

Economic consequences of chronic diseases and the economic rationale for public and private intervention

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Executive summary

Chronic diseases account for the greatest share of premature mortality and disability worldwide. Over the next few decades this burden is projected to rise and even accelerate in the developing and the developed world. To date, the global response to the epidemic of chronic disease has not been sufficient to slow its growth.

What economic costs does this burden of chronic disease impose on a society? Is there a role for public-policy intervention in chronic disease control? Can non-state actors effectively address the burden of chronic disease? These straightforward questions have yet to be carefully detailed for chronic diseases. The failure to address these politically salient issues may be part of what is holding back multi-sectoral action needed to curtail the growing epidemic.

This report summarises and analyses the available information, emphasising the evidence base in three main areas:

- 1) Economic costs and consequences of chronic disease
- 2) Rationale for public-policy intervention
- 3) Cost-effectiveness and efficacy of chronic disease interventions by state and non-state actors

The report concludes with a set of tentative policy recommendations that seek to stimulate future debate.

Economic burden of chronic disease

Chronic diseases, such as diabetes and cardiovascular disease, are harmful conditions that require extensive health services and careful long-term medical management.

Worldwide, the cost of chronic diseases and their risk factors – as measured by cost-of-illness studies – is significant and sizeable, ranging from 0.02% to 6.77% of a country's GDP.

Chronic diseases lower household income levels, labour productivity and social mobility, decrease the labour supply and bring forward retirement. They can increase reliance on the state through elevating levels of unemployment, disability and welfare participation.

Employers absorb a significant portion of the economic burden of chronic diseases through absenteeism, decreased on-the-job productivity and increased employee turnover. The expense to employers is increased where they carry costs for health insurance, as is often the case in highly developed countries.

The burden of chronic diseases is disproportionately carried by those least able to afford it, thereby increasing the risk of impoverishment for the families concerned.

Studies find a significant and robust positive impact on economic growth of working-age chronic disease mortality reductions.

Taking into account the impact of chronic disease mortality on economic growth when projecting future national per capita incomes (up to 2025) in five sample countries (Brazil, China, India, Russia and the United States) illustrates the very substantial macroeconomic impact that chronic disease can have. Reducing chronic disease mortality even 1.5% per year would generate a healthy boost to productivity.

Conclusion: Chronic diseases impose not only a major burden on health but also on the economy. Conditions such as diabetes and cardiovascular disease directly impact the economy through high medical costs and indirectly through decreased work productivity. These impacts have far-reaching economic consequences for both developed and developing countries.

An economic rationale for public-policy intervention

Lifestyle decisions that are the major risk factor of chronic disease (notably tobacco use, poor nutrition and lack of physical activity) are often attributed to the sphere of individual free choice, which suggests that governments have no legitimate reason to intervene. However, the presence of market failures in chronic diseases may justify consideration of public-policy intervention from a strict efficiency perspective.

Information asymmetries and imperfect information – There is evidence that in some cases consumers are insufficiently aware about health risks to make informed decisions. Inadequate information may be particularly relevant regarding the addictive aspects associated with the consumption of unhealthy goods.

Externalities – Harmful impacts of chronic diseases and their risk factors extend far beyond the individual. These impacts are felt by members of the household, community and society as a whole.

Time-inconsistent preferences / internalities – In some lifestyle decisions, individuals give in to the temptation to accept immediate gratification at the expense of long-term best interest. There is a case for an intervention (such as a tax or subsidy) that stimulates them to do what they would like, but are otherwise unable to do without external 'help'.

Market failures aside, government action may also be justified for achieving equity objectives. Given that the disproportionate burden of chronic disease tends to fall on the poorest in society, the equity argument is likely to have much to recommend it. This is, however, not addressed at length in this paper.

Conclusion: There is evidence for the presence of market failures based on three grounds: insufficient and asymmetric information, externalities, and time-inconsistent preferences. These market distortions provide governments with a clear efficiency-based rationale for adopting public-policy interventions to combat chronic disease. The justification of intervention to achieve equity objectives requires further analysis.

Cost-effectiveness and efficacy of chronic disease interventions

Evidence-based, cost-effective interventions are available to prevent and control chronic disease. State and non-state actors can reduce the burden of chronic diseases with interventions that are clearly cost-saving or cost-effective.

Targeting those at risk before the clinical onset of disease may have a greater impact on health and economic outcomes. There is evidence that targeting patients at risk for disease as opposed to persons experiencing disease may have a stronger influence on costly mortality and morbidity reductions.

Interventions must take into account the powerful economic incentives detailed in section 3 that influence the uptake and persistence of behavioural risk factors.

Workplace intervention programmes are effective at reducing the costs associated with chronic disease, with an average return on investment of about \$3 for every \$1 invested in the studies reviewed.

Conclusion: There is mounting evidence that the burden of chronic disease can be effectively addressed at a relatively low cost. Given the recent challenge of the World Health Organisation to reduce chronic disease mortality rates by 2% each year, the economic projections are particularly relevant.

The way forward

Despite the evidence presented, directed action to stop the global epidemic of chronic disease has not been forthcoming in low- and middle-income countries. What are the political barriers to change and what are potential means to overcome them?

- 1) **Make a stronger economic case for chronic disease prevention.** Public-health professionals have not made enough of the economic case for tackling chronic disease. Although the epidemiologic burden is clear, the analysis of the economic implications of chronic disease is comparatively underdeveloped, particularly in the developing-country context. This has not helped 'selling' the importance of chronic disease to stakeholders outside the health system, which is where there is arguably the largest untapped potential in tackling the chronic disease burden.
- 2) **'Health fundamentalism' may be counter-productive.** Public-health professionals might benefit from going beyond the idea of 'health fundamentalism' and accept that, while health is very important, it is not the only important issue in society. From such an acceptance could more easily emerge a mutually beneficial dialogue and collaboration with other policy sectors that are relevant for health would be more likely to emerge. The failure of public-health professionals to work in conjunction with other interests, rather than counter to them, is likely to be an important barrier to seeing policy emerging with a strong health agenda.
- 3) **Prevention of chronic disease starts much earlier than for infectious disease.** A further barrier relates to the slow progression of chronic diseases – requiring effective prevention to take place over a much longer timescale than for infectious disease. Effective chronic disease prevention must reach into people's lives years before the health system, or even the individuals themselves, realise they are ill or at risk. This is a very different programmatic context than that of traditional infectious diseases. Such long-term horizons often exceed the political windows of policy-makers, who are generally compelled to show the electorate quick and tangible results of the investment of public money.
- 4) **Political resources for prevention are lacking.** The lobby for prevention is diffuse or weak relative to the concentrated and well-organised lobby for medical treatment. The stakeholders for multi-sectoral preventive efforts are a dispersed group of actors that have various interests, only one of which is health. By contrast, the health sector 'lobby' is well organised, with very clear and shared interests.
- 5) **Adopt supranational strategies to overcome national barriers to intervention.** If the political economy limitations constraining national policy-makers forbid effective action, which occurs particularly in low- and middle-income countries, then supranational mechanisms may be the preferred pathway to reform. The World Bank and other development banks have the convening power to harmonise stakeholders' interests. No new mechanisms need to be established. Rather, existing mechanisms, such as the World Bank- and IMF-supported Poverty Reduction Strategies, could be amended to take relevant chronic disease policies into account.
- 6) **Beyond the Millennium Development Goals.** Part of the supranational mechanism could be launched via a widely shared commitment to appropriate goals. This requires the backing and support of a large set of national stakeholders. There is little doubt that the Millennium Development Goals have helped

bring the struggle of the very poorest countries to global attention – they do not, however, take account of the high and growing burden of chronic disease that is spreading in low- and middle-income countries.

7) **Inclusion of chronic disease in the UN Global Compact.** The UN Global Compact sends a critical market signal to corporations and validates state involvement in disease intervention. Given the documented importance of chronic disease for employers, one way of soliciting business action to prevent chronic disease would be to include chronic disease in the UN Global Compact – a voluntary agreement bringing companies together with UN agencies, labour and civil society to support universal environmental and social principles (<http://www.unglobalcompact.org>). This would highlight the importance of involving business in prevention strategies.

8) **Recognise that successful action needs a range of actors outside government.** In preventing and managing chronic disease, many different players may drive action. Government involvement may be appropriate in some settings, including the transaction of treaties for tobacco control and other macroeconomic interventions. In other areas, non-state actors could make key contributions to the prevention and control of chronic disease by enabling healthy lifestyle choices. In countries now emerging from the worst of the chronic disease epidemics, non-governmental organisations, patient-advocacy groups, health-promotion agencies and health professionals have joined forces to achieve positive health gain for their populations.

Key terms and abbreviations

BMI – Body mass index

CEO – Chief executive officer

COI – Cost-of-illness

CVD – Cardiovascular disease

DALY – Disability-adjusted life year

FDI – Foreign direct investment

GDP – Gross domestic product

HCL – Hypercholesterolemia

HTN - Hypertension

MDG – Millennium Development Goal

QALY – Quality-adjusted life year

WHO – World Health Organisation

Note that, following (for example) the WHO report, *Preventing Chronic Diseases: A Vital Investment* (October 2005), this paper focuses on the major chronic conditions of:

heart disease and stroke (cardiovascular disease);

cancer;

chronic respiratory disease; and

diabetes.

1. Introduction: health and economic development

Investing in health is a strategy essential to economic development. A healthy population is at the heart of an economy's productive potential – the Commission on Macroeconomics and Health found that a 10% increase in life expectancy raises the growth rate of national per capita income by 0.3–0.4% (CMH 2001). As health has been identified as a means to achieve economic development, rather than merely a by-product of it, global leaders are now beginning to acknowledge health investment as being key to future prosperity, assigning it a greater role in economic development agendas (van Schirring 2005, G8 Communiqué 2000, Yach et al. 2004).

Global investments for health primarily concentrate on infectious diseases and child and maternal health challenges. Chronic diseases (sometimes known as 'non-communicable diseases'),¹ despite being the leading cause of premature mortality and disability in working-age adults, receive little attention and support. In 2002, 50% of disability-adjusted life years (DALYs) in the working-age population (age 15–60) were attributed to chronic disease, and 30% to infectious disease. Though the percentage varies by countries' stage of economic development (see Figures 1 and 2), in each category the burden of chronic disease predominates. There is a popular misconception that chronic diseases are confined to the developed world – but the emergence of chronic diseases in the developing world is of great public-health importance. While among high-income countries the percentage of DALYs due to chronic disease in the working-age population was close to 80% (compared with 6% for infectious disease), in low-income countries it has reached 40%, versus 42% for infectious disease (WHO 2003).

The global prevalence and mortality rates of chronic diseases are projected to rise substantially over the coming decades (Murray/Lopez 1996) (see Figure 3). Despite clear epidemiological evidence, chronic diseases have generally not entered the global development agenda and do not figure in targets such as the Millennium Development Goals. Accordingly, chronic diseases have assumed only marginal importance in international development assistance (Michaud 2004, Yach et al. 2004).²

¹ See 'Key terms and abbreviations' for the definition of 'chronic disease' used in this paper, following WHO 2005.

² Just 0.1% of the health budget of official development assistance is earmarked for chronic diseases and their risk factors. The WHO European region devotes roughly 5% of its budget to chronic disease programmes. To date, the Gates Foundation, one of the largest philanthropic financiers of health, has yet to incorporate 'diseases of affluence' into its investment portfolio. Of the regional development bank health-sector strategies, only the Asian Development Bank refers to chronic disease, and then only to recommend a reallocation of subsidies from chronic disease to the prevention and treatment of infectious diseases (Yach 2005 chapter 14, Ramesh et al. 1999, WHO 2003 Financial Management Report).

While the epidemiological picture of a large current and increasing chronic disease burden is beyond debate, the economic implications of this trend remain far less well understood.³ The failure to present the economic case for investment in chronic disease may be partly responsible for holding back the most promising way to tackle its root causes: preventive action across a variety of sectors (Beaglehole/Yach 2003).

The main purpose of this paper is to review the current evidence on the economic costs and consequences of chronic diseases, given their present and projected health implications (section 2). In addition, section 3 starts exploring the economic rationale for public-policy intervention in the area of chronic disease. In particular it asks whether there are 'market failures' as a result of chronic diseases and their associated risk factors that would justify the consideration of public policy to improve efficiency. Such discussion is relevant because the lifestyle decisions that are proximal determinants of chronic disease (smoking, unhealthy diet, alcohol consumption and physical inactivity) are often presented as being within the sphere of individual 'freedom of choice', in which governments in liberal societies have limited or no *a priori* legitimacy to intervene. Inevitably, the discussion in this section is somewhat more technical than in the remainder of the text.

A complete justification for government intervention only exists if, in addition to the presence of a market failure, there are available interventions that governments can undertake at a cost lower than the associated benefit to society. Section 4 therefore briefly presents selected evidence on cost-effectiveness and cost-benefit studies of public-policy intervention. Acknowledging that public policy is an important but not the only means to combat chronic disease, section 4 also reviews the evidence of one non-governmental actor – employers. The last section (5) summarises the main results and proposes a set of tentative policy conclusions and issues for further debate.

³ See Leeder et al. 2004 for the first more comprehensive economic assessment of the economic implications of a major chronic disease – cardiovascular disease – for developing countries.

2. Economic costs and consequences of chronic disease

The impact of chronic diseases extends far beyond the health and financial well-being of individuals. The full burden of illness is borne by households, communities, employers and governments. This section reviews the literature on the economic costs and consequences attributable to chronic disease.

Table 1 provides a framework within which to organise the various types of economic consequences of chronic diseases as they develop – from the asymptomatic risk-factor stage to the clinical manifestation of disease. The table links the various mechanisms to empirical evidence. Intervention at any point can ameliorate the health risks and economic costs that accompany increasing severity.

Four broad areas of evidence are reviewed below, illustrating the economic consequences of chronic disease: cost-of-illness studies, the economic impact at the individual and household level (the biggest share of evidence), the cost for employers, and the economic impact on the level or the growth rate of gross domestic product (GDP) per capita (macroeconomic evidence).

I. Cost-of-illness studies

Worldwide, the cost of chronic diseases and their risk factors – as measured by cost-of-illness (COI) studies – is significant and sizeable, ranging from 0.02% to 6.77% of a country's GDP. COI studies are a useful means of illustrating *some* of the economic magnitude of the diseases or risk factors examined.⁴ The costs are commonly divided into two major types – direct and indirect costs. Direct costs are the costs of health care, such as clinical services, medications, hospitalisation and equipment costs. Indirect costs are losses due to foregone productivity.⁵

Table 2 and Table 3 present the total (i.e. direct and indirect) costs of selected chronic diseases and their risk factors as a percentage of GDP. Indirect costs contribute substantially to the overall cost burden. One study put the total costs of cardiovascular disease in Australia at more than 4% of GDP in 1996 (CDHA 2003), and in most other developed countries for which results are available, the figure varies between 1%

⁴ The output of COI studies, expressed in monetary terms, is an estimate of the total burden of a particular disease from either a societal or, if a restricted set of costs is included, sector-specific perspective. The cost of illness can be interpreted as a measure of the maximum gross economic benefit of eliminating the disease or risk factor in question. This does not necessarily make it an appropriate instrument in assigning intervention priorities. COI studies also do not explicitly examine causality (Rice 1994, Shiell et al. 1987).

⁵ A third category – psychological or intangible costs – exists, but only rarely are attempts made to measure it.

and 3%.⁶ Relatively few results are available for developing countries, with the exception of diabetes. Barcelo et al. (2003) find the share of total costs due to diabetes to be strikingly high in many developing countries, varying between 1.8% for Venezuela and 5.9% for Barbados. In China, costs associated with tobacco consumption accounted for 1.5% in GDP in 1995 (Hu 2002). In the same year, the costs of obesity amounted to 1.1% of GDP in China and 2.1% in India (Popkin 2001).

There is substantial variation in the share of indirect costs in total costs, but a reasonable approximation would be to say that on average about half the costs are indirect in developed countries. By contrast, in developing countries the share is significantly higher, as people living in poorer settings have less access to advanced (and therefore costly) health-care services and less social support provided by government. The lack of government expenditure may also make the direct costs appear to be misleadingly low.

II. Economic impact at the individual and household level

Several studies have found a significant effect of chronic disease on a wide range of labour-market outcomes, including wages, earnings, workforce participation, hours worked, retirement, job turnover and disability. Chronic diseases decrease wage opportunities, increase labour costs, and alter work preferences because of incentives contingent on being unable to work. People with chronic diseases and risk factors are more likely to face barriers to employment arising from productivity limitations, costs of disability and, in some cases, stigma.⁷ In many studies, these costs, even if assessed at the individual or household level, have been aggregated into national cost estimates (see Table 5 and Table 6 for a summary of the studies reviewed).

Experiencing chronic disease is costly simply because treating chronic diseases, once they are expressed clinically, is expensive. In many low- and middle-income countries, this burden is carried disproportionately by those least able to afford it, increasing the risk of impoverishment for the families concerned. Financial costs accrued by the household due to chronic disease account for a sizeable proportion of household expenditure – in some cases, exceeding average per capita incomes. The poorer a country is, the more regressive the health-care financing system tends to be and the higher the fraction of health costs borne by

⁶ In interpreting the figures it is important to note that the numerical results from COI studies are typically not directly comparable across countries and time.

⁷ Surveys of employers and obese individuals have found that they have reportedly been denied wage increases, promotions and insurance benefits due to their weight. Clear evidence shows a pervasive bias against overweight people in areas such as employment, health care, education and housing (Puhl and Brownell 2001). The American Civil Liberties Union reports that more than 6,000 employers refuse to hire smokers.

patients themselves. Evidence from developing countries shows that the costs of financing chronic diseases are often high, marking them out as a significant cause of poverty.⁸(17,20-26)

Table 7 presents the household impacts of chronic diseases and their risk factors. Medical costs of diabetes care for those who visited private health-care providers totalled between 15% and 25% of household income in India and 25% of the minimum wage in Tanzania. Studies on the costs of cancer in China identify that the average hospital stay amounts to more than the annual per capita GDP. Studies from Indonesia found that half the patients have no option but to finance the prohibitively costly expense of lung-cancer treatment completely on their own.

Even in 1992, the cost of insulin (then \$156 for a one-month supply) was well above the means of the majority of the Tanzanian population (Chale et al. 1992). In such cases, the poor may pay the ultimate price: the study notes that 'if African patients with diabetes have to pay for their treatment, most will be unable to do so and will die'. Even if patients can afford the expense, the medicines are not always readily available: surveys of 25 countries in Africa found that insulin was often unavailable in large city hospitals and in only five of the countries was insulin regularly available in rural areas (Savage 1994, Chale et al. 1992). When insulin is affordable, additional costs arise from the need for refrigerated storage and for syringes and support infrastructure.

Households do not react to chronic disease passively. When faced with a severe chronic disease, families adapt to offset the destabilising effects that can lead to destitution or dissolution of the family unit (Sauerborn et al. 1996). To cope with the costs of a family member with a chronic illness, households in developing countries mobilise and reallocate their productive resources in ways that may have long-term repercussions and that risk perpetuating socioeconomic inequalities. As these coping processes reduce the effects of illness, the full cost of chronic disease is hidden from traditional empirical studies.

The major mechanisms of coping involve intra- and inter-household strategies to make up for income losses – for example, the mobilisation and reallocation of household resources, substitution of household labour and production, and the receipt of gifts and remittances. The main factor guiding the response to illness by the household is whether the anticipated loss of production is long term or short term (Sauerborn et al. 1996, Kochar 2004). Over time, these social responses can have consequences that are more harmful to the family than the immediate economic consequences of the disease pathology itself.

⁸ See e.g. Wilkes et al. 1997, Savage 1994, Yudkin 2000, Chale et al. 1992, Kibirya et al. 1999, Shobhana et al. 2000, Fall 2001, Neuhann et al. 2001.

The most frequently invoked coping strategy involves tapping savings and liquefying assets to cover the costs of care and lost productivity. This in turn corresponds to lowered consumption and changes the profile of investments to be less capital intensive since ill-health limits the rate of return from these sources.⁹ Formal coping responses are less often used because credit is often not an option for poor populations where social-security safety nets are under-developed in comparison with wealthier countries (Makinen et al. 2000, Raymond/Greenberg/Leeder 2004).

A frequently used coping response is to engage other household members, usually women and children, in caring for sick family members. Caring for a family member has been shown to reduce the probability of workforce participation by 18–22%. Moreover, these decisions can permanently alter work and schooling prospects. Studies have found that even after women ceased care-giving, they did not return to their former hours of employment (Stern 1996).

Anthropological studies have found that children are likely to be removed from school during health crises to care for a sick older relative, compensate for production losses, or reallocate school expenditures to help cover medical costs. A World Bank review has concluded that the health of children's families is a major determinant of intergenerational poverty transmission (World Bank, *Voices of the Poor*). Since the effects on children – for example, reduced educational achievement – do not impact upon the economy until they reach working age, there is a lag of decades between implementation of these coping strategies and their market effects.

Risky behaviours, as well as chronic diseases themselves, play a role in poverty and the poor health of children. Behavioural risk factors displace expenditure on food purchases and capital investments. The damage of risky behaviours such as tobacco and alcohol use takes its toll on the wallet (Esson and Leeder 2005).

Socially disadvantaged groups tend to spend a disproportionate share of income on these behaviours, potentially substituting for investment in human capital, such as health and education. Evidence from India shows that smoking and alcohol use correspond with a 50% higher risk of borrowing or distress selling during hospitalisation of a family member (Bonu et al. 2005). Household studies in Bangladesh find that on average persons spent more than twice as much on cigarettes as per capita expenditures on housing,

⁹ There is evidence that some wealthier families who can afford capital investments increase the accumulation of such investments by increasing their productivity during periods of good health.

clothing, health and education combined (Efroymson 2001). In Egypt, expenditure on cigarettes amounted to over 10% of that spent on food. Table 7 reviews the household expenditures on tobacco, ranging from 2–6% of household expenditures and income, and up to 10% in the most impoverished households (Esson/Leeder 2005).

Behavioural decisions of adults also feed back into the health outcomes of their children. Family tobacco use relates to reduced take-up of immunisations and a greater likelihood of underweight. A higher body mass index (BMI) in parents has also been associated with poorer health in children and increased likelihood of chronic conditions. It is estimated in India that 7% of infant mortality can be attributed to population tobacco use (Bonu et al. 2005).

III. Costs of chronic disease to employers

Employers absorb a considerable portion of the economic burden of chronic disease through absenteeism, decreased on-the-job productivity and increased employee turnover. Table 4 presents the costs of chronic diseases and risk factors that accrue to employers. Business leaders are becoming increasingly aware of the economic toll that poor employee health imposes on their companies' competitiveness. CEOs in the United States rank health-care costs as their number one economic pressure (Berry et al. 2004). In April 2005, General Motors announced that it expects its bill for health care for employees to total \$5.6 billion over the year. McKinsey predicts that by 2008, the health-care costs of Fortune 500 companies will be greater than their net profit (McKinsey 2004).

From studies of employers, the top three leading causes of mortality and lost disability-adjusted life years were cardiovascular disease, hypertension and diabetes, and the three most costly conditions were cardiovascular disease, hypertension and depression. Even more costly than the health-care costs of chronic diseases was the cost of falls in on-the-job productivity, frequently referred to as 'presenteeism'. On average, their cost-impact on employers amounted to roughly three-fifths of the overall impact of chronic disease on employers – an effect larger than that of absenteeism (Goetzel/Hawkins et al. 1999, Goetzel/Long et al. 2004).

IV. The impact of chronic disease on economic growth

Health – measured as life expectancy or adult mortality – is a robust and strong predictor of economic growth in virtually all studies that have explored the issue in a worldwide sample of countries. Since chronic disease mortality accounts for a significant part of reduced life expectancy and adult mortality, chronic disease mortality would also be expected to impact upon economic growth.¹⁰ In some studies, the initial health status is a better predictor of subsequent growth than education (Barro 1996). According to Barro's research, other things being equal, a five-year increase in life expectancy will give a country a 0.3–0.5% higher annual GDP growth rate in subsequent years. The effect of chronic disease mortality on economic growth can then be indirectly calculated, once it is known what effect chronic disease mortality has on life expectancy (or adult mortality).

Table 11 and Table 12 illustrate the results of this approach in determining the future per capita income path in five countries: Brazil, China, India, Russia and the United States. Three different, arbitrary future chronic disease mortality scenarios are assumed: a status quo scenario in which chronic disease mortality rates remain constant; a medium scenario in which chronic disease mortality rates are reduced by 1.5% annually; and an optimum scenario in which the annual reduction is 3%. Even the medium scenario demonstrates very substantial gains. Discounting future gains to the year 2000 – using a discount rate of 3% – produces a gross benefit (in per capita terms) worth at least 38% of GDP per capita in Russia and (at a maximum) an almost 168% gain in China (using the more conservative estimation methodology). The interpretation is that any hypothetical programme that would cost less today than these figures would provide an economic net gain. Unfortunately, chronic disease mortality (and health in general) is generally not taken into account in the assessment of growth prospects in these (and in other) countries (Wilson/Purushothaman 2003). In the light of our results, this is a considerable shortcoming.

Very few studies have directly tested the independent impact of chronic disease on economic growth. One recent study, however, found a significant positive effect of working-age CVD mortality reductions on economic growth, beyond a certain per capita income threshold (Urban/Suhrcke 2005). It would be a strong argument underlining the importance of chronic disease mortality at the macroeconomic level if (in addition to the 'indirect' reasoning applied in the previous paragraphs) there was a direct impact of chronic disease mortality on economic growth, even controlling for other general health indicators such as adult mortality

¹⁰ See, for example, Barro 1996, Barro 1991, Barro and Lee 1994, Barro and Sala-i-Martin 1995, Bhargava et al. 2001, Easterly and Levine 1997, Gallup and Sachs 2000, Sachs and Warner 1995, Sachs and Warner 1997, Levine and Renelt 1992 and Sala-i-Martin et al. 2004.

and life expectancy. Such independent effects of specific diseases have been found for HIV/AIDS and malaria.¹¹ In a recent paper, a first attempt was made to assess the impact of cardiovascular disease mortality (of the working-age population) on economic growth in a worldwide set of countries (Urban/Suhrcke 2005), controlling for adult mortality. Reductions in CVD mortality were found directly to improve economic growth, but only in a subset of countries where GDP per capita exceeds almost US \$10,000. Essentially, this sample corresponds to the high-income countries. The size of the effect of CVD mortality on growth in the high-income sample is notable: a 10% decrease in CVD mortality rates triggers a subsequent 1% increase in the per capita income growth rate. Summed over 20–30 years, this corresponds to a large amount in absolute dollar terms. Since the empirical model was controlled to take account of adult mortality, the effect that is directly attributable to CVD will be only part of the total impact of CVD on economic growth, with the remainder running via CVD on adult mortality and then to growth.

V. Conclusions

Worldwide, the cost of chronic diseases and their risk factors – as measured by cost-of-illness studies – is significant and sizeable, ranging from 0.02% to 6.77% of a country's GDP.

Chronic diseases lower household income levels, labour productivity and social mobility, decrease the labour supply and bring forward retirement. They can increase reliance on the state through elevating levels of unemployment, disability and welfare participation.

Employers absorb a significant portion of the economic burden of chronic diseases through absenteeism, decreased on-the-job productivity and increased employee turnover. The expense to employers is increased where they carry costs for health insurance, as is often the case in highly developed countries.

The burden of chronic diseases is disproportionately carried by those least able to afford it, thereby increasing the risk of impoverishment for the families concerned.

Studies find a significant and robust positive impact on economic growth of working-age chronic disease mortality reductions.

Taking into account the impact of chronic disease mortality on economic growth when projecting future national per capita incomes (up to 2025) in five sample countries (Brazil, China, India, Russia and the United States) illustrates the very substantial macroeconomic impact that chronic disease can have. Reducing chronic disease mortality even 1.5% per year would generate a healthy boost to productivity.

¹¹ Arndt/Lewis 2000, Gallup/Sachs 2001.

3. A rationale for public-policy intervention to prevent chronic disease

I. Introduction

Individual behaviours such as smoking, alcohol use, poor diet and physical inactivity act as proximate determinants of the burden of chronic disease, but are largely driven by environmental factors and incentives beyond the reach of the health system.

The contribution of stakeholders outside the health sector is essential in tackling the challenge posed by chronic disease, but it is unrealistic to expect them to be driven to action by the public-health rationale alone. If an *economic* rationale for public-policy intervention could be demonstrated, this might enhance the argument for action. This section explores whether there is reason to argue that such a rationale exists and, if so, in what areas the argument can be made with the most confidence. The focus on government intervention in this section does not imply that non-government actors would have no relevant role in preventing and controlling chronic disease.

This section also notes some gaps in understanding as to whether or not there is a role for public policy. Such gaps are inevitable because to date the case for public-policy action has been largely confined to the areas of infectious diseases and childhood and maternal diseases.

II. Overcoming market failure

In standard economic reasoning, public-policy intervention is merely an afterthought – market forces are usually considered to work best (or at least better than governments) in achieving efficiency.¹² There are, however, at least four conditions (below) under which the market, if left alone, fails to maximise efficiency. In these cases, economists recommend policy interventions to correct the market failure:¹³

- a) insufficient and asymmetric information;
- b) existence of production or consumption externalities;

¹² Efficiency is defined by economists in a very specific way: an allocation of resources is efficient if there is no way to increase benefits to an individual without making another individual worse off. This concept is known as Pareto efficiency.

¹³ More precisely, public-policy intervention is justified from an economic perspective, if two conditions are fulfilled: a market failure exists, and interventions exist that correct the market failure without imposing costs on society that exceed the benefits. This section focuses on the evidence regarding the first condition, relegating evidence on cost-effectiveness of interventions to the annex (Table 9), and postponing further discussion of this literature to subsequent work. Nor is the possibility of 'government failure' discussed at length here, despite this also being an important and empirically relevant issue.

- c) time-inconsistent preferences/internalities, and
- d) natural monopoly.¹⁴

Are any of these market failures likely to occur in the case of chronic disease and of the lifestyle risk factors that are their prime proximate causes? To provide an exhaustive answer, two issues need to be separated: i) the case for intervention in the health sector that provides access to chronic disease treatment and ii) the case for intervention in the domain of 'broader' government policy outside the health sector that has influence over the lifestyle choices that cause chronic disease. This paper focuses on the latter, since for many of the 'classic' arguments (Arrow 1963) that have been applied to justify a government role in the health sector in general can, of course, be applied to the treatment of chronic disease. This applies in particular to asymmetric information between buyers and providers of health care, and to asymmetric information between the insured and the insurers. Such cases unambiguously justify some degree of public intervention – but as this has been demonstrated elsewhere, further details are not given here.

The case for public interventions targeting lifestyles (or the determinants of lifestyles) is a controversial issue, because in liberal societies, government should not interfere with what seems, at least at first glance, to belong to the private sphere in which people decide how to lead their lives – the issue of 'freedom of choice'.

III. Disclaimer

At this point it is important to emphasise that this paper focuses on the case for intervention based on the efficiency objective alone. There are clearly other good reasons for government intervention beyond efficiency – for example, intervention to protect the poor (i.e. equity¹⁵ concerns) is a well-recognised government role (Musgrove 1999). Given the evidence presented above on the negative economic effects of chronic disease (coupled with the observation that a disproportionate share of the burden of chronic disease is carried by the poor), the rationale of poverty reduction may well be highly relevant for the specific case of chronic disease intervention. Although this report does not specifically address the equity justifications for public policy, we recognise that the traditional economics textbook division between efficiency and equity is at least partly misplaced, and may even be counter-productive, in the light of more

¹⁴ In industries characterised by high fixed costs, economies of scale can induce the industry to become increasingly concentrated, to the point when a single firm remains in the market. Such a firm does not face any competition – it has the power to set the equilibrium price.

¹⁵ The World Bank defines 'equity' as the creation of circumstances in which individuals have equal opportunities to pursue a life of their choosing and are spared from extreme deprivation in outcomes.

recent evidence on potential complementarities between the two (World Bank 2005). This issue should be developed in further research.

A further disclaimer, already flagged in the introduction above, relates to the possibility of government failure, as opposed to market failure. The assumption is that if the market fails, governments can readily step in and improve on the markets' performance – but this is a far too general and probably unrealistic assumption, which needs to be examined in each specific national context.

IV. Market failure and chronic disease

Three potential reasons for a market failure are explored below that are likely to be of particular relevance to chronic disease: insufficient and asymmetric information, externalities, and time-inconsistent preferences ('internalities').

a) Insufficient and asymmetric information

Insufficient and asymmetric information are interrelated market problems that differ in important ways. Under asymmetric information, one party to the exchange has private information that it does not share with the other party. In the case of insufficient information, the information is not deliberately hidden, but some individuals cannot use or interpret the information adequately. These differences lead to very different policy conclusions: in the case of asymmetric information, a mechanism has to be developed by which the party with private information reveals the information; insufficient information can be corrected using comprehensive or targeted information campaigns, for example.

Two key features of consumers' incomplete and possibly asymmetric information are potentially relevant in the context of chronic disease:

- 1) insufficient awareness about health risks involved in consumption choices; and
- 2) inadequate information about certain addictive aspects associated with the consumption of unhealthy goods.

The former potentially applies to all unhealthy behaviours, while the latter is arguably more relevant to smoking and alcohol consumption than to diet and physical inactivity.

Whether or not consumers in a given country have been sufficiently informed about the health consequences of risk behaviour is an empirical question. Government intervention in the form of the

provision of health information is typically justifiable, as information is a public good,¹⁶ which leads to it being under-supplied in the absence of government intervention. Insufficient and/or asymmetric information is more likely to prevail: i) in cases where the health effects of a behaviour are insufficiently understood and researched (for example, because of the long time lag between behaviour and outcome);¹⁷ in developing countries;¹⁸ among children and teenagers; and where industry's marketing efforts distorts information, intentionally or otherwise.¹⁹

There is undoubtedly a case for public provision of information, and this can take many forms, including product labelling, comprehensive or targeted public-information campaigns, or restricting the marketing of unhealthy food. However, while the information deficit will be reduced in most cases, there remain doubts as to how far this will actually change people's behaviour. Even perfectly informed people might decide to consume unhealthy goods if the pleasure derived from consumption exceeds the short and long-term private costs, particularly so if the private costs do not fully account for the social costs. In this case, the informational interventions will be insufficient to produce the desired change in behaviour.

b) Externalities

Externalities are costs or benefits associated with the consumption of a good or service that accrue to society in general but are not borne by the consumer. As the costs or benefits are not borne by the individuals, they are not automatically factored into consumption decisions, so levels of consumption (e.g. of tobacco, alcohol or unhealthy foods) can be higher or lower than is beneficial to society as a whole. The magnitude of the external costs/benefits is a challenging empirical question, and is dependent on the institutional context as well as the cost-valuation method employed.²⁰

¹⁶ A pure 'public good' is one for which consumption is non-rival (consumption by one individual does not reduce someone else's consumption) and non-excludable (a consumer cannot be excluded from consuming the good either by having to pay or through some other mechanism).

¹⁷ The health effects of smoking have only gradually come to be understood by scientists over the course of decades. A similarly thorough understanding of obesity, a relatively new phenomenon, will take more time to materialise.

¹⁸ In China, where about 70% of adult men smoke, there is clear evidence that many people lack even basic information about the hazards of smoking. A 1996 survey of Chinese adults revealed that half of smokers – and half of non-smokers – believed that there was little harm in smoking. (Chinese Academy of Preventive Medicine (1997), *Smoking and health in China: 1996 national prevalence survey of smoking patterns*. Beijing: China Science and Technology Press.)

¹⁹ The history of the tobacco industry, recently revealed in several studies, offers plenty of examples of a concerted effort to conceal information that would reveal the negative health impacts of smoking. See P. A. Diethelm, J.-C. Rielle, M. McKee (2005) *The whole truth and nothing but the truth? The research that Philip Morris did not want you to see*, *The Lancet*; vol. 366: 86–92. For the effect of food promotion on the dietary or lifestyle behaviour of children, see also Hastings, G. et al. (2003), *Review of the research on the effects of food promotion to children*, Report prepared for the Food Standards Agency, University of Strathclyde.

²⁰ Note that, in defining what is 'external', studies differ as to whether they see the family/household as a single unit. Considering each member of the household separately increases the external cost estimates.

Tobacco smoking is a classic example of behaviour with negative externalities – for instance, second-hand smoke and the failure of health insurance to account for the increased use of medical services by smokers (World Bank 1999).

The accumulation of knowledge on the health consequences of second-hand smoke has increased estimates of the external costs of tobacco use. There has been a vigorous debate about the significance of the external effects of smoking-related diseases on health-care costs. Smokers undoubtedly accrue higher-than-average health-care costs while they are alive – but overall lifetime costs may be the same or even less than for non-smokers in the developed world, as smokers die at a younger age than non-smokers (Viscusi 1995, 2000). However, this argument loses much of its force in the case of developing countries, where smokers die while of working age to a far greater extent than in developed countries. Studies have pointed out that research that found no or positive externalities of smoking had ignored certain cost categories, such as the lost productivity of smokers dying prematurely or being less productive at work (Gruber 2001). A recent, extensive US study calculated the total (i.e. private and external) cost of cigarettes as almost \$40 per pack over a lifetime (Sloan et al. 2004).

A major component of the external effects of tobacco use is accounted for by second-hand smoke. For children born to mothers who smoke, the effects include low birth-weight and an increased risk of various diseases (USDHHS 1986, Charlton 1996). Several studies have assessed the magnitude of external effects of second-hand smoke – Gruber (2002) puts the costs at \$0.70 per pack in the United States, and the negative effects on infant health due to smoking mothers have been estimated to equal the same amount.

Arguments derived from second-hand smoke may be of particular relevance for poor and middle-income countries, where many do not have health insurance and where ‘social security’ is often provided by informal social networks, mainly by extended families. Consider a breadwinner’s illness or disability: within his/her household, over and above the costs of care, lost labour earnings might have substantial repercussions for children dependent on intra-family transfers and who might be required to abandon their education in order to supply additional income, with negative consequences on the accumulation of their human capital. This is likely to affect girls more than boys in developing countries, which – given the key role of female education for a wide range of development outcomes – could in turn risk undermining some of past achievements in public health (Leeder et al. 2004).

The external costs of heavy alcohol consumption are also substantial – namely traffic-accident fatalities and violence. Manning et al. (1989) estimate that in the United States the total property damage from alcohol-related motor-vehicle accidents was approximately \$3.6 billion in 1983. According to Kenkel (1993), for the year 1986 in the United States, the total value of death and injuries resulting from drunk driving was \$17.6 billion. Manning et al. (1989, 1991) also estimate that \$3.1 billion was spent to finance the criminal justice for alcohol-related trials.

There do not appear to be any immediate external health consequences arising from unhealthy diet (except certain inter-generational effects that are transmitted either socially²¹ or physiologically), but the insurance costs are substantial. One study directly comparing the two rates found external costs of obesity to be higher than those of smoking (Manning et al. 1991). According to more recent research (Finkelstein et al. 2003), health expenditures related to overweight and obesity accounted for 9.1% of total US medical expenditures in 1998 and are estimated at \$92.6 billion (in 2002 dollars). As Table 3 shows, many cost-of-illness studies provide similarly high cost estimates. Taken literally, the estimates measure social costs, which include both private and external costs. It is fair to assume that under the given institutional health insurance arrangements in developed countries, private costs will account for only a small fraction of this total.

c) Time-inconsistent preferences / internalities

A potentially powerful justification for government intervention to prevent unhealthy lifestyles comes from the recently proposed hypothesis of time-inconsistent individual preferences. Behavioural economists, in particular, argue that, on the basis of experimental evidence, in some situations individuals give in to the temptation to accept immediate gratification at the expense of their long-term best interests.²² This feature characterises individual preferences only, and is not the result of imperfect information or information asymmetry.

In this model, a commitment made to act in a particular way in the future – made today by a perfectly informed and perfectly rational individual, who has time-inconsistent preferences – will be reneged upon at the point when the commitment should be respected. For example, a smoker asked today to stop smoking

²¹ In this context, it is worth noting the social ‘communicability’ of certain risky behaviors such as smoking, alcohol consumption, and perhaps dietary patterns. For instance, studies have found peer smoking to be a significant determinant of one’s own smoking (Molyneux et al. 2002). This could be interpreted as a negative external effect – but one that has to be balanced against the positive benefits to the individual that derive from being part of the peer group.

²² In more precise, technical terms this means that preferences are such that the discount factor applied in an intertemporal decision involving a present and a future date is much lower than the discount rate applied on the same decision but involving two future dates. This feature is also known as ‘non-hyperbolic discounting’.

immediately will probably answer 'no', but might agree, if asked today, to stop smoking in one year. But in one year from now, if asked again to quit smoking, the smoker will prefer to continue smoking rather than adhere to the previous decision to quit.²³ As time progresses, each future date comes into the present and the preference for immediate enjoyment will prevail. In other words, the present 'self' of the individual disagrees with his future 'self' at any time. Moreover, the decisions of the present 'self' are harmful for the future 'self': such kind of externalities between the time-contingent 'self' are known as 'internalities'. Gruber and Koszegi (2001), using the Viscusi value-of-life valuation method, estimated the 'internal' effect to total around \$35 per pack of cigarettes.

There is some empirical evidence in support of this hypothesis from the United States: within the smoker community, eight out of ten smokers express the desire to kick the habit, but many fewer than that actually quit. Figure 5, Figure 6 and Figure 7 present the parity across social status to quit, but failures in lower socioeconomic groups to actually do so. Gruber (2002) reports that over 80% of smokers try to quit in a typical year, and the average smoker tries to quit every 8_ months. Strikingly, 54% of serious cessation attempts fail within one week.

The same contrast between the current and future self can be indirectly detected in the well-documented difficulty to commit to diets. Cutler et al. (2003), examining the US case, argue that eating decisions often appear inconsistent: 'People continue to overeat, despite substantial evidence that they want to be thinner and try to lose weight (there is a \$30 to \$50 billion annual diet industry). Unhealthy foods, much like smoking, can also be pose serious self-control problems, bringing immediate gratification, while health costs of over-consumption accumulate in the future. Maintaining a diet is also very difficult. People on diets frequently yo-yo; their weight rises and falls as they start and stop dieting.' In a similar vein, Figure 4 illustrates the relationship between current weight and the person's self-described optimal weight in the United States. Desired weight rises only slightly corresponds with actual weight, particularly for obese people, resulting in an increasing disparity between how individuals actually are and how they would like to be.

If individuals have time-inconsistent preferences, there is a case for an intervention (such as a tax) that stimulates them to do what they would like, but are unable to do without external 'help'. Time-inconsistency

²³ In the first decision the discount factor applied to the value of future health improvements is low enough to make the individual opt for the present enjoyment of one more year of smoking, and the discount rate applied is high enough to make the individual 'decide' to quit and enjoy health improvements after next year.

can be easily confused with insufficient information (see above), especially in the case of addictive goods.²⁴ The outcomes of both market failures may be identical, but the causes – and hence the policy implications – differ significantly. While the solution to limited information is to provide more information, in particular to young people who are most likely to be ill-informed, the solution to time-inconsistent preferences is to provide individuals with effective commitment devices. A commitment device is a mechanism that requires a previously adopted decision to be respected. As examples, individuals can bet on their ability to stop smoking, announce publicly their willingness to quit, impose punishments upon themselves if they fail to follow the commitment, or reward themselves for being able to respect it. Clearly, such devices are very weak and can be easily bypassed as they cannot be externally enforced.

Government has some advantage with respect to individuals: given its enforcement power it is generally in the position to provide fully effective commitment devices. Introducing per-unit taxes²⁵ would be one such example – taxes would lower the present benefit, offsetting the immediate enjoyment for the individual.²⁶

Gruber (2002) suggests that taxes should be accompanied by a portfolio of other measures able to decrease present enjoyment associated with smoking, such as banning smoking in public places or at the workplace. This suggestion can be generalised to cover the full set of unhealthy behaviours – i.e. introducing measures that change the incentives of private decision-making, without the need to forbid the unhealthy lifestyle choices. Individuals' self-control can be reinforced, achieving the same effect of a commitment device, while conserving individuals' freedom to make their own choices.

Note that, while private benefits are (by definition) outside the scope of public intervention, both immediate and future costs can be manipulated, thus helping make healthy choices easy choices. Wider use of standardised nutritional certification programmes would reduce the time costs of gathering nutritional

²⁴ When taking up consumption, individuals – especially young people – might have insufficient information precisely to assess the addictive power and may think that they will be able to commit themselves to quit in the future, although in reality they will by then have lost control over their actions. This implies, for instance, that individuals will never quit smoking (because they do not have enough self-control) – this is the same result as that observed under time-inconsistent preferences. Nevertheless, time-inconsistency is unrelated to limited information: time-inconsistency is a feature just of the preferences of individuals who otherwise are fully informed about the consequences of their actions. They are also aware of their contradictory behaviour attributable to the non-hyperbolic discount rate.

²⁵ Interestingly, courts can also (indirectly) introduce a type of 'tax'. In the United States, the large compensation payments by the tobacco industry to settle the disputes with deceased smokers' families were transferred into the price of cigarettes: the price per pack increased by \$1.31 between 1997 and 2002 to provide the industry with sufficient funds to pay. At the same time only an extra \$0.21 per pack of formal taxation was added (Gruber 2002).

²⁶ Taxes that adjust for time-inconsistent preferences are Pareto improving, as they provide individuals with little self-control an effective commitment device able to increase their surplus. At the same time if the proceeds of the tax are returned evenly to everyone in the society, individuals with high self-control are (more than) compensated for the loss suffered by the tax, providing a further incentive to be self-controlled (O'Donoghue and Rubín 2005).

information. Making running lanes, gym facilities, swimming pools and cycling paths widely available would reduce the immediate cost of physical activity (for instance, by reducing search and transportation costs). Similarly, taxation and clean-air regulation increases immediate costs.

Expected future costs are also important: in spite of the low discount factor adopted to assess the consequences of deteriorating health, if rational individuals realise that the future welfare lost due to the current smoking is sufficiently high, they will not smoke. Conversely, if future economic conditions are predicted to be grim, then the health costs of current smoking are too low to discourage this habit. It has been widely documented that the lower socioeconomic groups are more likely to display unhealthy lifestyles. However, it should be taken into account that the socioeconomic environment may itself induce unhealthy lifestyles. This opens a much broader area for public intervention: improving the prospect for future economic conditions is a very effective tool in discouraging unhealthy lifestyles today.

V. Conclusions

Information asymmetries and imperfect information – There is evidence that in some cases consumers are insufficiently aware about health risks to make informed decisions. Inadequate information may be particularly relevant regarding the addictive aspects associated with the consumption of unhealthy goods.

Externalities – Harmful impacts of chronic diseases and their risk factors extend far beyond the individual. These impacts are felt by members of the household, community and society as a whole.

Time-inconsistent preferences / internalities – In some lifestyle decisions, individuals give in to the temptation to accept immediate gratification at the expense of long-term best interest. There is a case for an intervention (such as a tax or subsidy) that stimulates them to do what they would like, but are otherwise unable to do without external 'help'.

4. Cost-effectiveness and efficacy of chronic disease interventions

Demonstrating the presence of market failures is a necessary but not a sufficient step in providing an efficiency-based rationale for public-policy intervention. For the complete case, cost-effective interventions must be available that achieve the health improvement at a cost below the benefits that accrue. Many evidence-based and cost-effective interventions do exist to reduce and, in particular, prevent the chronic disease burden. There remains scope, however, for future cost-effectiveness and cost-benefit analyses to incorporate the wider economic benefits highlighted in section 2.

I. Scope of chronic disease care

Chronic diseases strongly relate to behavioural risk factors such as smoking, physical inactivity and unhealthy dietary patterns that tend to precede and exacerbate their traditional risk factors, such as raised blood pressure, cholesterol and blood glucose levels. Since the accumulation of damage from behavioural risk factors to the point of clinical relevance (such as the path from tobacco use to lung cancer) often takes decades, most chronic diseases tend to manifest first in people in the middle and later stages of life. Once the clinical stage of the disease progression has been reached, chronic diseases are less or no longer amenable to curative intervention and require careful 'maintenance management' to suppress the disability associated with the co-symptoms and morbidities that accompany them. These palliative treatments have been shown to reduce considerably the risk for costly disease complications and acute events such as stroke or myocardial infarction. In this regard, for chronic diseases the successful reduction of risk factors is equivalent to prevention of disease, and the treatment of clinical disease is equivalent to the prevention of acute episodes.

Primary and secondary prevention explain much of the historical reductions in chronic diseases.

In England and Wales, 58% the reduction in CVD mortality since the early 1980s was attributable to population changes in risk factors.

In the Netherlands, 44% of the decline in CVD mortality in the 1980s was attributed to smoking cessation and blood-pressure treatment.

Reduction in dietary fat intake would reduce coronary events considerably and avert \$4.1–12.7 billion in costs.

In the UK, risk factor reduction in 'healthy persons' has had a three-fold higher mortality impact than in cardiac patients.

Since having a chronic disease exacerbates individuals' risk for other long-term diseases, the diseases tend to occur in multiples. For example, diabetes patients are at two to four times greater risk of heart disease than non-diabetics (American Heart Association, 2005). It is currently estimated that one-third of all middle-aged and two-thirds of elderly Americans have two or more chronic conditions (Wagner, 2001). The complications and co-morbidities associated with chronic diseases are often protracted illnesses that necessitate and complicate treatment. In scenarios where a chronic disease state is a direct cause of other serious diseases, the patient has a combination of illnesses that each requires an individualised treatment regime to be coordinated by health-care providers. The intertwined networks of symptoms and sicknesses impose substantial costs on the health-care systems, as patients are 'ping-ponged' from one specialist to another.

II. Chronic disease intervention approaches

Interventions for chronic disease prevention and health promotion have been tried and tested. Systematic reviews, notably by the Cochrane Collaboration process, have evaluated the available evidence of effectiveness of these interventions. A wide range of interventions at the community, population and macroeconomic level have been found to be effective in developed countries for tobacco, diet, alcohol and physical activity. There remains an urgent need to develop best practices for obesity control, and there have been few studies to date on effectiveness in low- and middle-income countries. Evidence does, however, suggest that health-promotion initiatives can be effective in low- and middle-income countries (Yach/Hawkes 2004, Leeder 2004, Table 9)²⁷ A more comprehensive review of evidence-based interventions is given in Leeder et al. (2004). The authors distinguish three different levels of interventions and provide detailed evidence in each category, as follows:

a) Macroeconomic and whole-of-government interventions

Macroeconomic and whole-of-government interventions include policies in a range of fields in which national treasuries have an interest, and that impact upon chronic disease, in particular on cardiovascular disease. Examples include policy on tobacco production and consumption, nutrition, education and urban planning. Macroeconomic interventions usually derive from ministries other than health and influence sectors other than health care per se. They are implicitly political in nature.

²⁷ A very useful resource on evidence-based community interventions to reduce the burden of chronic diseases is available at <http://www.thecommunityguide.org>.

A recent World Bank review of strategies and successes in tobacco control in Brazil, South Africa, Thailand, Poland, Bangladesh and Canada showed that a range of policies and regulations can contribute towards smoking reduction. In Poland, for example, strong warnings and pricing policies contributed to a 10% reduction in cigarette consumption between 1990 and 1998, despite aggressive advertising by tobacco companies. Macroeconomic interventions in Poland, part of economic restructuring, reduced animal-fat consumption, promoted vegetable oil, and increased fruit and vegetable consumption – with dramatic effects on CVD mortality.

Cost-benefit of nutrition labelling is estimated at \$2.7 billion over 20 years and projected to save between \$47–67 million per year.

100% smoke-free workplace policies in the United States would save \$60 million in direct medical costs in the first year of implementation alone – \$506 per QALY or \$799 per quitter.

b) Population-based interventions

Governments and other interested agencies direct health-promotion interventions at broad populations, addressing the structural and behavioural determinants of health. Unlike macroeconomic interventions, these interventions have an explicit health goal. Recent examples from Poland and North Karelia (Finland) are often cited as successful examples.

In China, blood pressure has been shown to decline in cohorts involved with community-based hypertension-control programmes. Activities include weight control, modification of dietary salt and alcohol intake, and increased physical activity.

The introduction of the Sports for Life Program in Singapore is associated with a reversal in the decline of sporting activities in the country. In 2001, participation in sports activities was 38% compared with 28% in 1987 and 24% in 1992.

In the United States, programmes to reduce the price of healthy foods led to a 78% increase in consumption.

In Norway, lowering population blood pressure by 2 mmHg would translate into a saving of over 188 million.

The most comprehensive economic evaluation of public health campaigns in Australia valued the cost-benefit to tobacco intervention at 47.9:1, which also generated a public finance savings of \$2 for each \$1 invested; for cardiovascular disease the net benefit was estimated at US\$8.478 billion and achieved a public finance savings of US\$557 million.

c) Provider-based interventions

As risk factors accumulate and become more prominent in the population, chronic disease prevention must become more individualised and medical. Interventions include the treatment and counselling of individuals in relation to risk factors. In many instances, health authorities have developed clinical-practice guidelines that specify best practice for the management of patients at high risk or with established disease.

Cost-effective medicines for preventing and treating heart disease such as aspirin are estimated to a mere \$3 per life saved.

In the United States, interventions such as retinopathy screening to prevent blindness and pre-conception care in mothers to prevent birth defects improved quality and/or quantity of life in diabetes patients at a net savings (Klonoff and Schwarz 2000); cost-effective interventions were identified that provide nephropathy prevention in type I diabetes and improved glycemic control to prevent complications

UK Prospective Diabetes Study Group reports that tight blood pressure control in diabetes patients compared favourably with accepted health-care programmes (UKPDS 1998; Klonoff and Schwarz 2000).

d) Non-state actor interventions

Firms have started to respond more aggressively to the threat of chronic diseases to the productive health capital of their employees and to capitalise on the financial benefits of prevention and treatment. Some companies in the United States, such as Pfizer and Green Mountain Coffee Company, have taken the lead in incorporating disease management into their human resource development models. Workplace interventions for chronic disease control in industrialised societies have proven effective at reducing the associated costs, with an average return on investment of \$3 for each \$1 invested.

Table 8 presents a review of chronic disease interventions in the workplace in developed economies. The best-integrated corporate wellness programmes cost approximately \$200 per employee per year, which represents about 3% of the average employer's spend on medical costs per employee. Even though economic analyses of employer workplace health promotion consider the indirect benefits, these estimates are likely to be conservative because they do not include subsidiary savings such as returns to decreased turnover.

Despite these very important pieces of evidence, there are still some key areas in need of development:

There has been very little evaluation of the diffusion and institutionalisation of public-health programmes and initiatives in the developed world, and even less for the developing world (Oldenburg 1999).

It is important that interventions take into account the rational economic incentives that produce unhealthy choices and risky behaviours. Failing to consider the environmental factors that have promoted the rise and spread of chronic diseases ignores the root social causes that are key targets for intervention.

Based on the most recent review of what is feasible given the current state of knowledge about the effectiveness of interventions, the World Health Organisation has now set out a global challenge to reduce chronic disease mortality by 2% every year through 2015. From our projections in Table 11, even a 1.5% reduction would translate into a healthy boost to GDP growth.

III. Conclusions

State and non-state actors can reduce the burden of chronic diseases with interventions that are clearly cost-saving or cost-effective.

Targeting those at risk before the clinical onset of disease may have a greater impact on health and economic outcomes. There is evidence that targeting patients at risk for disease as opposed to persons experiencing disease may have a stronger influence on costly mortality and morbidity reductions.

The next generation of interventions must take into account the powerful economic incentives detailed in section 3 that influence the uptake and persistence of behavioural risk factors.

5. Policy implications and recommendations

Section 2 showed that chronic diseases impose a major burden not only on health but also on the economy. The impact of chronic diseases on economic outcomes has been more extensively researched in the case of developed countries, despite the growing chronic disease trends being observed in developing countries. However, the limited empirical evidence that is currently available from low- and middle-income countries – as well as the transferable parts of the empirical evidence from high-income countries – point to sizeable economic benefits that could be gained from efforts to prevent at least some of the chronic disease burden.

Section 3 looked into the evidence for market failures in the area of chronic disease prevention. The presence of market failure would justify a consideration of public-policy intervention from a strict efficiency perspective – a criterion that is widely used among governments and international development banks to decide about public-policy interventions across all sectors of the economy.²⁸ It would be beyond the scope of this report to provide an exhaustive answer, as this would require far more space and research in this area is still relatively underdeveloped. That said, there is evidence supporting the presence of market failures based on the three grounds of insufficient and asymmetric information, externalities and time-inconsistent preferences.

Of the three, the informational argument offers perhaps the least ambiguous reasons to intervene, but doubts remain as to how effective this will be in actually changing behaviour, in the absence of accompanying measures that address people's incentives more directly. Given the methodological challenges involved in assessing externalities, there is unlikely to be consensus about the size and the sign of the externalities associated with unhealthy lifestyles. Much depends on the choice of external cost categories, the valuation method, the unit of analysis (household or individuals), and also on the state of epidemiological knowledge. The growing evidence on the damage associated with second-hand smoke has clearly increased the external cost estimates related to tobacco consumption – if further evidence on the external costs of unhealthy lifestyles were to be provided, this would serve as a powerful argument for intervention.

²⁸ This should not be misunderstood to imply that public policy is the only way to intervene against chronic disease. It is important to bear in mind that just as markets may systemically fail to achieve the socially desirable outcome, governments are also subject to failure.

Other research in the area of behavioural economics has recently been applied to lifestyle decisions of the kind discussed here (see e.g. Cawley 2004). It was suggested that the presence of time-inconsistent preferences justified interventions that stimulate individuals to do what they would like to do, but that they are unable to do without external 'help'. The argument offers a wide range of policy interventions. Again we emphasize the potential importance of government failure, which might in fact prevent the successful implementation of theoretically effective interventions, and which we have not addressed in the present paper.

Section 4 has presented a brief review of evidence-based cost-effective and effective interventions to prevent chronic disease. At the same time the reader is referred to significant recent reviews on this topic (e.g. WHO 2005, chapter 3). Most of the section focused on public policy interventions, directly linking to the discussion of the economic rationale for public policy intervention initiated in section 3. Section 4 also presented evidence on the cost-effectiveness of preventive health interventions at the workplace, acknowledging that public policy intervention can only be one part of an effective response to chronic disease. Non-government actors, such as the industry and civil society, play just as important a role. In sum, many evidence-based and cost-effective interventions do exist to reduce and in particular prevent the chronic disease burden, even if there remains scope for future cost-effectiveness and cost-benefit analyses to incorporate the wider economic benefits highlighted in section 2.

If the expected economic benefits from reducing the burden of chronic disease are as significant as shown in section 2, if there is much to suggest that market failures exist in the area of chronic disease prevention, and if evidence-based cost-effective interventions are known to exist, what then is holding back action? And if there are barriers, how can they be overcome?

The way forward

Despite the evidence presented, directed action to stop the global epidemic of chronic disease has not been forthcoming in low- and middle-income countries. What are the political barriers to change and what are potential means to overcome them?

- 1) **Make a stronger economic case for chronic disease prevention.** Public-health professionals have not made enough of the economic case for tackling chronic disease. Although the epidemiologic burden is clear, the analysis of the economic implications of chronic disease is comparatively underdeveloped, particularly in the developing-country context. This has not helped 'selling' the importance

of chronic disease to stakeholders outside the health system, which is where there is arguably the largest untapped potential in tackling the chronic disease burden.

2) **'Health fundamentalism' may be counter-productive.** Public-health professionals might benefit from going beyond the idea of 'health fundamentalism' and accept that, while health is very important, it is not the only important issue in society. From such an acceptance could more easily emerge a mutually beneficial dialogue and collaboration with other policy sectors that are relevant for health would be more likely to emerge. The failure of public-health professionals to work in conjunction with other interests, rather than counter to them, is likely to be an important barrier to seeing policy emerging with a strong health agenda.

3) **Prevention of chronic disease starts much earlier than for infectious disease.** A further barrier relates to the slow progression of chronic diseases – requiring effective prevention to take place over a much longer timescale than for infectious disease. Effective chronic disease prevention must reach into people's lives years before the health system, or even the individuals themselves, realise they are ill or at risk. This is a very different programmatic context than that of traditional infectious diseases. Such long-term horizons often exceed the political windows of policy-makers, who are generally compelled to show the electorate quick and tangible results of the investment of public money.

4) **Political resources for prevention are lacking.** The lobby for prevention is diffuse or weak relative to the concentrated and well-organised lobby for medical treatment. The stakeholders for multi-sectoral preventive efforts are a dispersed group of actors that have various interests, only one of which is health. By contrast, the health sector 'lobby' is well organised, with very clear and shared interests (McGinnis et al. 2002).

5) **Adopt supranational strategies to overcome national barriers to intervention.** If the political economy limitations constraining national policy-makers forbid effective action, which occurs particularly in low- and middle-income countries, then supranational mechanisms may be the preferred pathway to reform. The World Bank and other development banks have the convening power to harmonise stakeholders' interests. No new mechanisms need to be established. Rather, existing mechanisms, such as the World Bank- and IMF-supported Poverty Reduction Strategies, could be amended to take relevant chronic disease policies into account.

6) **Beyond the Millennium Development Goals.** Part of the supranational mechanism could be launched via a widely shared commitment to appropriate goals. This requires the backing and support of a large set of national stakeholders. There is little doubt that the Millennium Development Goals have helped bring the struggle of the very poorest countries to global attention – they do not, however, take account of the high and growing burden of chronic disease that is spreading in low- and middle-income countries.

7) **Inclusion of chronic disease in the UN Global Compact.** The UN Global Compact sends a critical market signal to corporations and validates state involvement in disease intervention. Given the documented importance of chronic disease for employers, one way of soliciting business action to prevent chronic disease would be to include chronic disease in the UN Global Compact – a voluntary agreement bringing companies together with UN agencies, labour and civil society to support universal environmental and social principles (<http://www.unglobalcompact.org>). This would highlight the importance of involving business in prevention strategies.

8) **Recognise that successful action needs a range of actors outside government.** In preventing and managing chronic disease, many different players may drive action. Government involvement may be appropriate in some settings, including the transaction of treaties for tobacco control and other macroeconomic interventions. In other areas, non-state actors could make key contributions to the prevention and control of chronic disease by enabling healthy lifestyle choices. In countries now emerging from the worst of the chronic disease epidemics, non-governmental organisations, patient-advocacy groups, health-promotion agencies and health professionals have joined forces to achieve positive health gain for their populations.

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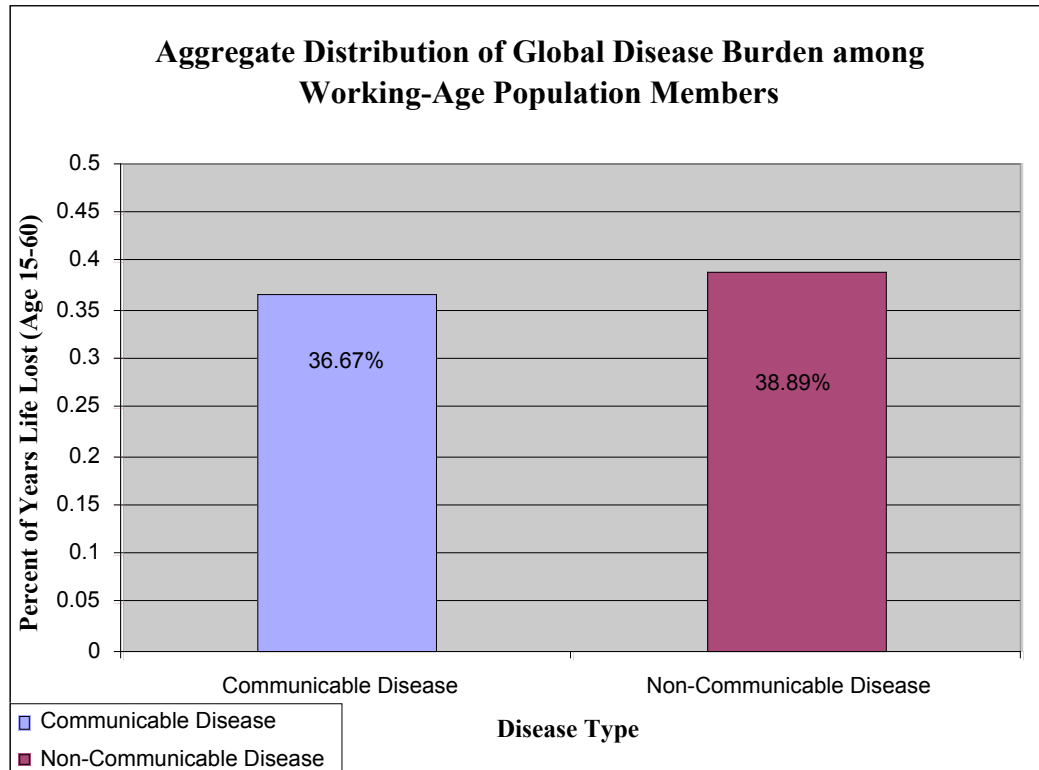
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Tables and Figures

Figure 1: Global burden of chronic disease among the working-age population (2002)



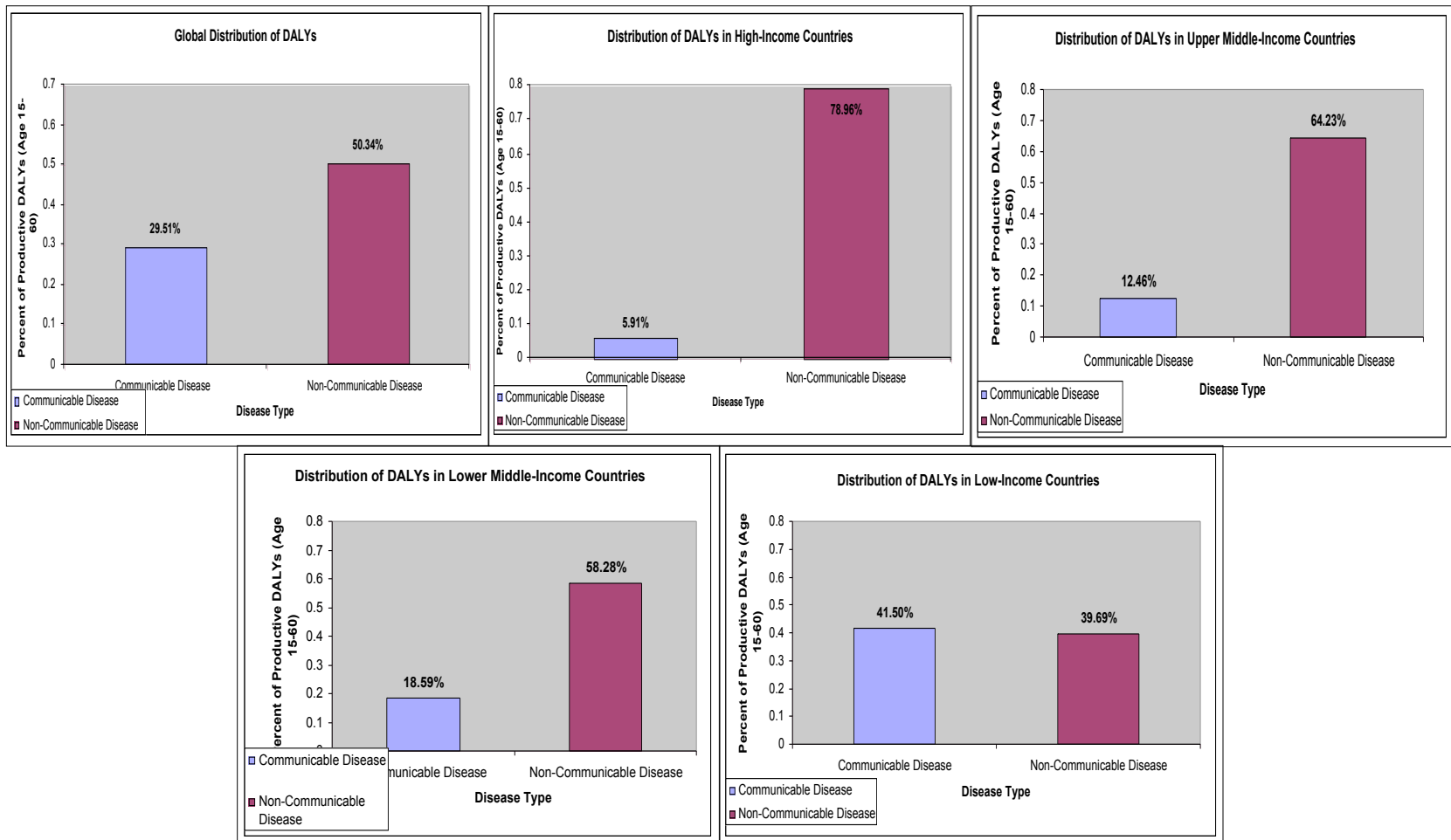
Communicable diseases include infectious diseases as well as maternal, perinatal and nutritional conditions
Non-communicable diseases include diabetes, cancers, endocrine disorders, neuropsychiatric conditions, sense organ diseases, cardiovascular diseases, respiratory diseases, digestive diseases genitourinary diseases, skin diseases, musculoskeletal diseases, congenital anomalies and oral conditions.

Source: Author's calculations, Global Burden of Disease Study 2003 update

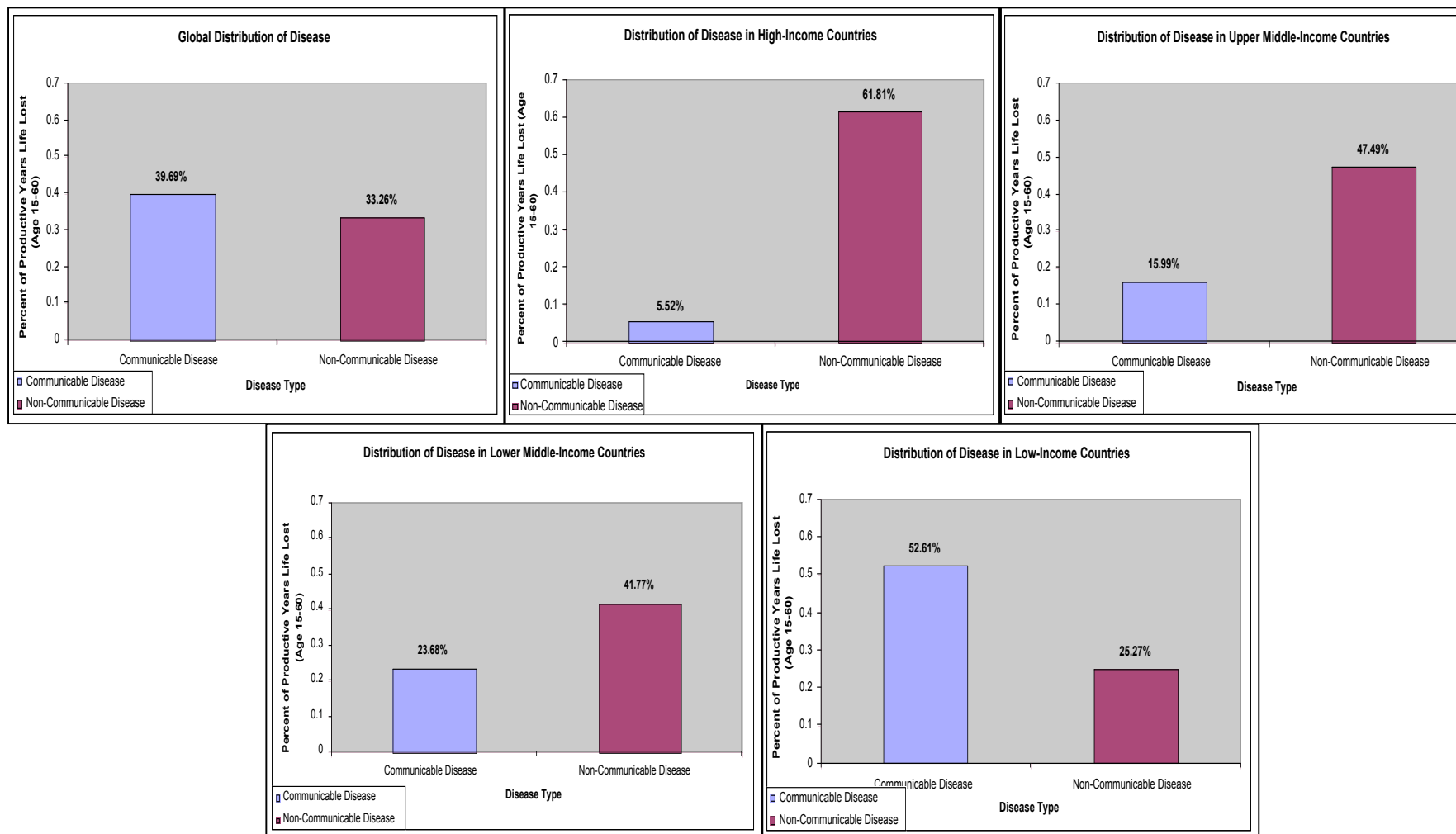
Figure 2: Burden of chronic disease by World Bank Region relative to infectious disease for working-age panel

Global impact of non-communicable and communicable diseases

DALY



Premature Mortality

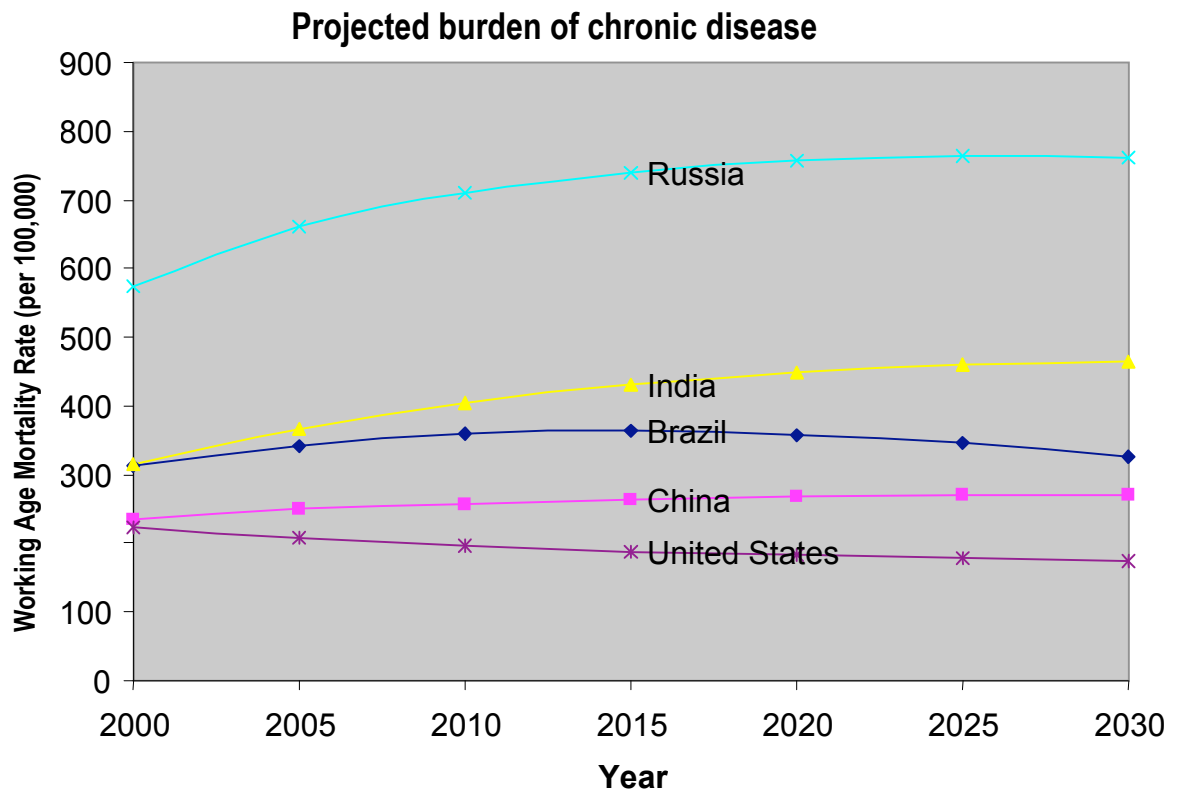


Communicable diseases include infectious diseases as well as maternal, perinatal and nutritional conditions.

Non-communicable diseases include diabetes, cancers, endocrine disorders, neuropsychiatric conditions, sense organ diseases, cardiovascular diseases, respiratory diseases, digestive diseases genitourinary diseases, skin diseases, musculoskeletal diseases, congenital anomalies and oral conditions.

Source: Authors' calculations, Global Burden of Disease Study 2003 update.

Figure 3: Projected burden of chronic disease in selected countries



Source: Calculations by the authors using a version of the approach followed by Murray/Lopez 1996.

Table 1: Economic framework for chronic disease and the risk factors in the household: type and timing of impact

Type of economic impact	Timing of impact			
	Risk factor and asymptomatic phase	Clinical onset of disease and morbidity experience	Short-run mortality effects	Long-run mortality effects
<i>Production and earnings</i>	a. Organisation of economic activity	a. Work absenteeism ^{3, 67-72, 8, 186, 87, 89, 90, 91}	a. Lost returns from productivity	a. Lost returns from productivity
	b. Residential location	b. Decreased productivity ^{68, 70, 75, 77} and decreased wages ^{3, 88, 91, 92, 121}	b. Employee turnover ^{115, 117}	b. Reallocation of land and labour
	c. Diminished productivity and decreased wages ^{7-10, 32, 38, 43, 46, 58, 65}	c. Labour force participation ^{75, 87-91} and premature retirement ^{81-85, 121}	c. Widening of social gradient through differential coping and impoverishment ^{11, 122-127}	c. Widening of social gradient through differential coping and impoverishment ^{11, 122-127}
	d. Increased welfare reliance ^{38, 46}	d. Increased likelihood of release from employment ^{89, 90} and disoccupation ^{110, 106}		
	e. Work absenteeism ^{17, 20, 22, 45, 72, 80}	e. Disability costs ⁷⁰		
		f. Social Security and pension costs ⁹⁷		
		g. Increased welfare reliance ^{89, 90}		
<i>Investment and consumption</i>	a. Health insurance premiums ¹³	a. Direct medical cost of diagnoses and procedures ^{6, 14, 18, 22, 90}	a. Funeral costs ¹¹⁴	a. Long-term changes in investment and consumption patterns ¹³⁰
			b. HH transfers	
	b. Direct medical costs of prevention and risk factor management	b. Chronic health maintenance costs	c. Legal fees	
	c. Precautionary savings ^{116, 118, 119}	d. Disruption of consumption smoothing and investment patterns by chronic medical costs ^{24, 7}		
	d. Displacement of household investments in capital accumulation	c. Dissaving ¹¹⁹ and indebtedness ^{23, 39}		
d. Household transfer of resources ^{124, 129}	e. Reallocation of household labour and resources (Schultz 2004, Stern 1996)			
<i>Household health and composition</i>	a. Extended family ¹²⁸	a. Reduced allocation of labour to health maintaining activities	a. Loss of deceased/head of household	a. Poor health of surviving household members ¹¹¹
	b. Fertility ¹²⁸			b. Dissolution or reconstitution of household ¹²⁰

Note: numbers here in the table need fixing as they do not correspond to the present numbering of the references!

Cost-of-illness studies

There have been numerable COI studies conducted on chronic disease in OECD countries, but relatively few have been performed in the developing world. Whenever possible, studies included in this review have been selected for their fidelity and consistency in methodology, albeit with more flexibility for developing countries due to the limited availability of studies.

Table 2: Cost-of-illness studies for non-communicable chronic diseases

<u>Country</u>	<u>Condition</u>	<u>Year of estimate</u>	<u>Total costs (% of GDP)</u>	<u>Percentage indirect costs</u>	<u>Source</u>
<i>Chronic Disease</i>					
United States	All types	2002-04	6.77	n/a	AHA 2005
<i>Cardiovascular disease</i>					
United States	CVD	2004	3.80	38.50	AHA 2005
Canada	CVD	1998	2.59	63.09	CCDPC 2002
Australia	CVD	1996	4.11	93.98	CDHA 2003
United Kingdom	CVD	1999	1.00	75.48	Liu et al. 2002 British Heart Foundation
United Kingdom	CVD	2003	2.88	41.77	2005
Austria	CVD	2003	1.88	36.91	"
Belgium	CVD	2003	1.70	38.68	"
Cyprus	CVD	2003	1.27	54.55	"
Czech Republic	CVD	2003	2.69	38.50	"
Denmark	CVD	2003	1.59	47.52	"
Estonia	CVD	2003	2.56	47.98	"
Finland	CVD	2003	2.39	52.52	"
France	CVD	2003	1.55	35.43	"
Germany	CVD	2003	3.34	35.09	"
Greece	CVD	2003	2.20	35.04	"
Hungary	CVD	2003	2.10	42.84	"
Ireland	CVD	2003	0.91	50.50	"
Italy	CVD	2003	1.79	30.60	"
Latvia	CVD	2003	1.69	59.84	"
Lithuania	CVD	2003	2.12	41.04	"
Luxembourg	CVD	2003	1.06	38.61	"
Malta	CVD	2003	0.48	45.16	"
Netherlands	CVD	2003	2.19	36.49	"
Poland	CVD	2003	2.50	53.37	"
Portugal	CVD	2003	1.92	44.97	"
Slovakia	CVD	2003	2.21	35.23	"
Slovenia	CVD	2003	1.53	41.69	"
Spain	CVD	2003	1.36	42.60	"
Sweden	CVD	2003	2.29	42.19	"

<u>Country</u>	<u>Condition</u>	<u>Year of estimate</u>	<u>Total costs (% of GDP)</u>	<u>Percentage indirect costs</u>	<u>Source</u>
United States	Stroke	2004	0.40	38.43	AHA 2004
					British Heart Foundation
Austria	Stroke	2003	0.43	56.76	2005
Belgium	Stroke	2003	0.41	56.89	"
Cyprus	Stroke	2003	0.46	81.94	"
Czech Republic	Stroke	2003	0.66	58.35	"
Denmark	Stroke	2003	0.48	57.62	"
Estonia	Stroke	2003	0.70	66.49	"
Finland	Stroke	2003	0.60	70.87	"
France	Stroke	2003	0.26	52.64	"
Germany	Stroke	2003	0.87	44.41	"
Greece	Stroke	2003	0.52	67.49	"
Hungary	Stroke	2003	0.47	63.75	"
Ireland	Stroke	2003	0.28	64.83	"
Italy	Stroke	2003	0.32	49.68	"
Latvia	Stroke	2003	0.65	70.12	"
Lithuania	Stroke	2003	0.64	53.98	"
Luxembourg	Stroke	2003	0.19	70.08	"
Malta	Stroke	2003	0.13	76.99	"
Netherlands	Stroke	2003	0.70	44.31	"
Poland	Stroke	2003	0.70	75.11	"
Portugal	Stroke	2003	0.40	61.06	"
Slovakia	Stroke	2003	0.53	58.19	"
Slovenia	Stroke	2003	0.31	60.39	"
Spain	Stroke	2003	0.31	61.69	"
Sweden	Stroke	2003	0.56	60.53	"
United Kingdom	Stroke	2003	0.94	50.57	"
<i>Diabetes</i>					
United States	Diabetes	2002	1.30	30.72	ADA 2004
Canada	Diabetes	1998	0.17	76.65	CCDPC 2002
Mexico	Diabetes	1995	0.79	na	Villearreal-Rios et al. 2002
Mexico	Diabetes	2000	2.60	na	Barcelo et al. 2003
Argentina	Diabetes	2000	3.85	93.17	"
Bahamas	Diabetes	2000	3.05	92.81	"
Barbados	Diabetes	2000	5.87	91.53	"
Bolivia	Diabetes	2000	2.71	62.47	"
Brazil	Diabetes	2000	3.76	82.51	"

<u>Country</u>	<u>Condition</u>	<u>Year of estimate</u>	<u>Total costs (% of GDP)</u>	<u>Percentage indirect costs</u>	<u>Source</u>
Chile	Diabetes	2000	3.20	87.80	"
Colombia	Diabetes	2000	3.09	83.96	"
Costa Rica	Diabetes	2000	2.97	79.59	"
<i>Dominican Republic</i>					
Republic	Diabetes	2000	3.17	63.89	"
Ecuador	Diabetes	2000	3.75	61.00	"
El Salvador	Diabetes	2000	3.80	72.49	"
Guatemala	Diabetes	2000	4.36	65.37	"
Guyana	Diabetes	2000	5.09	43.80	"
Haiti	Diabetes	2000	1.97	39.01	"
Honduras	Diabetes	2000	4.03	52.52	"
Jamaica	Diabetes	2000	5.15	66.76	"
Mexico	Diabetes	2000	2.60	86.94	"
Nicaragua	Diabetes	2000	3.26	34.01	"
Panama	Diabetes	2000	3.74	75.98	"
Paraguay	Diabetes	2000	2.82	66.97	"
Peru	Diabetes	2000	3.48	72.76	"
Trinidad/Tobago	Diabetes	2000	3.49	86.64	"
Uruguay	Diabetes	2000	3.86	87.79	"
Venezuela	Diabetes	2000	1.76	88.15	"
Tanzania	Diabetes	1992	0.54		Chale et al. 1992
<i>Hypertension</i>					
Mexico	Hypertension	1999	0.71	na	Villearreal-Rios et al. 2002
United States	Hypertension	2004	0.4	25.58	AHA 2004

Table 3: Cost-of-illness studies on chronic disease risk factors

<u>Country</u>	<u>Condition</u>	<u>Year of estimate</u>	<u>Total cost (% of GDP)</u>	<u>Percentage of Costs indirect</u>	<u>Source</u>
United States	Tobacco use	1997–2001	1.71	55.09	CDC 2005
Canada	Tobacco use	1991, 1992	1.39–2.20	-	Kaiserman 1997, Xie et al. 1996
Australia	Tobacco use	1992	3.40	48.7	Collins/Lapsley 1996
France	Tobacco use	1997	1.10	49.87	Fenoglio et al. 2003
Finland	Tobacco use	1995	0.80	-	Pekurinen 1999
Hungary	Tobacco use	1998, 2002	3.2–4.0	-	GKI 1998, Szilagyi 2004
Puerto Rico	Tobacco use		0.43	-	Jha/Chaloupka 2000
Peru	Tobacco use	1997	0.77	-	Jha/Chaloupka 2000
Venezuela	Tobacco use	1997	0.30	-	Pan American Sanitary Bureau 1998
Myanmar	Tobacco use	1999	0.14	-	Kyaing 2003
China	Tobacco use	1989	1.50	74.4	Hu 2002
Taiwan	Tobacco use	2001	0.50	77.8	Yang et al. 2005
India	Tobacco use	1990–91	0.02	-	Rath/Chaudry 1995
South Korea	Tobacco use	1993–98	0.59–1.19	-	Kang et al. 2003
United States	Obesity	2000	1.20	47.86	DHHS 2001
Canada	Obesity	2001	0.73	69.81	Katzmarzyk/Janssen 2004
Switzerland	Obesity	2002	0.64	-	Schmid et al. 2005
Germany	Obesity	1998	0.20	48.2	Sander/Bergemann 2003
India	Obesity	1995	1.10	67.3	Popkin 2001
China	Obesity	1995	2.10	23.8	Popkin 2001
Germany	Alcohol use	1995	1.13	-	Horch/Bergemann 2003
France	Alcohol use	1997	1.42	56.51	Fenoglio et al. 2003
Switzerland	Alcohol use	2001	0.14	na	Frei et al. 2001
United States	Depression	2000	0.85	68.6	Greenberg et al. 2000

Table 4: Economic impact of chronic disease and risk factors on employers

<u>Country</u>	<u>Study</u>	<u>Year(s)</u> <u>of study</u>	<u>Condition</u>	<u>Type of cost</u>	<u>Economic impact</u>			
<i>Clinical conditions and risk factors</i>								
United States	Goetzel et al. 2004	1997–19 99	Chronic disease	Cost per employee	Total cost per employee per year	Productivity loss (% of total)	Daily cost per sick employee	
					CHD	\$368	19%	\$13
					HTN	\$392	63%	\$13
					DM	\$257	62%	\$21
					COPD	\$134	25%	\$32
					Depression	\$348	71%	\$28
United States	Goetzel et al. 2003	1999	Chronic disease	Cost per employee	Total cost per employee	Absenteeism and short-term disability (% of total)		
					CHD	\$305	13%	
					HTN	\$160	43%	
					DM	\$104	28%	
					COPD	\$65	43%	
United States	Goetzel et al. 1998	1990–95	Chronic disease and risk factors	Medical costs	Total cost per employee per year	Relative cost (% of low-risk)		
					CHD	\$2,646	228%	
					Stroke	\$1,077	85%	
					Depression	\$2,005	147%	
					HBP	\$407	12%	

<u>Country</u>	<u>Study</u>	<u>Year(s) of study</u>	<u>Condition</u>	<u>Type of cost</u>	<u>Economic impact</u>		
					Tobacco	\$446	15%
					Obesity	\$747	21%
					Physical activity	-\$1,369	-80%
United States	Bertera et al. 1999	1994–95	Chronic disease and risk factors	Productivity loss	Total hours per week		
					DM	9.9	
					Obesity	1.4	
					Physical activity	-1.2	
United States	Bertera et al. 1991	1984–88	Chronic disease and risk factors	Cost per employee	Smoking	\$960	32% higher absenteeism
					Overweight	\$401	
					Alcohol	\$389	
					HBP	\$343	
					HCL	\$370	
United States	Vijan et al. 2004	1992-2000	Diabetes	Productivity loss	\$7.5 billion per year		
United States	Unum Provident 2004	n/a	Type II diabetes	Cost per case	\$33,945 per year		
					5.5 days greater claim duration		

Behavioural risk factors

<u>Country</u>	<u>Study</u>	<u>Year(s) of study</u>	<u>Condition</u>	<u>Type of cost</u>	<u>Economic impact</u>
United States	CDC 2002	1995-99	Tobacco use	Productivity Loss Medical costs Absenteeism	\$1760 productivity per year \$1623 medical expenditures per year Males: 4 days higher Females: 2 days higher
United States	Sturm 2002	1997-98	Tobacco use	Medical costs	\$230 higher costs; 21% higher health care costs compare with 20 years aging increases health costs 20%
United Kingdom	North et al. 1993 Whitehall Study	1985-88	Tobacco use	Absenteeism	Males: 46% higher short-term; 81% higher long-term Females: 9% higher short-term; 37% higher long-term
Ireland	Madden 2003	2002	Tobacco use	Total national cost	0.70% GDP
Scotland	Parrott et al. 2000	1997	Tobacco use	Total national cost	0.51–0.77% GDP
United States	CDC 2002	1995–99	Tobacco use	Total national cost	0.98% GDP
United States	Max 1997	1980	Tobacco use	Cost per employee	\$336–\$601
Taiwan	Tsai et al. 2005	1999	Tobacco use	Total national cost Absenteeism	0.36% GDP Males: 1.06 extra sick days Females: 1.21 sick days Overall: 27% greater absenteeism
China	Wang and Dobson	1992	Tobacco Use	Absenteeism	OR sick leave 1.32-1.56

<u>Country</u>	<u>Study</u>	<u>Year(s) of study</u>	<u>Condition</u>	<u>Type of cost</u>	<u>Economic impact</u>
China	McGhee et al. 1992 2000	1995	Environmental tobacco smoke	Absenteeism Healthcare utilisation	Males: 91% higher Females: 62.5% higher Males: 41% higher Females: 38% higher
United States	Burton et al. 1998	1989-95	Obesity	Absenteeism Medical costs	\$1379 sick day costs \$3514 greater
United States	Thompson et al. 1998	1994	Obesity	Total national cost	\$12.7 billion Health ins. 61%; sick leave 19%; life ins. 14%; disability 6%
United States	Sturm 2002	1997-98	Obesity	Medical costs	\$395 greater; 36% greater health care costs Ref: 20 years aging corresponds to health cost increase of 20%
United States	Kessler et al. 1999	1990-96	Depression	Productivity loss Disability cost	\$182 –\$395 per month 1.5–3.2 short-term disability days
United States	Greenberg et al. 1996	1996	Depression	Productivity loss	\$33 billion; 74% due to absenteeism
United States	Stewart et al. 2003	2002	Depression	Productivity loss	\$31 billion per year 4.1 h/wk lost productive time

<u>Country</u>	<u>Study</u>	<u>Year(s) of study</u>	<u>Condition</u>	<u>Type of cost</u>	<u>Economic impact</u>
United States	Simon et al. 2000	-	Depression	Productivity loss Medical costs	2.7-fold greater work loss days or 10.6 days per year; 36% greater care costs

Table 5: The economic impact of chronic disease and risk factors on labour supply

<u>Country</u>	<u>Study</u>	<u>Year(s) of study</u>	<u>Employment indicator</u>	<u>Impact of chronic condition</u>
Ireland	Gannon and Nolan 2004	2000	Probability of labour force participation	Men: -61%
		2002	<i>Chronic disease</i>	Women: -52% Men: -66% Women: -42%
Sweden	Lindholm et al. 2001	1979-97	Probability labour force participation Welfare reliance <i>Chronic disease</i>	Unemployment: 1.9-fold higher Social allowance: 2.5-fold Financial difficulties: 1.8-fold Economic inactivity: 3.5-fold
Canada	Kraut et al. 2001	1983-90	Probability of labour force participation <i>Diabetes</i>	2.1-fold less likely
United States	Simon et al. 2000	-	Probability of labour force participation <i>Depression</i>	15.3% higher employment rate for depression remission vs. control
United States	Cawley 2004	1997-2004	Probability of labour force participation Welfare reliance	White: 10% weight increase corresponds to 12% decrease in probability of full-time employment; 5.4% fewer hours worked, 5% fewer months, 16% increase in months on welfare, and 10% lower earnings African American: 10% gain corresponds to 10.9% increase in months

<u>Country</u>	<u>Study</u>	<u>Year(s) of study</u>	<u>Employment indicator</u>	<u>Impact of chronic condition</u>		
			<i>Obesity</i>	spent on welfare		
Finland	Sarlio-Lahteenkorva/ Lahelma 1999	1994	Probability of labour force participation	Women: 2.5-fold higher likelihood of unemployment		
			<i>Obesity</i>			
Taiwan	Schultz 2002	1989–96	Probability of labour force participation	Parameter estimate	Men	Women
			<i>Chronic disease and risk factors</i>	HBP	-0.119	-0.091
				DM	-0.185	-0.207
				CVD	-0.273	-0.105
				Stroke	-0.728	-0.288
				Ref: literacy	0.016	0.241
United States	McGarry 2004	1992–94	Probability of full-time participation at age 62	-3.5%		
Russia	Suhrcke et al. 2005	2002	Retirement age	-2.5 years		
			Probability of retirement	Men: 13.6% greater		
			<i>Chronic disease</i>	Women: 14.0% greater		
Europe	Jimenez-Martin et al. 1999	1994- 1995	Probability of retirement	Men: 56.3%		
			<i>Chronic disease</i>	Women 22.9%		
United States	Dwyer and Mitchell 1999	1992	Expected retirement age	CVD: -0.7 years		
			<i>Chronic disease and risk factors</i>	High BP -1.0 years		
				DM -.12		
				Cancer -.13		

<u>Country</u>	<u>Study</u>	<u>Year(s) of study</u>	<u>Employment indicator</u>	<u>Impact of chronic condition</u>
United States	Coile 2003	1992–2000	Probability of retirement	Men: 42%
			<i>Chronic disease</i>	Women: 31%
			Labour force hours	Men: - 1030 hours
				Women: -654 hours
United States	Pellekowski/Berger 2004	1992–93	Labour force hours	Men: -6.1%
			<i>Chronic disease</i>	Women: -3.9%
United States	Serxner et al. 2001	1990–98	Absenteeism	Mental health 47% higher
			<i>Chronic disease and risk factors</i>	Tobacco use 19% higher
				Obesity 23% higher
Global	Ormel et al. 1994	1991–92	Occupational impairment	2.1-fold greater occupational limitation for subthreshold disorder
			<i>Depression</i>	4.3-fold greater occupational limitation for psychiatric disorder
			Disability days	1.5-fold greater for subthreshold disorder
				2.6-fold greater occupational limitation for psychiatric disorder
				7.7 mean days disability within past month

Table 6: Impact of chronic disease and risk factors on wages, earnings or incomes

<u>Country</u>	<u>Study</u>	<u>Year(s) of study</u>	<u>Condition</u>	<u>Wage or earnings impact</u>
<i>Clinical conditions and risk factors</i>				
United States	Pelkowski/Berger 2004	1992–93	Chronic disease	Men: 5.6% lower Women: 8.9% lower
Russia	Suhrcke et al. 2005	2002	Chronic disease	5.6% lower median per capita income
United States	Ng et al. 2001	1989	Diabetes	33% reduction; \$3700–\$8700 per year
Canada	Kraut et al. 2001	1983–90	Diabetes	28% lower
United States	Berndt et al. 2000	1995	Depression	12–18% lower over lifecycle
<i>Behavioural risk factors</i>				
United States	Levine et al. 1997	1984–92	Tobacco use	4–8% lower
Canada	Auld 1998	1991	Tobacco use	8%, simultaneity adj 30% lower
Australia	Lee et al. 1999	1980–89	Tobacco use	6.6% lower current smokers; 5.5% lower former smokers
United States	Sloan et al. 2003	-	Tobacco use	Over lifecycle -\$40,000
Netherlands	van Ours 2004	2001	Tobacco use	10% lower
Indonesia	Kosen 1998	1995	Tobacco use	US\$115 lost income per year for individual US\$115 per year for family-members and community care-taking
United States	Cawley 2003	1981–2000	Obesity	Two stdevs above mean 9% lower; corresponds to 1.5 years of education or 3 years work experience HH incomes \$6710 lower 10% higher poverty rates

United States	Zagorsky 2004	1985–2000	Obesity	one-point increase in BMI drops net worth \$1,000
United States	Bhattacharya/Bundorf 2004	1989–98	Obesity	Men: \$0.71 per hour
United States	Mitra 2001	1993	Obesity	1 pound increase in weight associated with 2% decrease in wages for women in professional and managerial positions Women: \$1.26 less per hour
United States	Averett/Korenman 1999	1990	Obesity	White women: 17% reduction
United States	Haskins/Ransford 1999	1988	Obesity	26% less likely to occupy managerial positions Beta = -0.18 income for entry-level professional positions
United States	Gortmaker 1993	1981–88	Obesity	Men 9% lower HH income or \$2876 Women 22% lower HH Income or \$6710
United States	Tucker/Friedman 1998	n/a	Obesity	Men: 1.7-fold likelihood absenteeism Women: 1.6-fold likelihood absenteeism
United States	Pronk et al. 2004	n/a	Obesity	Cooperability with coworkers Beta = -.24 Absenteeism Beta = 1.02 Job performance Beta = 0.05
			Moderate physical activity	Quality of work performed Beta = 0.06
			Cardiac fitness	Quantity of work Beta = 0.02 Extra effort exerted Beta = 0.21
United States	Fielding 1996	n/a	Physical inactivity	Productivity declined 50% last two hours of work
Finland	Sarlio-Lahteenkorva/Lahelma 1999	1994	Obesity	1.5-fold likelihood low household income 1.6-fold likelihood low individual income
United Kingdom	Sargent/Blanchflower 1994	1974–81	Obesity	Females age 23 -6.4%

Table 7: Household impacts of chronic diseases and risk factors

Country	Study	Year(s) of study	Condition	Adverse coping impact		
India	Shobhana et al. 2000		- Diabetes	15–25% HH income for treatment		
Bangladesh	Kibirya et al. 1999		- Diabetes	6–12 months wages, or \$160 per year		
Tanzania	Neuhann et al. 2001	1996–98	Diabetes	25% of minimum wage; costs exceed per capita health expenditure by factor of 20		
China	-		- Cancer	Average hospital stay exceeds per capita GDP		
Indonesia	-		- Cancer	_ patients completely financed lung cancer costs themselves		
United States	Case et al. 2002		- Behavioural risk	Poor child health:	Children ages 0–8 (_)	Children ages 9–17 (_)
				Mother BMI:	0.008	0.011
				HH member smokes:	0.092	0.064
India	Bonu et al. 2005	1995–96	Tobacco use	OR 1.35 of borrowing/distress selling during hospitalization for individuals who use tobacco OR 1.38 for non-users who lived in household with smoking OR 1.51 for non-users in households with both tobacco and alcohol use Population attributable risk for borrowing due to tobacco use: 16%		
India	Bonu et al. 2004	1998–99	Tobacco use	Adjust findings: Children less likely to be immunised, more likely to have acute respiratory infection, malnourished, and die before year one OR=1.21 less likely from smoking OR=1.15 more likely respiratory illness OR=1.21 more likely underweight AR Infant mortality of tobacco = 7%		
Bangladesh	Efroymsen et al. 2001	1991–96	Tobacco use	Male smoker spent 18x more money on cigarettes than health and 20x than education		

Country	Study	Year(s) of study	Condition	Adverse coping impact
				2-times as much as health, education, clothing and housing combined corresponds to 500 more calories to diet of children 10.5 million malnourished could have adequate diet if money were spent on food, saving 350 children each day
New Zealand	Thomson et al. 2002	1988–98	Tobacco use	Enabling lower-income households to be smoker-free would allow 14% of non-housing budget to be reallocated
China	Hu et al. 2005	2002	Tobacco use	Poor urban 6.6% HH income on cigarettes
Egypt	Nassar et al. 2003	1995–2000	Tobacco use	5-6% HH income
Indonesia	Adioetomo et al. 2005	1999	Tobacco use	6.2% HH income
Morocco	Aloui 2003	1998–99	Tobacco use	2.4% HH expenditure 4.2 fold increase since 1959
Myanmar	Kyaing 2003	1999	Tobacco use	2.7% HH expenditure lowest quintile: 4.4%
Nepal	Karki et al. 2003	2001	Tobacco use	9.6% lowest HH expenditure
Russia	Suhrcke et al. 2005	2002	Chronic disease	5.6% lower median per capita income

Table 8: Returns on employer investments in chronic disease intervention

Returns on employer investments in chronic disease intervention					
Company	Source	Programme	Intervention type	Length of follow-up	Return on investment (\$)
Washoe County	Aldana et al. 2001	2001–02		2	15.6
Matria Healthcare	Merx 2004				2
American Association of Health	AAH 2004		Disease management		2.3-2.5
Progressive Corporation	Musich et al. 2000	1990–95		6	avg. \$96; high cost group \$993
J&J	Goetzel et al. 2002	1995–99		4	\$225 per employee per year
DuPont	Edington 1992				2.1
Pepsico					3
Motorola					3.2
Providence Health System	Schoettle 2003				4.2
Citibank	Ozminkowski et al. 1999				4.6; \$1.9 million investment, \$8.9 million savings
Prudential Life Insurance	AIPM 1991			5	1.91
BankOne	Stevens 2004				3
Union Pacific Railroad	Abresch/Deas 2002		Risk factor management		3
Comprehensive Review1	Goetzel et al. 1999		Disease management		Median 3.0
Comprehensive Review2	Aldana et al. 2001		Demand and disease management		Average 3.5

Review

Kelly 2003

Demand mgt 4.5

Disease mgt 8.9

\$2-10

Table 9: Population interventions

<u>Country</u>	<u>Study</u>	<u>Year(s) of study</u>	<u>Intervention description</u>	<u>Outcome</u>	<u>Cost-effectiveness</u>
United States	French, et al. 1997	-	Reduce price of healthy foods	Obesity	increased sale by 78%
-	Reddy, KS 2004	-	Aspirin use in primary care settings	CVD	\$3 per life saved
Norway	WHO Draft	-	Lower population blood pressure by 2 mmHg through reduction in salt intake	CVD	\$188 million savings over 25 years
	Group Health Cooperative	-	Effective Treatment vs. Non-Treatment	Depression	Non-recovery missed 2-3 times more work 25% more likely to find a job
Australia		1998	Programmes to reduce tobacco consumption Assumes 10% decline due to PH programmes		\$1.22 billion Benefit:cost at 47.9:1 Net benefit: \$8.427 billion Public finances \$1.95 for every \$1 expenditure on PH programmes to reduce tobacco
			CVD prevention Reduction in cholesterol, blood pressure and smoking		Net benefit: \$8.478 billion
United States	Rizzo 1996	-	Prescription medications	CVD and diabetes	\$810 million cost Public finance: \$557 million savings; Reduce absenteeism

\$286 HTN
 \$633 CVD
 \$1475 DM

Projections

	Lightwood/Glanz	-	Projection	Tobacco use	Reduce by 1% would generate immediate savings of \$26–44 million Within the first two years, risk of stroke and cardiac mortality fall 50% 10% reduction in body weight corresponds to savings of \$2200–5300 in obesity-related medical expenditures
UK	UK Research Partnership 2005 Greater Manchester Sub-Region	-	Projection	Tobacco Use	40% reduction in tobacco would yield 5750 new jobs and £107million in additional wages Costs local economy nearly £630 m every year – 75% borne by businesses 1% reduction equals saving of £34.4million per annum and £1,630 per smoker
United States	Ong/Glantz 2004	-	Projection		Smoke-free workplace policies would save in the first year \$60 million in direct costs; at steady-state \$279 million annually. These policies were 9 times more cost-effective than nicotine-replacement \$506 per QALY or \$799 per quitter
United States	Oster/Thompson 1996	-	Projection	Obesity	Reduction in dietary fat would reduce CHD events between 30,000–90,000 per year avoiding \$4.1–\$12.7 billion in costs
United States		1994	Projection	Obesity	Cost-benefit of nutrition labelling at \$2.7 billion over 20 years
Australia	Leeder 2003	-	Projection	Obesity	Nutrition labelling projected to prevent 400 deaths per year, with savings between \$47–\$67 million
New Zealand	Leeder 2003	-	Projection		
Canada	Leeder 2003	-	Projection	Obesity	Cost-benefit of nutrition labelling at \$5 billion over 20 years

Table 10: Growth regression results

Dependent variable: GDP per capita.	OLS	FE
Lagged-GDP p.c.	.86*** (.02)	.65*** (.05)
Lagged Fertility growth rate	-.05 (.03)	-.17*** (.06)
Openness	.16*** (.02)	-
Lagged adult mortality rate	-.08** (.04)	-.18*** (.06)
R ²	0.97	0.98
No. of observations	302	332

Notes: heteroscedasticity-consistent standard errors in parenthesis.

*, **, *** denote significance at the 10%-, 5%-, 1%-level, respectively.

Constant terms are not reported.

OLS stands for ordinary least squares regression. FE means fixed effects regression. For more details see Suhrcke et al. 2005.

Table 11: Forecasted GDP per capita scenarios

Forecasted GDP per capita scenarios and associated economic benefits – based on the ordinary least squares estimates

		GDP per capita (US\$)			Economic benefits compared to 'status quo'-scenario (undiscounted)	
		Status quo (1)	Medium (2)	Optimistic (3)	Medium (2) - (1)	Optimistic (3) - (1)
Russia	2000	8013	8013	8013	0	0
	2005	9106	9139	9172	33	66
	2010	10142	10247	10350	106	209
	2015	11114	11334	11545	220	431
	2020	12000	12376	12731	376	732
	2025	12792	13365	13898	573	1106
Brazil	2000	7185	7185	7185	0	0
	2005	8386	8414	8441	27	55
	2010	9601	9691	9777	89	176
	2015	10813	11003	11184	191	371
	2020	12004	12338	12649	335	645
	2025	13160	13683	14158	523	998
China	2000	856	856	856	0	0
	2005	1377	1381	1385	4	8
	2010	2073	2090	2106	17	33
	2015	2943	2988	3030	45	87
	2020	3977	4073	4160	96	183
	2025	5156	5333	5489	177	333
India	2000	2480	2480	2480	0	0
	2005	3280	3289	3299	10	19
	2010	4194	4229	4262	35	68
	2015	5208	5290	5367	82	159
	2020	6305	6461	6604	157	299
	2025	7462	7725	7960	264	498
United States	2000	33308	33308	33308	0	0
	2005	38800	38966	39131	166	331
	2010	44256	44794	45328	539	1072
	2015	49641	50793	51924	1152	2283
	2020	54901	56928	58906	2027	4005
	2025	59956	63134	66211	3177	6255

Source: Authors' calculations

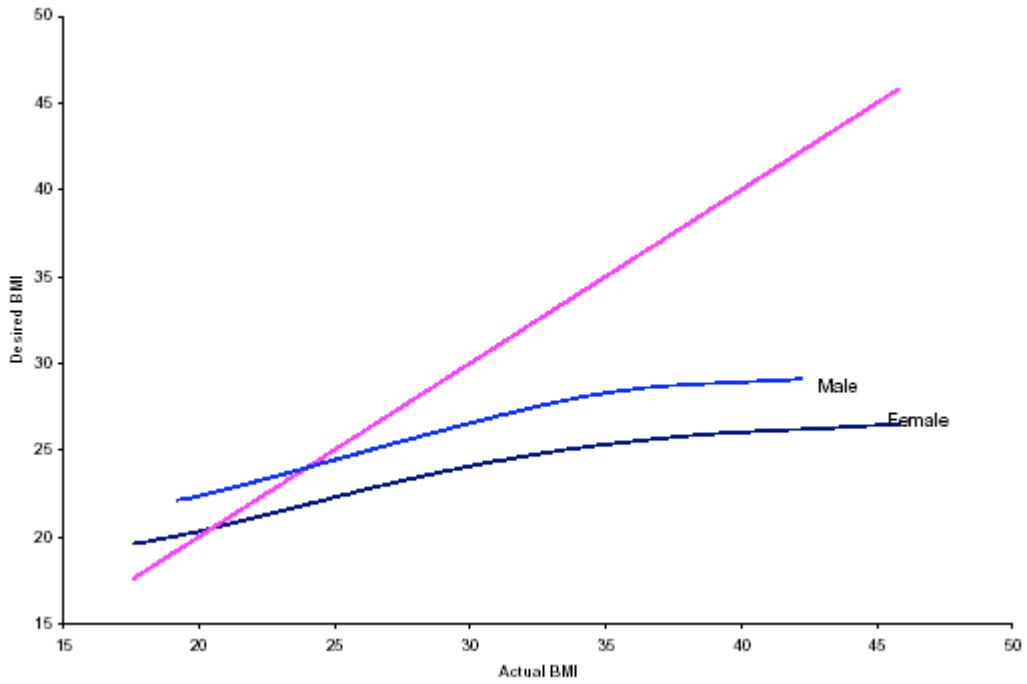
Table 12: Discounted benefit of medium and optimum scenario (in % of 2000 GDP per capita)

	Medium scenario	Optimum scenario
Russia	39%	76%
Brazil	39%	75%
China	88%	168%
India	51%	98%
USA	50%	100%

Source: Authors' calculations

Note: Results based on OLS estimates only. The less conservative Fixed Effects results are not reported here.

Figure 4: Actual and desired body mass index (BMI) in the United States



Source: Cutler et al. 2003

Notes: Calculated using data from Behavioral Risk Factor Surveillance Survey (BRFSS).

Figure 5: Disparities in quitting trends in Norway

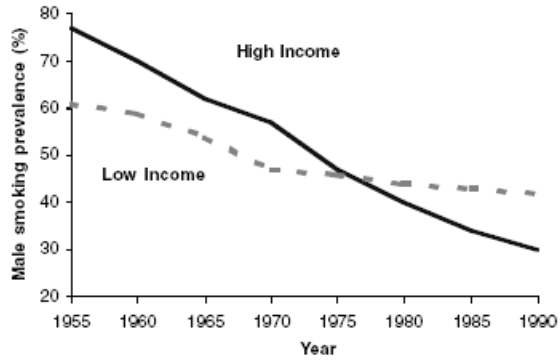


Fig. 3.5 Smoking trends in Norwegian men by income group, 1955–90. Source: Lund *et al.* 1995.

Figure 6: Motivation to quit among adult smokers by socioeconomic group in the United Kingdom

GHS 1998 – “Would you like to give up smoking altogether?”

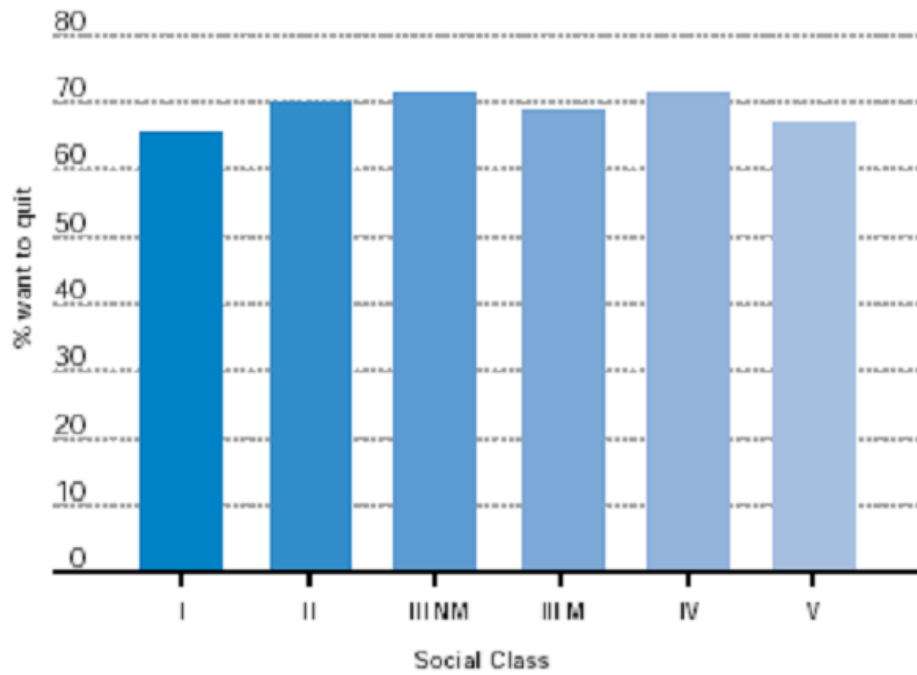


Figure 7: Smoking cessation by social class, Great Britain: GHS 1973 and 1998

