take necessary measures to implement the WHO recommendations on marketing of foods and non-alcoholic beverages to children (64).

Several countries have explored fiscal measures such as increased taxation on foods that should be consumed in lower quantities and decreased taxation, price subsidies or production incentives for foods that are encouraged. A longitudinal study of food prices and consumption in China found that increases in the prices of unhealthy foods were associated with decreased consumption of those foods (65). In the United States, programmes to reduce the price of healthy foods led to a 78% increase in their consumption (66). Modelling studies suggest that a combination of tax reduction on healthy foods and tax increases on unhealthy foods may result in a stimulation of the consumption of healthy food, particularly for lower-income populations (67).

A combination of national and local level actions is clearly beneficial to the implementation of food and nutrition policies. At the community level, programmes can effectively combine healthy food consumption with physical activity, which has been shown to control the rate of increase of childhood obesity in France and Sweden. Such multi-level actions are needed to raise political support for policy changes regarding diet and exercise.

In conclusion, while a combination of actions addressing food supply and information to the public is required to improve diet quality and reduce NCD risk, some actions stand out as being highly cost-effective and affordable even in low-income contexts. These include the reduction of salt through mass media campaigns and reformulation of manufactured food, the replacement of trans-fat with polyunsaturated fat possibly through regulatory measures, initiatives to promote consumers' awareness about healthy diet including information at the point of choice.

Specific strategies to prevent 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. Comprehensive cancer control encompasses primary prevention, early detection/screening, treatment and palliative care. Screening is discussed in this chapter while early detection is dealt with in Chapter 5. There is evidence that population-based interventions are superior to individual-based approaches in terms of coverage, equity, quality control, and cost-effectiveness (68, 69)

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. HBV is highly infectious through contact with blood or other body fluids of an infected person. 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** (70).

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 (71). 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 (72). 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 (68, 69). Essential elements for successful organized screening are an informed decision to initiate screening for priority cancers in the context of a national cancer control programme, and the political will to proceed, with support and funding from the ministry of health, on the basis of an adequate health-care infrastructure. The target population for screening must be defined and informed, including a list of priority cancers, and a means to identify the target population and to invite them for screening. An active call and recall system of the target population is necessary to achieve a high coverage. Whereas in high-resource countries such systems are generally based on population lists and written invitations, elevated participation rates can be obtained in low-resource countries by mobilizing communities and community health workers (73, 74).

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. (68).

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 high-income 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 (72). 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 (75). Colorectal cancer is the most frequent cancer in non-smokers worldwide. Different screening options (i.e. search for occult fecal blood, sigmoidoscopy, and colonoscopy) have been validated and included in organized screening programmes in high-income 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 (76). 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 (77).

Promising methods of early detection and screening are also available for cancers of the skin and oral cancers (78).

Increasing impact

There are concrete indications of progress over the past decade in the development of effective interventions, programmes and policies for the prevention and control of NCDs, including best practices for low-, middle- and high-income countries. The rise of NCDs and related deaths can be reversed, and gains can be achieved rapidly, if appropriate action is taken.

Notable interventions where impact is evident include tobacco tax increases and restrictions on smoking in public places and workplaces; alcohol tax increases and restriction of sales; mandatory and voluntary salt reduction; and improved access to places for physical activity such as walking.

Wide implementation of the best buys should be considered (Table 1). The intervention strategies shown in the second column have been demonstrated to be highly cost-effective in high-, middle- and low-income resource settings.

Table 1. Interventions to tackle non-communicable disease risk factors: identifying 'best buys'

Risk factor	Interventions / actions	Avoidable burden	Cost-effectiveness^b	Implementation cost	Feasibility
(DALYs, in millions; % global burden)^a	(* core set of 'best buys', Others are 'good buys')	(DALYs averted, millions)	(US\$ per DALY prevented) [Very = < GDP per person; Quite = < 3xGDP per person Less = > 3xGDP per person]	(US\$ per capita) [Very low = < US\$0.50 Quite low = < US\$ 1 Higher = > US\$ 1]	(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 * Offer counselling to smokers	Combined effect: 25-30 m DALYs averted (> 50% tobacco burden)	Very cost-effective Quite cost-effective	Very low cost Quite low cost	Highly feasible; strong framework (FCTC) Feasible (primary care)
Harmful use of alcohol (> 50m DALYs; 4.5% global burden)	Restrict access to retailed alcohol * Enforce bans on alcohol advertising * Raise taxes on alcohol * Enforce drink-driving laws (breath-testing) Offer brief advice for hazardous drinking	Combined effect: 5-10 m DALYs averted (10-20% alcohol burden)	Very cost-effective Quite cost-effective	Very low cost Quite low cost	Highly feasible Intersectoral action Feasible (primary care)
Unhealthy diet (15-30m DALYs; 1-2% global burden) ^c	Reduce salt intake * Replace trans-fat with polyunsaturated fat * Promote public awareness about diet * + 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 workplaces Promote healthy eating in schools	Effect of salt reduction: 5 m DALYs averted Other interventions: Not yet assessed globally	Very cost-effective Very cost-effective (more studies needed) Quite cost-effective Less cost-effective	Very low cost Very low cost Higher cost Quite low cost	Highly feasible Highly feasible Feasible (primary care) Highly feasible
Physical inactivity (> 30m DALYs; 2.1% global burden)	Promote physical activity (mass media) * + Promote physical activity (communities) Support active transport strategies Offer counselling in primary care Promote physical activity in workplaces Promote physical activity in schools	Not yet assessed globally	Very cost-effective Not assessed globally Quite cost-effective Less cost-effective	Very low cost Not assessed globally Higher cost	Highly feasible Intersectoral action Feasible (primary care) Highly feasible
Infection	Prevent liver cancer via hepatitis B vaccination *	Not yet assessed globally	Very cost-effective	Very low cost	Feasible (primary care)

^a 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 Main data sources for globally applicable cost-effectiveness estimates are the Disease Control Priorities project (www.DCP2.org) and the WHO-CHOICE project (www.who.int/choice)

^c 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. (m=millions)

+ Considered a best buy when the two interventions are implemented together.

Key messages

- The majority of noncommunicable diseases can be averted through interventions and policies that reduce major risk factors.
- Many preventive measures are cost-effective, including for low-income countries.
- Some preventive actions can have a quick impact on the burden of disease at the population level.
- Interventions that combine a range of evidence-based approaches have better results.
- Comprehensive prevention strategies must emphasize the need for sustained interventions over time.

The majority of noncommunicable diseases can be averted through interventions and policies that reduce major risk factors

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