

**The Oxford
Health Alliance**



**Confronting the Epidemic
of Chronic Disease**

Chronic disease: an economic perspective

Contents

Foreword	5
About this document	6
Executive summary	8
1 Introduction	10
2 The distribution of chronic disease by wealth and age	11
2.1 The relationship between chronic disease and economic wealth	
2.2 The age distribution of chronic disease	
2.3 Conclusions	
3 Economic consequences of chronic disease	17
3.1 Cost-of-illness studies	
3.2 Microeconomic consequences of chronic disease	
3.3 Macroeconomic consequences of chronic disease	
3.4 Conclusions	
4 The economic rationale for public-policy intervention against chronic disease	29
4.1 Externalities	
4.2 Departures from rationality	
4.3 Insufficient and asymmetric information	
4.4 Time-inconsistent preferences or 'internalities'	
4.5 Conclusions	
5 Cost-effectiveness of interventions to prevent chronic diseases	40
5.1 What is cost-effectiveness?	
5.2 Barriers to measuring cost-effectiveness	
5.3 Gathering information about intervention cost-effectiveness	
5.4 Cost-effectiveness of interventions to prevent chronic diseases	
5.5 Conclusions	
6 Further research needs and concluding remarks	48
Endnotes	51
References	54

Marc Suhrcke, Rachel A. Nugent, David Stuckler and Lorenzo Rocco
Chronic Disease: An Economic Perspective
London: Oxford Health Alliance 2006

This report is also available on the Oxford Health Alliance website at www.oxha.org.
Published by the Oxford Health Alliance

ISBN 0-9554018-1-X

Figures

Figure 1	Worldwide share of deaths by cause and World Bank income category (2002)	11
Figure 2	Worldwide share of deaths by cause and World Bank region (excluding high-income countries, 2002)	12
Figure 3	Projections of cause-specific deaths (as a percentage of total deaths) in low-income countries, baseline scenario	12
Figure 4	Male mean body mass index (BMI) versus gross domestic product (GDP) per person (2002)	13
Figure 5	Mean systolic blood pressure for females (age > 14) versus gross domestic product (GDP) per person (2002)	13
Figure 6	Smoking prevalence among men (age > 14) versus gross domestic product (GDP) per person (2002)	13
Figure 7	Prevalence of daily smokers in the poorest and richest income quintiles in selected low- and middle-income countries	14
Figure 8	Obesity prevalence among women from south-eastern Brazil, 1975–1997	15
Figure 9	Ratio of expenditures on tobacco versus education in Bangladesh, 1995–1996	22

Tables

Table 1	Out of all cause-specific deaths, what share occurs before age 60?	15
Table 2	Out of all cause-specific disability-adjusted life years (DALYs), what share occurs before age 60?	16
Table 3	Out of all deaths before 60, how many are accounted for by each disease category?	16
Table 4	Risk of distress borrowing and selling during hospitalisation in India, 1995–1996	22
Table 5	Change in wages associated with changes in indicators of chronic disease	25
Table 6	Change in the probability of labour-market participation in response to limited ADL among countries in the Commonwealth of Independent States	25
Table 7	Examples of internal, quasi-external and external costs (and benefits) of chronic disease and unhealthy lifestyles	31
Table 8	Percentage of students exposed to tobacco at home and outside the home	32
Table 9	Cost per DALY saved for interventions to reduce blood pressure and serum cholesterol by country income group	45

Boxes

Box 1	Cost-of-illness studies in the United States	18
Box 2	Methodology – measuring chronic disease and assessing its causal impact in micro data sets	20
Box 3	How communicable are non-communicable diseases?	33

Foreword

In the last few years, the attention of the world has been dramatically drawn to the plight of those in low-income countries afflicted with HIV/AIDS, malaria and tuberculosis. In contrast, the heavy burden that chronic diseases – cardiovascular disease, diabetes, respiratory ailments and cancer – impose on large shares of the population in low- and middle-income countries has received far less attention. This is lamentable, not only because of the pressures these illnesses are creating on overstretched health systems and the immense cost of the disease burden, but because the prevalence and cost of addressing these issues will only rise in coming years. A combination of fundamental structural trends – the ageing of the population in many large low- and middle-income countries, rapid urbanisation rates, and important changes in lifestyle (greater exposure to hypertension, changed diet and less physical exercise) – have created the preconditions for an expansion in the prevalence of chronic disease problems in the future. Add to this the fact that medical technologies for the diagnosis and treatment of chronic diseases continue to advance in sophistication and cost, and one can immediately see the difficult financial burden that will be borne by these countries in coming decades in providing treatment for afflicted individuals.

This paper thus comes at an opportune moment. It first underscores that chronic diseases are not simply diseases of the affluent, but rather affect households in all income strata, with incidence largely depending on the key risk factors underlying the incidence of the disease. Diabetes, for example, is principally a disease of lower-income households in industrial countries, while in low-income countries a heavy burden is now borne by urban households (often from middle- and low-income groups) exposed to new diets. Tobacco consumption leads to a heavy burden of disease on low-income households. While the elderly certainly bear a heavy burden (which increases with the ageing of populations), working-age individuals are also seriously affected.

The paper then provides a careful survey of what economists have concluded about the costs of chronic diseases, not only at the household level, but at the level of the macroeconomy. It also highlights the economic rationale for governments to play a role in addressing the various causes of chronic disease at a *preventative* level, before the disease burden strikes hardest.

Finally, the paper surveys what is known about the cost-effectiveness of interventions to prevent the occurrence of chronic disease. In many respects, this last discussion is the most useful because it underscores *how much we still need to learn*

about what interventions can, at low cost, reduce the prevalence and severity of the various chronic disease problems.

And that is only the beginning. It is increasingly clear that in the future, as industrial countries wrestle with the high cost of diagnosing and treating chronic diseases, more efforts will be needed by governments to learn how to rationalise their approach to the provision of treatments. Most industrial governments are heavily involved in the financing of medical care. It is thus of critical importance that they are able to judge the relative cost-effectiveness of the many medical interventions – ever increasing in their sophistication and cost – that are available to physicians. In the absence of a strategy for judging the cost-effectiveness of alternative interventions, including prevention efforts, the projections of economists on the likely growth of medical expenditures will become a grim reality. And these forces will not be solely limited to the industrialised countries. In a globalised world, the pressures experienced by the most advanced treatments will be increasingly felt by the governments of low-income and middle-income countries, as they respond to the pressures of increasingly wired middle- and upper-income households.

Peter Heller

International Monetary Fund

Deputy director of the Fiscal Affairs Department

About this document

The authors

Marc Suhrcke, PhD, is with the WHO Regional Office for Europe (Venice, Italy), where he is in charge of the Health and Economic Development workstream. His main current research interests are the economic consequences of health, economics of prevention and the socioeconomic determinants of health. (msu@ihd.euro.who.int)

Rachel A. Nugent, PhD, is director of health and economics at the Population Reference Bureau. She is a contributor to the Disease Control Priorities Project in Developing Countries, published in 2006. Her current research interests include: the cost-effectiveness of interventions for chronic diseases in developing countries, intellectual property, and nutrition and agricultural policies in developing countries. (rnugent@prb.org)

David Stuckler is a PhD candidate at Cambridge University in the faculty of Social and Political Sciences. He recently completed a Master's in Health Policy at Yale University. He has published several articles relating to chronic diseases and development and is actively working with OxHA members and the WHO on issues pertaining to the global governance of chronic diseases. (ds450@cam.ac.uk)

Lorenzo Rocco is an assistant professor of economics with the University of Padova in Italy. He obtained a PhD from the University of Toulouse I in 2005. His main current fields of research are development economics and health economics. (lorenzo.rocco@unipd.it)

Marc Suhrcke coordinated work on this report and wrote Chapters 1–4 and Chapter 6. Rachel Nugent wrote Chapter 5. David Stuckler and Lorenzo Rocco provided essential research, writing and revision for most chapters. All authors contributed to the final writing of the report.

This report is a complete revision of a draft paper that had been prepared for the 2005 conference of the Oxford Health Alliance – also available on the OxHA website (www.oxha.org). The title of the former version is 'Economic consequences of chronic diseases and the public and private rationale for intervention', written by M Suhrcke, D Stuckler, S Leeder, S Raymond, D Yach and L Rocco.

Acknowledgements

The authors thank the Oxford Health Alliance for its support during the preparation of the report and for the opportunity to publish and actively disseminate this work. We are particularly grateful to Hanna

Neuschwander, our editor – without her proactive support, encouragement and management, it is unlikely that we ever would have finalised the report. We are also grateful to Katy Cooper (OxHA), for her extremely valuable contribution in the final phase of production of this report, and to Paul Mayer and Stig Pramming from OxHA for their support and contribution. In addition, for the visual excellence of the final product, we thank Danny Abelson and The Abelson Company.

The report, in its present format as well as in its previous version, has directly and indirectly benefited from comments by and discussions with a large number of people. In particular, we would like to thank Soji Adeyi, Steve Leeder, Tom Gaziano, Owen Smith, Michael Thiede, Dieter Urban, Derek Yach and Peter Heller for their contributions at various stages of the report.

All remaining errors are exclusively the responsibility of the authors.

Funding

The publication and dissemination of the report was funded by the Oxford Health Alliance. The contribution of Rachel Nugent was also partially funded by OxHA.

Disclaimer

Views expressed in the report are exclusively those of the authors and may not necessarily reflect the official views of the organisations they are affiliated with, nor those of the Oxford Health Alliance.

A note on terms and definitions

'Chronic disease', according to the World Health Organization (WHO), comprises the major chronic conditions of heart disease and stroke (cardiovascular disease), cancer, chronic respiratory disease and diabetes. There are many other chronic conditions, including mental disorders, vision and hearing impairment, oral diseases, bone and joint disorders and genetic disorders – these are not addressed in this paper.

Over half of the deaths in the world are due to just four chronic conditions – diabetes, lung diseases, some cancers and heart disease – caused by three risk factors – smoking, poor diet and lack of physical activity. For the purposes of this paper, the main risk factors that give rise to chronic conditions are considered to be obesity, poor diet, physical inactivity, and tobacco and alcohol consumption. The prevalence of overweight and obesity is commonly assessed by using body mass index (BMI), defined

as a person's weight in kilograms divided by the square of their height in metres (kg/m²). A BMI over 25 kg/m² is defined as overweight, and a BMI of over 30 kg/m² as obese. These markers provide common benchmarks for assessment, but the risks of disease in all populations can increase progressively from lower BMI levels.

Following the WHO in *Preventing Chronic Diseases: A Vital Investment* (WHO 2005), this paper uses the term 'chronic disease' in place of 'non-communicable disease' because 'it suggests important shared features: chronic disease epidemics take decades to become fully established; given their long duration, there are many opportunities for prevention; they require a long-term and systematic approach to treatment; and health services must integrate the response to these diseases with the response to acute, infectious diseases'. The authors of this paper recognise the many difficulties in finding an accurate vocabulary to discuss chronic, non-communicable or what some call 'lifestyle' diseases, and that some diseases referred to as 'chronic' in this paper may actually be acute (such as some forms of heart disease), just as some communicable diseases (such as HIV/AIDS) may assume 'chronic' characteristics.

Frequent reference is also made to the World Bank's classification of economies by per-person gross national income as low income, lower-middle income, upper-middle income and high income. They are defined as follows: high income, ≥US\$9,206; upper-middle income, US\$2,976–\$9,205; lower-middle income, US\$746–\$2,975; low income, ≤US\$745 (World Bank 2003).

A note to readers

This paper addresses both technical and non-technical readers. For an abridged experience of the report, the following guide may provide useful shortcuts for both types of readers.



For **non-technical readers**, key points have been highlighted throughout the paper, using the symbol indicated here in the margin. Reading this highlighted information in conjunction with the Introduction and Conclusion (Chapters 1 and 6) provides a good overview of the central points of the case and its assumptions. It should leave the reader with a serviceable understanding of where chronic diseases are concentrated, what they cost, when intervention is justified to address the burden of disease, and the quality and costs of possible interventions – at the current state of knowledge.

- **Who is affected by chronic disease** is addressed in Chapter 2
- The **costs of chronic disease** are the subject of Chapter 3
- The **theoretical argument for government intervention** is elaborated in Chapter 4
- A summary of **cost-effective interventions** is provided in Chapter 5
- For a review of **major areas for improvement of research** see Chapter 6

Technical readers will find more elaborate discussions, for example, of how costs are determined and evaluated and the methodological difficulties in determining the origins of costs and causality in Chapter 3. In particular, Box 2 touches upon the econometric challenges presented by standard statistical techniques. Chapter 6 contains specific suggestions for improvements to data-collection techniques, as well as areas of research that deserve further consideration.

A note regarding the Web-Annex

Further background material in the form of figures and tables is provided in a Web-Annex, found by following links from <http://www.oxha.org/initiatives/economics>. Each Web-Annex figure and table is referred to in the text at the relevant location.

Key terms and abbreviations

ADL	Activities of daily living
BMI	Body mass index
CBA	Cost-benefit analysis
CEA	Cost-effectiveness analysis
COI	Cost-of-illness
CVD	Cardiovascular disease
DALY	Disability-adjusted life year
DCPP	Disease Control Priorities Project
DHS	Demographic and Health Surveys
GBD	Global Burden of Disease
GDP	Gross domestic product
GNP	Gross national product
GYTS	Global Youth Tobacco Surveys
LSMS	Living Standard Measurement Surveys
MDG	Millennium Development Goal
OLS	Ordinary least square
PPP	Purchasing power parity
QALY	Quality-adjusted life year
RHS	Reproductive Health Surveys
VSL	Value of a statistical life
WHO	World Health Organization
WTP	Willingness to pay

Executive summary



Chronic diseases account for the greatest share of early death and disability worldwide. Over the next few decades this burden is projected to rise particularly fast in the developing world. The lack of research on the economic implications of chronic disease contrasts with the available knowledge on the sheer epidemiological burden of the problem. **This paper assesses and evaluates the current state of knowledge, with a primary focus on low- and middle-income countries, and a secondary focus on high-income countries (where information on the former is lacking).** Very few such attempts have been undertaken, especially with an interest in developing countries. Thus a critical review of the available evidence is a necessary first step in exploring the case for governments and donors to invest in chronic disease prevention and in clarifying areas in which further research is required.

As the evidence is complex, the report should meet the needs of technical audiences for whom detailed knowledge is central as well as be accessible and useful to those for whom synthesised understandings are sufficient.

Who is affected by chronic diseases?

Chronic diseases have traditionally been considered 'diseases of affluence' that affect only the elderly and wealthy. While the observed patterns defy oversimplified conclusions, the data presented in this report strongly suggest that chronic diseases and related risk factors impose a significant burden on both the poor – across countries and within countries – and those of working age. To the extent that the traditional view has prevailed among economists, it may be partly responsible for the lack of research into the economic implications and public-policy relevance of chronic disease.

Chronic diseases account for the largest share of the overall mortality in all regions of the developing world, except sub-Saharan Africa. While the prevalence of risk factors varies across countries, it is clear that they are significant in countries other than the most affluent. Within countries, in particular low- and middle-income countries, the picture is clearest for smoking (which is concentrated among the poor) and female obesity (where above a fairly low national per-person income level, the burden is concentrated among the poor). The picture appears more mixed for other indicators, such as physical inactivity.

Contrary to widespread views, a substantial share of the chronic disease burden rests on the shoulders of working-age populations (even when 'working age' is conservatively defined as 60 years or younger),

particularly in developing countries. Approximately 80% of all disability-adjusted life years (DALYs) are lost due to chronic disease before age 60 in low- and middle-income countries. Yet, even the disease burden on the elderly has a significant and sometimes underappreciated economic impact.

What are the economic consequences of chronic disease and related risk factors?

The report distinguishes three (partly overlapping) sets of evidence that illustrate the economic impact of chronic disease: 'cost-of-illness', microeconomic, and macroeconomic data. Taken together, there exists evidence enough to conclude that there are important economic consequences of chronic disease – important for the individual and his/her family, but also potentially important for the economy at large. Chronic diseases and related risk factors have an impact upon consumption and saving decisions, labour-market performance, and human-capital accumulation. There is also recent evidence that chronic diseases have significantly detracted from economic growth in high-income countries. To the extent that this evidence points to future impacts in developing countries, it may function as a reminder to policymakers to act now to stem the growing burden of disease in addition to health as a means to promote economic development.

Are there market failures that justify public-policy intervention to prevent chronic disease?

It is far from obvious that there is an economic justification for governments to interfere in the private sphere of the individual, especially as the largest share of the costs of disease are borne by the individual directly concerned (i.e. they represent private or 'internal' costs). There are, however, conditions under which the market fails to achieve socially optimal outcomes on its own, potentially justifying government intervention to improve social welfare. There are four potential market failures for the risk factors that give rise to chronic diseases: externalities, non-rational behaviour, insufficient and asymmetric information and time-inconsistent preferences (which cause problems of self-control over time). Since there is little work that has directly examined the rationale for intervention against chronic disease in developing countries, much of the evidence discussed relates to developed countries. In short, the main conclusions of this chapter are as follows:

- The presence of health or social costs of an individual's unhealthy behaviours that are borne by society at large ('externalities') or by family members ('quasi-externalities') may represent a justification

for intervention, although the former, in particular, are typically not considered to be large in comparison with internal costs.

- There is widespread recognition that parts of the population, in particular children, are not (yet) the rational actors that economic theory assumes. Therefore, interventions that protect children stand a good chance of finding support.
- Information is a public good and as such it will generally be undersupplied compared to the social optimum. Hence, there is in principle a case for governments to intervene to provide information, especially in developing countries.
- A recently defined justification for intervention, grounded in behavioural economics, is the idea of time-inconsistent preferences (giving rise to 'intra-personal' externalities or 'internalities'): individuals accept instant gratification at the expense of their long-term best interests.

Though more research is needed, the latter argument (as well as non-rational behaviour and imperfect information) can in principle justify an acceptance of some of the large internal costs of chronic diseases as relevant to public policy, on top of any external costs that may exist.

Is there evidence that interventions can prevent chronic diseases for a reasonable cost?

There is evidence that cost-effective interventions exist to address chronic disease in developing countries. Some of this evidence has come from studies carried out in developing countries, some is from modelling based on available data, and some is from experience in developed countries that suggests a likelihood of cost-effectiveness in developing countries.

Cost-effective interventions include tobacco-cessation programmes, tobacco taxes, contextually appropriate mass-media education campaigns to improve diet, community-based physical activity programmes, and secondary prevention through pharmacological interventions. However, much more investment in carefully designed and conducted interventions trials in developing countries is needed. Many of the interventions that are generally thought to be effective or even cost-effective have not been evaluated in a developing-country context. Because there is little economic incentive for the private sector to conduct such research, it could be an excellent investment for the public sector as the burden of

chronic diseases grows with ageing populations and the factors contributing to many chronic diseases spread around the world.

Overall, though significant evidence is available to suggest that chronic diseases merit a marked increase in policy attention, there remain gaps that point to a need for more research on the burden and cost of chronic diseases, as well as on the effectiveness and cost-effectiveness of interventions, particularly for developing countries.

1. Introduction

It is well documented that in public health terms chronic diseases have come to 'matter' in developing countries, where they impose a sizeable and growing disease burden (WHO 2005, Strong et al. 2005). The Global Burden of Disease (GBD) project estimates that, as of 2002, chronic or non-communicable conditions accounted for 54% of deaths in low- and middle-income countries, compared with 36% attributed to communicable (i.e. infectious) diseases, maternal and perinatal conditions and nutritional deficiencies. The share of chronic conditions is predicted to rise to 65% by 2030 (Mathers and Loncar 2005). There is also reason to believe that in public health terms developing countries may be particularly affected as chronic diseases spread around the globe, and that they may be less able to cope with the adverse impacts brought about by chronic disease (Schmidhuber and Shetty 2005). [Please see 'A note on terms and definitions', above, for discussion of terminology and how chronic diseases are defined.]

Key Despite the unambiguous predominance of chronic disease in sheer epidemiological terms, the economic dimensions of the growing disease burden have not been thoroughly documented – particularly in the developing-country context.¹ In recent years, economists have dedicated significant attention to the analysis of communicable and nutritional diseases affecting mothers, children and the poor. A large share of this work has been summarised by the Commission on Macroeconomics and Health (CMH 2001). Diseases and conditions such as HIV/AIDS, malaria, tuberculosis and child malnutrition have been singled out as key factors holding back the economic development and poverty-reduction efforts of many developing countries. Perhaps in recognition of the comparatively strong available economic evidence, the policy attention devoted to those diseases has increased markedly. This is reflected in the explicit inclusion of several communicable and child/maternal conditions in the Millennium Development Goals, the core set of development objectives that the international community set for itself in 2000. By contrast, there is a relative lack of evidence regarding the economic burden of chronic diseases.

Key This paper fills in some of these gaps by collecting and evaluating the current state of knowledge, with a primary interest in low- and middle-income countries. Evidence from high-income countries is also presented because in some cases it is the only data available and in others it may be instructive. In addition, few comprehensive discussions of the available economic data, even from developed countries, exist.

Over the course of this report, five central arguments are set out. First, chronic diseases are not limited to

wealthy nations and the rich within countries, nor do they afflict only the elderly. These findings should provide an incentive for reconsidering the costs that chronic diseases impose on a global scale, as well as the potential motivation for policy action on equity grounds (Chapter 2).

Second, the economic burden of chronic disease is manifold in all levels of society, imposing costs at the individual, family, community and national levels. Partly overlapping sets of evidence – comprising 'cost-of-illness', microeconomic, and macroeconomic data – paint a nuanced but coherent picture of significant costs. Simultaneously, there are important barriers to accurately determining the cost of chronic disease, which could be overcome by future research (Chapter 3).

Third, there are conditions under which the observed economic consequences of chronic disease or related risk factors can justify public-policy intervention from an 'efficiency' perspective. Although it is often fiercely denied that there exists a justification for governments to interfere in the private sphere of the individual (see *Financial Times*, 3 September 2006), there are conditions under which the market fails to achieve socially optimal outcomes. In these cases, there are grounds for governments to step in, with the aim to improve net social welfare (Chapter 4).

Fourth, effective interventions that improve social outcomes do exist, and they are available at reasonable cost. This is critical because the presence of a market failure – should one exist – only represents a complete justification for government action if there are also cost-effective, evidence-based interventions at hand. Primary prevention, which occurs before any disease has been detected, is emphasised and includes tobacco-cessation programmes, tobacco taxes, mass-media education campaigns and community-based physical activity programmes. These interventions can improve health without heavy reliance on a sophisticated health system, which is often not widely available in developing countries (Chapter 5).

Fifth and finally, there are significant gaps in current knowledge and research, especially as they relate to developing countries. Though there is a growing evidence base, more evidence on the economic consequences of disease, public-policy rationales and – above all – the cost-effectiveness of interventions is urgently needed (Chapter 6).

With a clearer picture of the real scope of the economic consequences of chronic disease should come more informed policymaking and better opportunities to improve the quality of life of millions of people worldwide.

2. The distribution of chronic disease by wealth and age

Two fundamental notions have characterised the common perception of chronic diseases: they are concentrated among the rich and among the elderly. Yet neither of these notions fully stands up to the recent empirical evidence. In addition, they contribute to a misunderstanding about the real costs of chronic disease, which may have consequences for how policymakers view the importance of investing in their prevention and control. If chronic diseases are ‘diseases of affluence’, indicating wealth rather than poverty, there is limited motivation – from an equity standpoint – for economic policy to confront the problem (section 2.1). If chronic diseases strike only toward or after the end of working age and, hence, after the lifetime productive contribution to the economy has been delivered, then early death or disability due to chronic disease may not represent a significant economic loss (section 2.2). In addition to not corresponding to the evidence, this is based on a misconception of what constitutes ‘economic value’.

2.1 The relationship between chronic disease and economic wealth

To determine whether chronic diseases can really still be considered ‘diseases of affluence’, at least two questions can be asked: ‘Do chronic diseases only affect rich countries?’ and ‘Do chronic diseases affect only the rich within countries?’ Although it becomes clear that recent epidemiological evidence contradicts the ‘diseases of affluence’ notion, the actual picture that emerges, especially regarding the distribution of chronic disease and risk factors within countries, is more nuanced than is often indicated in the literature.

2.1.1 Do chronic diseases only affect rich countries?

It is possible to test whether chronic diseases affect poor countries in at least two ways: 1) by examining the overall burden of disease across countries or regions, and 2) by examining the prevalence of risk factors, such as smoking and body mass index (BMI), in relation to wealth. Overall burden can be measured by mortality (the number of deaths due to a particular cause) or by disability-adjusted life years (DALYs). Rather than measuring deaths exclusively, DALYs capture both mortality and morbidity in a single measure that accounts for both the time lived with a disability and the time lost to premature death. Mortality and morbidity data are highly relevant as they describe the current scope of the chronic disease burden worldwide. However, risk factor data is intriguing in that it can illuminate the possible future shape of the disease burden – where risk factors are prevalent, a future

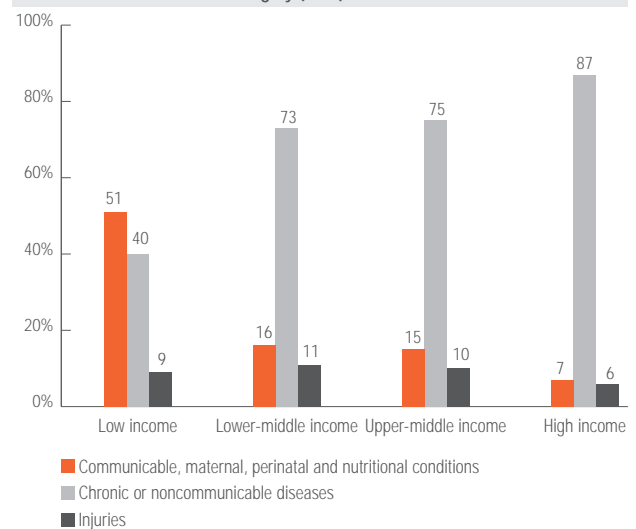
burden is likely. In addition, risk factors are relevant to discussions of the prevention of chronic disease because most preventive interventions will be targeting risk factors either directly or indirectly.²

The overall burden of chronic diseases

Determining whether chronic diseases impose a ‘considerable’ share of the disease burden in poor countries can be done making use of the wealth of data available from the recent Global Burden of Disease (GBD) project.³ Most of the data come in the form of regional aggregates (by geographical location and income category), although some of the data are broken down to the country level. Projections of future cause-specific death and disease burdens are also available, which can give some indications of how the relative weight of chronic diseases may evolve.⁴ (It should be noted that the GBD terminology refers to ‘non-communicable diseases’ rather than ‘chronic diseases’.)

The GBD project has aggregated regional data about causes of death into four groups according to the income categories used by the World Bank: low, lower-middle, upper-middle and high income. This classification can be used to understand whether chronic diseases account for a high or even the highest share of deaths or of DALYs in poor and rich countries. In judging whether a given share of chronic diseases is high, it can be compared to the share accounted for by the other two main disease categories:⁵ 1) communicable, maternal, perinatal and nutritional conditions (for the sake of brevity, all diseases in this category are subsequently referred to in this paper

Figure 1 Worldwide share of deaths by causes and World Bank income category (2002)



Source Mathers et al. (2003)

Note Although the category ‘Injuries’ is included here, it is not included in the following figure.



as ‘communicable’) and 2) injuries. The data show that in all but the low-income countries, chronic conditions account for a greater share of deaths than communicable diseases (see Figure 1). (A similar picture is obtained when looking at DALYs instead of deaths – see Web-Annex, * Figure A 1.)

The disaggregation by income group depicted in Figure 1 may hide important geographical differences. Looking at the geographical break-up only among low- and middle-income regions, it becomes obvious that what has been driving the higher share of communicable diseases in the low-income group is actually the extraordinarily large share of this disease category in sub-Saharan Africa. In all other geographical regions, the largest share of mortality is accounted for by chronic diseases (see Figure 2). The same qualitative picture obtains when looking at the country-specific GBD data from Mathers et al. (2003). When looking at DALYs instead of deaths, South Asia joins sub-Saharan Africa as the second region in which, by a narrow margin, communicable diseases still account for a higher share of the disease burden.



Not only do chronic diseases compose a ‘considerable’ share of the overall disease burden in low- and middle-income countries, they in fact account for the major share of the mortality burden in all places outside of sub-Saharan Africa. This begs the question of how the picture is expected to change in the near future. Given past trends and the nature of the epidemiological transition, the relevant question is not if but when chronic diseases will overtake communicable and other diseases also in the low-income countries (see Figure 3).

Recent WHO projections show that chronic diseases will be the biggest contributor to mortality in low-income countries before 2015, and in terms of DALYs before 2030 (see Web-Annex, Figure A 2). In other regions, the predominance of chronic disease will increase further (see Web-Annex, Table A 1).

The burden of chronic disease risk factors

In addition to overall disease burden, risk factors can be examined to assess, from a different angle, the potential burden that chronic diseases impose on the poor. The data presented below track in a very simple manner whether risk factors relevant for chronic disease are more prevalent in rich countries compared with poorer ones.

Data about risk factors typically come from primary survey data and serve as a complement to the GBD method of estimation. The data presented in this section and in the Web-Annex (Figures A 3 – A 8) are drawn mainly from the WHO’s Global InfoBase⁶ (covering mean BMI, overweight and mean systolic blood pressure), the WHO’s World Health Statistics 2006 (covering adult smoking prevalence),⁷ and the WHO’s Global Alcohol Database (covering alcohol consumption).⁸ It must be emphasised that the relationships depicted by this data merely describe associations between risk-factor prevalence and wealth and do not necessarily imply that one causes the other. (In the graphs, a non-linear regression line is chosen, in contrast to a linear regression line whenever the square term of a non-linear regression is statistically significant at least at the 5% level.)

Figure 2 Worldwide share of deaths by cause and World Bank region (excluding high-income countries, 2002)

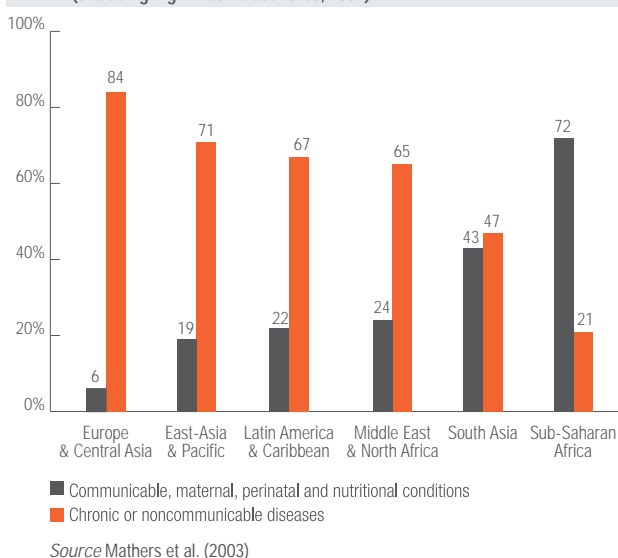
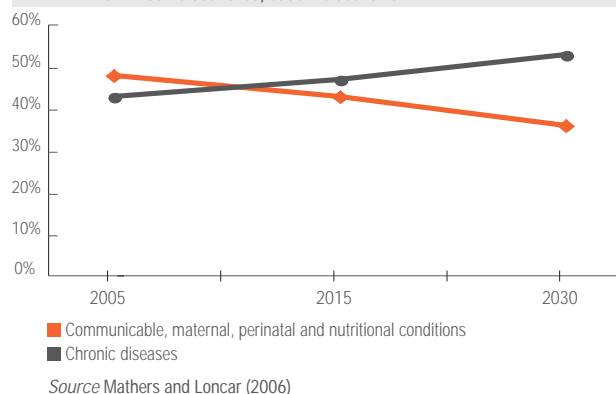
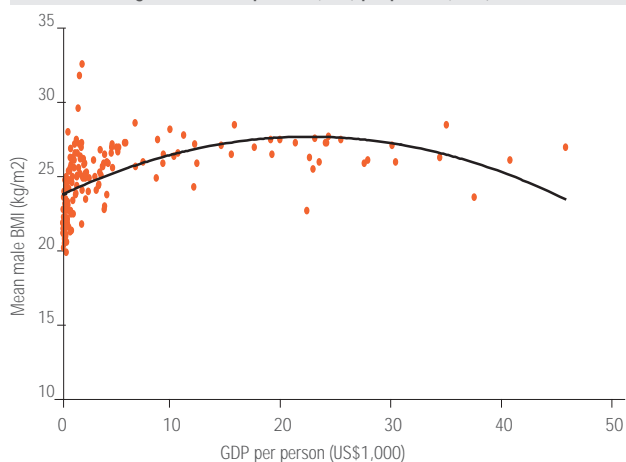


Figure 3 Projections of cause-specific deaths (as a percentage of total deaths) in low-income countries, baseline scenario



* The figures and tables of the Web-Annex are available through the Oxford Health Alliance website at <http://www.oxha.org/initiatives/economics>.

Figure 4 Mean body mass index (BMI) versus gross domestic product (GDP) per person (2002)



Source WHO Global InfoBase (http://www.who.int/nccd_surveillance/infobase; accessed 14 July 2006)
 Note The sample comprises 170 countries and the robust regression results are:
 Male BMI = 23.7 + 0.35 GDPpc - 0.0078 (GDPpc)² (R²=0.29).
 The coefficients are significant at the 1% level.

For many risk factors an inverted U-shape seems to describe the relationship to per-person gross domestic product (GDP) better than a linear one. At first sight this seems broadly in line with the hypothesis proposed in the recent public health literature (Yach et al. 2004): consumption of tobacco, alcohol and foods high in fat and sugar grows in conjunction with economic wealth, and then begins to fall when certain levels of wealth are reached (see Figure 4 for BMI).

However, data suggest that the variation around the curve is very large. Namibia, for instance, has a per-person GDP of US\$1,805 and a mean BMI of only 21.5 among men, while Micronesia, at only marginally higher income (US\$1,818), records a mean male BMI of 32.6 – higher than any other country in the world. Much of the increasing slope (before the turning point)

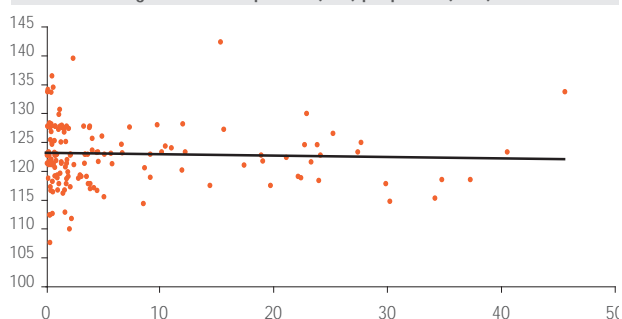
is driven by low levels of BMI in the poorest countries, specifically those of sub-Saharan Africa, but even within that region there is notable variation. A line that would measure the relationship excluding these countries would be essentially flat, implying that mean BMI would be about the same in both rich and (fairly) poor countries. The variation around the mean trend appears even larger for women (see Web-Annex, Figure A 3). The U-shape tends to be more visible if the indicator is the percent of overweight people per country (see Web-Annex, Figures A 5 and A 6). In particular, there is a steeper positive relationship in the poorest countries (per-person GDP of approximately US\$1,000), which is driven almost exclusively by low prevalence rates of overweight in these areas.

By contrast, for another risk factor – systolic blood pressure in women – the regression line is flat, with no statistically significant relationship to per-person GDP at all (the same is true for men – see Web-Annex, Figure A 4), suggesting that economic ‘affluence’ is not associated with this particular chronic disease risk factor (see Figure 5).

As for the global pattern of tobacco consumption, the regression line again suggests an inverted U-shape, indicating that as countries begin developing, smoking prevalence tends to increase; once a certain economic development level is reached, smoking prevalence declines (see Figure 6).

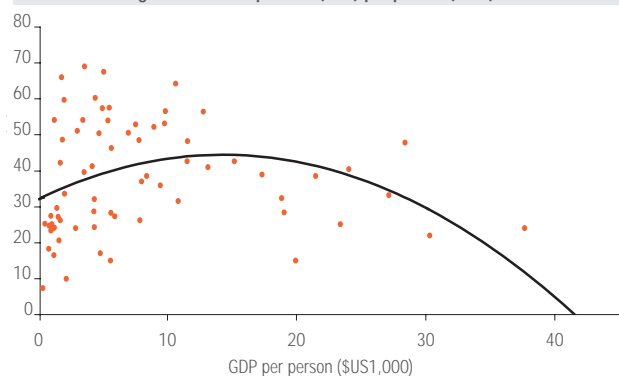
However, this interpretation must again be qualified by the substantial variation around the potential mean trend, in particular at the low-income end of the distribution. It is worth noting that in many poor countries the prevalence of smoking is much higher than in most high-income countries. A different pattern seems to hold in the case of alcohol

Figure 5 Mean systolic blood pressure for females (age > 14) versus gross domestic product (GDP) per person (2002)



Source WHO Global InfoBase (http://www.who.int/nccd_surveillance/infobase; accessed 14 July 2006).
 Note The sample comprises 170 countries and the robust regression results are:
 Female blood pressure = 123.1 - 0.025 GDPpc (R²=0.0019).
 The linear coefficient is statistically insignificant.

Figure 6 Smoking prevalence among men (age > 14) versus gross domestic product (GDP) per person (2002)



Source WHO World Health Statistics 2006 (<http://www.who.int/whosis/whostat2006/en/index.html>; accessed 16 September 2006).
 Note The sample comprises 69 countries and the robust regression results are:
 Male smoking prevalence = 31.8 + 1.72 GDPpc - 0.060 (GDPpc)² (R²=0.11).
 The coefficients are significant at the 1% level.

consumption, which appears to be increasing with wealth (see Web-Annex, Figure A 8). There is again, however, large variation around the mean trend.

The important conclusion from these rather crude exercises is that the actual distribution of risk factors for chronic disease across countries does not follow a simple pattern. Depending on the risk factor considered, there may be a marginal positive relation to economic wealth (e.g. alcohol consumption), no obvious relationship at all (e.g. systolic blood pressure) or an inverted U-shape relationship (e.g. smoking prevalence, BMI and overweight).⁹ Overall, the notion that chronic disease risk factors are significant only in the most affluent countries can be safely dismissed in the light of the above data.

2.1.2 Do chronic diseases only affect the rich within countries?

Looking at the correlation between income and chronic disease risk factors within countries is no less important than looking at differences between countries. A valid criticism of the health-related Millennium Development Goals (MDGs) illustrates this point: the health-related MDGs were formulated in terms of national averages, such that a given country can reach the target of a two-thirds reduction in child mortality without necessarily improving the relative position of the poor within the country (Gwatkin 2002). Hence, a monitoring of ‘progress for the poor’ worth its name requires monitoring of how the poor are doing within countries relative to the rich. This is of course relevant in the context of chronic disease, too.¹⁰ The cross-country patterns presented in the previous

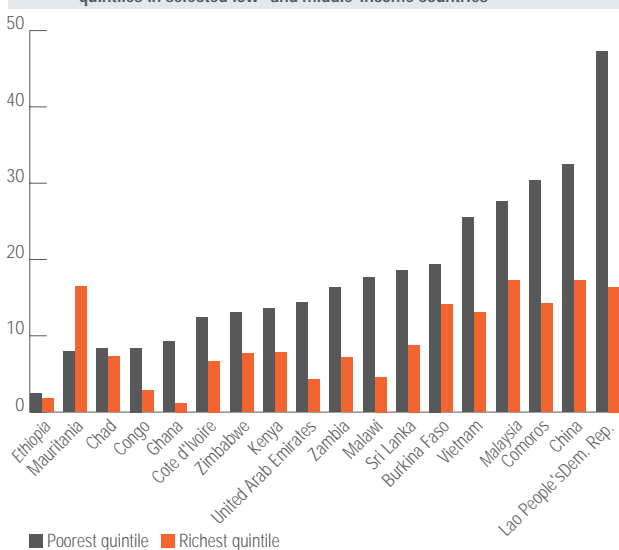
section could still be compatible with the affluence paradigm if the rich within each country primarily accounted for the burden of chronic disease. If this were the case, then from the perspective of a national policymaker, chronic disease prevention could hardly be considered a priority in addressing the needs of the poor. The present section provides a snapshot of poor/rich differences in chronic diseases and – in particular – in relevant risk factors within countries.

Few studies have examined the within-country distribution of chronic diseases or their risk factors over a worldwide set of countries. However, a fair and growing amount of material for high-income countries (see e.g. Mackenbach 2005) almost unanimously shows that the poor within countries carry a higher chronic disease burden than the rich. Much less empirical evidence is available from developing countries – in large part due to the lack of surveys that would allow an assessment of chronic disease conditions by socioeconomic status.

On balance, the evidence available for developing countries suggests a somewhat less straightforward within-country pattern than in high-income countries, with notable differences depending on the risk factor considered and on the proxy for socioeconomic status that is used to distinguish ‘the poor’ from ‘the rich’. Perhaps the clearest picture relates to tobacco consumption. As was extensively documented by the World Bank (Jha and Chaloupka 1999, Bobak et al. 2000), in the vast majority of low-, middle- and high-income countries, smoking prevalence is higher among the poor (the proxy for poverty in this case was educational attainment). Somewhat surprisingly, the poor/rich differences turned out to be even greater in low-income countries compared with the high-income countries.¹¹ The finding that the poor smoke more than the rich is also confirmed by more recent data from the World Health Survey¹² (see Figure 7). In 17 out of the 18 countries considered, people in the poorest quintile are more likely to smoke than those in the richest quintile. One advantage to this data is that the results are fairly comparable across countries, as the survey was designed in the same way for all countries.

The picture appears somewhat less clear in the case of other risk factors. In 9 out of 16 cases, the poor are at least as likely to be heavy drinkers as the rich (see Web-Annex, Figure A 9). In 13 out of 18 cases, the poor are more likely to have angina than the rich (see Web-Annex, Figure A 10). For physical inactivity, the poorest quintile is worse off than the richest in only three cases (see Web-Annex, Figure A 11), and with type 2 diabetes the number increases slightly to four (see Web-Annex, Figure A 12). It is important to bear in mind that at least part of the higher prevalence among

Figure 7 Prevalence of daily smokers in the poorest and richest income quintiles in selected low- and middle-income countries



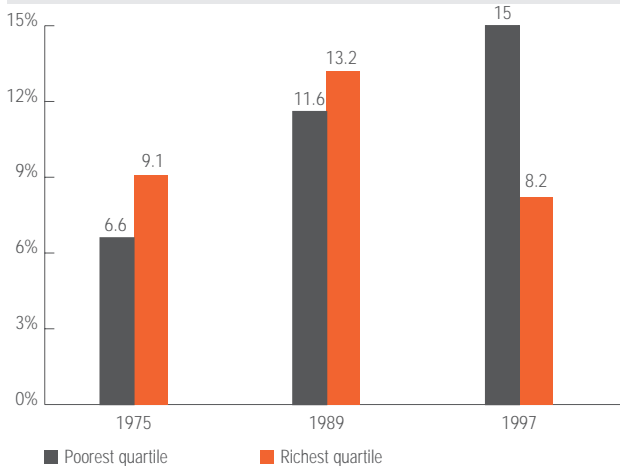
■ Poorest quintile ■ Richest quintile

Source World Health Survey

(<http://www.who.int/healthinfo/survey/en/>; accessed 20 July 2006).

Note Countries are ordered by the size of smoking prevalence in the poorest quintile.

Figure 8 Obesity prevalence among women from south-eastern Brazil, 1975–1997



Source Monteiro et al. (2000)

the rich can be explained by the fact that they are more likely to be diagnosed compared with the poor. Any temptation to generalise this data should be strongly resisted because the sample of countries is unlikely to be representative for any global or regional pattern.

The rise of obesity in many developing countries has stimulated research into the socioeconomic distribution of obesity within these countries. (Most of the work on high-income countries confirms the inverse relationship between wealth and obesity, though the evidence is stronger for women than for men.¹³) A recent review shows that not only has obesity increased on average in low- and middle-income countries, but it also appears to have shifted toward the poor at a lower level of economic development than it did previously (Monteiro et al. 2004). The authors found that, within a sample of 37 countries, the crossover to higher rates of obesity among poor women occurs once per-person gross national product (GNP) reaches about US\$2,500, the mid-point value for lower-middle-income economies. For men the relationship is less conclusive.¹⁴ While the Monteiro et al. study presents a snapshot of countries at a single point in time, the findings are broadly confirmed by evidence from some countries' experiences over time. One such example is of women living in south-eastern Brazil, where the burden of obesity has shifted from the richest quartile to the poorest quartile since 1975 (Monteiro et al. 2000) (see Figure 8).



To summarise, while in developed countries there is little doubt that chronic disease risk factors are predominantly concentrated among the poor, the observed pattern in developing countries appears to vary with the risk factor considered. At present the picture is clearest for smoking, which is concentrated among the poor in the majority of low-income countries. Some of the data presented, especially on obesity, suggest that, as countries develop, the

burden of poor health habits switches from the rich to the poor within countries. On the other hand, the limited data available for diabetes suggests a predominance among the rich within both poor and rich countries. The picture is more mixed for other indicators, such as physical activity and angina. For diabetes and angina in particular, the observed pattern is likely to be influenced by the higher propensity among the rich to seek a diagnosis.

There is significant scope for improving the assessment and explanation of the distribution of chronic diseases and risk factors within countries, in particular in low- and middle-income countries. Most of the data in this section are isolated to single points in time and do not show the evolution of poor/rich differences within countries.¹⁵ In light of these limitations, it is clear that further research is needed to provide a more comprehensive picture across countries and time to improve the understanding of the observed patterns.

2.2 The age distribution of chronic disease

In addition to the association between chronic disease and wealth or poverty, the relationship between disease and age is crucial from an economic and public-policy standpoint. Frequently, economists and others focus on the working population – commonly understood to be people between the ages of 15 and 65 – to determine whether disease is occurring prematurely and to determine what are the economic impacts of disease.

There are different ways of looking at the question of whether chronic diseases affect working-age populations. One way to approach the question is to ask: out of all deaths due to chronic disease, how many occur below a certain age limit? In the brief analysis below, 60 years is used as this age limit instead of 65 years because data (again from the GBD project) were available only for 10-year intervals. The findings using the 60-year age limit will understate the effects as would have been documented using a

Table 1 Out of all cause-specific deaths, what share occurs before age 60?

	Low income	Lower-middle income	Upper-middle income	High income
I. Communicable, maternal, perinatal and nutritional conditions	90%	80%	71%	21%
II. Chronic or non-communicable conditions	44%	33%	34%	19%
III. Injuries	87%	82%	83%	61%

Source Mathers et al. (2003)

65-year age limit. (Data for the 70-year limit is presented in Web-Annex, Tables A 2 and A 3.)

The data indicate that a considerable share of deaths due to chronic disease occur prior to age 60, even in high-income countries where the average age of death is older than elsewhere. Approximately one-third of deaths due to chronic disease occur before age 60 in middle-income countries and 44% occur before age 60 in low-income countries (see Table 1). Clearly, this is a lower percentage than for early deaths due to communicable diseases and injuries, as those generally strike at particularly young ages. Nevertheless, the figures are far from negligible.

The above mortality figures overlook one point that distinguishes chronic diseases from acute communicable diseases: chronic diseases tend to last longer before eventually leading to (premature) death. Hence, considering mortality alone is likely to paint a too 'optimistic' picture of the age distribution of the disease burden. The picture changes markedly if the overall burden of disease (measured in DALYs) is considered instead of death alone. **Measured in this way, chronic diseases impose the greatest burden on populations younger than 60 years of age in both low- and middle-income countries (see Table 2).** In addition, the chronic disease burden in these countries begins to look very similar to the burden of the other causes of death – about 80% or more of DALYs occur before age 60 in all categories.

Another way to approach the question of whether chronic diseases affect the working-age population is to ask: is a substantial share of all deaths or DALYs before age 60 due to chronic disease? The picture presented in Table 3 is not qualitatively different from the one presented in Figure 1 in that, except for the low-income countries, chronic diseases do account for a higher share of the premature disease burden than other causes. (See also Web-Annex, Tables A 4 – A 6, which provide expanded data for the 70-year age limit and for DALYs with the 60-year limit with qualitatively similar results.)

Table 2 Out of all cause-specific disability-adjusted life years (DALYs), what share occurs before age 60?

	Low income	Lower-middle income	Upper-middle income	High income
I. Communicable, maternal, perinatal and nutritional conditions	98%	97%	96%	81%
II. Chronic or non-communicable conditions	84%	78%	82%	68%
III. Injuries	98%	96%	97%	91%

Source Mathers et al. (2003)

In short, the above data suggest that the notion of chronic diseases being a problem 'only' for the elderly can be quite safely dismissed – particularly in low- and middle-income countries.

The above findings should be tempered by a recognition that the effects of chronic disease on the productive workforce are not a valid proxy for the overall economic importance of disease. In economics, consumption is the objective to be maximised, not production by itself. Production is merely the means to an end, and as such it cannot be the unit by which economic contributions are valued. Even if chronic disease afflicted only those retired from the workforce, the economic loss caused by their premature death or illness would be substantial, because of the sizeable contribution that the elderly make to consumption (of both tangible and intangible 'goods'), which is largely what they have worked for.

2.3 Conclusions

This chapter has briefly examined the distribution of chronic disease (and related risk factors) by economic wealth and by age. **In light of the data presented in this chapter, it is clear that chronic diseases cannot be characterised any longer as 'diseases of affluence', nor as problems affecting only the elderly retired population. To the extent that those notions have been common, they may have been responsible for a lack of recognition among economic policymakers of chronic disease as an issue of potential public-policy relevance.**

The findings of this chapter taken together create sufficient justification for exploring more deeply the economic consequences of disease, as is done in Chapters 3 and 4. The fact that a large share of the working-age population is affected by chronic disease should make rationales for intervention relevant to those who are specifically interested in the productive capacity of developing and developed countries.

Table 3 Out of all deaths before 60, how many are accounted for by each disease category?

	Low income	Lower-middle income	Upper-middle income	High income
I. Communicable, maternal, perinatal and nutritional conditions	69%	32%	26%	8%
II. Chronic or non-communicable conditions	20%	46%	53%	72%
III. Injuries	11%	23%	21%	21%

Source Mathers et al. (2003)

3. Economic consequences of chronic disease

Compared with evidence of the public health burden of chronic disease, evidence of the economic consequences is comparatively scarce – especially for developing countries. Though the economic language can sometimes appear to trivialise the human lives involved, there is, in fact, a strong immediate relationship between improved health (in the form of reduced mortality or morbidity) and economic gain. Good health increases the lifetime consumption possibilities of individuals, thereby directly augmenting utility – the maximisation of which is seen by economists to be the ultimate objective of human endeavour.¹⁶

There are, of course, different ways of measuring the economic consequences of chronic disease, and the boundaries between them are not always clear. For the purpose of the present chapter, three approaches are distinguished: the ‘cost-of-illness’ (COI) approach (section 3.1), the microeconomic approach (section 3.2) and the macroeconomic approach (section 3.3). COI studies are a useful means of beginning to illustrate the economic magnitude of chronic disease or its risk factors, accounting for both direct medical expenditures and losses due to foregone productivity. Despite its popularity, however, there are limitations to the COI approach as it is often implemented, rendering it less suitable to assess the true economic consequences of chronic disease or of ill health in general. Relatively few COI studies are available for developing countries.

The microeconomic perspective – examining economic consequences at the level of the individual and the household – is another way of analysing the costs of disease. Microeconomic studies are a promising approach because they offer reasonable possibilities to address causality – this is necessary for policymakers, who must tease out the relationship between cause and effect in targeting determinants of disease and poverty. In addition, the relationships they describe are often more intuitive than those observed at the macroeconomic level. Overall, there is an increasing but still limited amount of microeconomic evidence available from developing countries.

The consequences of chronic disease can also be analysed at the macroeconomic level. Based on the existing research on health in general as a determinant of growth, it is credible to assume that chronic diseases have an impact on economic growth (measured as annual per-person GDP). The macroeconomic perspective is important because of its immediate appeal to economic policymakers (e.g. finance ministers). However, research in this area has been limited to date, partly due to data and methodological challenges.¹⁷

3.1 Cost-of-illness studies

It seems obvious that there are costs associated with being ill. First, there is the cost of obtaining treatment, whether it is a trip to a shop to purchase a simple painkiller or a major operation in a hospital. Second, there is the income foregone by those who are sufficiently unwell to be prevented from working. Third, and less easy to measure, there is the intangible cost associated with pain, disability and suffering.

The challenge is how to measure these costs. This question has given rise to an extensive body of research, most of which has focused on high-income countries. Cost-of-illness studies estimate the quantity of resources (in monetary terms) used to treat a disease as well as the size of the negative economic consequences of illness in terms of lost productivity to society or to a specific sector. They represent a useful first step in developing some idea about the economic burden of ill health in general and of chronic disease in particular – and they usually show that the burden is substantial. They can also lay the foundation for an economic evaluation of specific interventions or policy measures to reduce the burden.

COI studies separate the costs of illness into three components (of which, in most cases, only the first two are actually measured).¹⁸

- **Direct costs** are the costs of medical care in relation to prevention, diagnosis and treatment of disease. They include costs such as ambulances, inpatient or outpatient care, rehabilitation, community health services and medication. Of all the cost components, this is the least controversial measurement (which is far from saying there are no problems involved).
- **Indirect costs** seek to measure the loss of human resources caused by morbidity or premature death. The measurement of indirect costs is a matter of much debate. Some COI studies consider the loss of future earnings (the human-capital approach) and thereby restrict the estimate to the working population. Others use the much broader willingness-to-pay method, which assesses what people are willing to pay for relatively small changes in the risk of death. From these figures, which are not restricted to the working population, one can derive the value that people assign to life.
- **Intangible costs** capture the psychological dimensions of illness including pain, bereavement, anxiety and suffering. This is the cost category that is typically hardest to measure.

Based on the selective literature review undertaken for the present study, 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.

In most developed countries for which results are available, the total costs of cardiovascular disease (CVD) varies between 1% and 3% of GDP (Web-Annex, Tables A 7 and A 8 present the total – direct and indirect – costs of selected chronic diseases and their risk factors as a percentage of GDP). In interpreting the figures it is important to note that the numerical results from COI studies are typically not directly comparable across countries, disease categories and time. (See Box 1 for a more in-depth review of COI studies for the United States – a very frequent focus of the COI literature – with potential relevance for other countries.)

Relatively few results are available for developing countries, although there are some exceptions. 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% of GDP in 1995 (Hu and Mao 2002). In the same year, the costs of

obesity amounted to 2.1% of GDP in China and 1.1% in India (Popkin et al. 2001).

The data suggest that indirect costs contribute substantially to the overall cost burden. There is variation, but a reasonable approximation would be to say that on average about half of total costs are accounted for by indirect costs in developed countries. In developing countries, the share is likely to be much higher. The significant differences in methodologies and types of data used in the various studies do not, however, allow for generalisation of these findings.

Despite their usefulness, COI studies – as they are most often practised – are limited by certain conceptual and methodological challenges. Some have argued that the COI approach represents a public health view of 'costs', as opposed to an economic view (Sindelar 1998). On public health grounds, society should be as healthy as possible, which would reduce expensive medical treatments. It is, hence, internally consistent for COI studies to assign a monetary value to all the morbidity and mortality that is associated with a disease or a risk factor, and to measure the medical expenditures that could be saved if only there had been no illness.

Box 1 **Cost-of-illness studies in the United States**

The availability of a large number of COI studies from the United States can provide relevant conceptual insights for other countries (including developing countries) as to the relative weight of risk factors in driving healthcare costs. Increasingly, these studies have applied an econometric approach (as opposed to an epidemiological one – see endnotes 18 and 19 for more details), which brings them methodologically close to some of the microeconomic studies discussed in section 3.2.

Pronk et al. (1999) found that a 'healthier' lifestyle (defined as the simultaneous occurrence of physical activity three times per week, moderate BMI and non-smoking status) reduces healthcare costs by 49% compared to an 'unhealthy' lifestyle for adults 40 years and older.

Similarly, Sturm (2002) assessed the additional per-person annual healthcare costs associated with obesity, overweight, smoking and heavy drinking among the working-age US population (age 18 to 65). Obesity increased costs by \$395 (36%), smoking (currently or ever) increased costs by \$230 (21%) and heavy drinking increased costs by \$150 (10%). The higher cost increases for obesity may be partly explained by the especially detrimental impact of obesity on chronic conditions (which in turn are the primary drivers of healthcare costs).

Using an advanced econometric approach, Finkelstein et al. (2003) examined the costs of obesity for a representative sample of the US adult population (including people over age 65), based on survey data from 1996 to 1998. The average increase in per-person annual medical spending associated with obesity in the sample was \$732 (37.4%). When these figures are extrapolated, the expenditures for overweight and obesity together amount to 9.1% of total annual US medical expenditures in 1998.

The findings of these studies point to the fact that healthcare costs associated with obesity are considerable and have reached, if not exceeded, the costs of smoking and heavy drinking. Informed speculation can be made about the lifetime net costs associated with risk factors when COI data is combined with recent epidemiological evidence. One hypothesis, defended by Finkelstein et al. (2003), is that the lifetime costs imposed by overweight and obesity will be higher than those for smokers, because smokers are more likely to die prematurely than the obese or overweight (Stevens et al. 1998). This is in line with earlier research, which suggested that lifetime external costs for physical inactivity, a risk factor for obesity, were almost double those for smoking (Manning et al. 1991) (for more on externalities, see section 4.1).

From an economic perspective, the attempt to measure the costs of all mortality and morbidity associated with one disease or risk factor tends to overstate true costs. Economists assess the cost of a given situation by comparing it to its next best (and feasible) alternative situation (called the 'counterfactual'). Implicitly, COI studies assume that the counterfactual is the absence of chronic disease, mortality or the risk factor that gives rise to disease. This is often too ambitious a counterfactual, either because it cannot be achieved even with massive interventions, or because some interventions to prevent unhealthy behaviour (e.g. smoking) may simply be undesirable from the individuals' perspective. Despite the undeniable health costs involved, individuals that consume tobacco or alcohol, eat too much or exercise too little will at least partly do so because it confers some sort of benefit and, hence, utility to them. Health does enter their utility-maximising decision but it is only one out of several components. Hence, from a liberal economic perspective, the socially optimal level of such unhealthy behaviour will always be greater than zero. This would produce a less ambitious counterfactual than the COI studies, thereby reducing – other things being equal – the overall cost estimate of chronic disease.

A significant further limitation of COI studies, irrespective of whether one takes a public health or economic perspective, is that the methodologies commonly applied do not address causality. COI studies include costs that are apparently associated with chronic disease and risk factors but do not establish that chronic disease or risk factors cause the costs to occur.¹⁹ (This is of particular relevance in relation to unhealthy behaviours, where the assignment of costs is problematic.) From a policy standpoint it is, however, critical to know the ultimate causes in order to be able to target them.²⁰

Establishing causality is a persistent challenge in all empirical methods, not just COI studies. Nevertheless, several of the microeconomic studies reviewed in the following section do at least attempt to tackle some of the technical challenges involved in determining causality.

3.2 Microeconomic consequences of chronic disease

Microeconomic studies measure the economic impacts of chronic disease and its risk factors for individuals and their families. The scope of these studies conveys one advantage: the evidence is generally easier to relate to than, for instance, evidence that describes relationships at the comparatively abstract macro level. A further advantage is in the possibilities that microeconomic data offer for

examining causality (see Box 2). To individuals, microeconomic evidence of this kind may illustrate the price they are paying in addition to the disease burden itself. To economic policymakers, it provides information to help target efforts to improve economic outcomes (such as productivity increases or poverty reduction).

There are several dimensions of the economic consequences of chronic disease at the microeconomic level, and there are, of course, interlinkages between them. Three main types of consequences are distinguished here: consumption and savings (section 3.2.1), labour supply and labour productivity effects (section 3.2.2), and education and human-capital accumulation (section 3.2.3). In each of the dimensions it is useful to differentiate between the effects on the individual directly concerned and the effects on other household members – an issue to be taken up again in more detail in section 4.1.

3.2.1 Effects on consumption and saving

There are two fundamental aspects of a household's consumption associated with chronic diseases: (1) direct spending on treatment or on goods, such as tobacco and alcohol, that may have caused poor health in the first place and (2) the household's ability to hold consumption levels constant in the face of 'health shocks' from disease. Several studies have found that disease-related spending can be considerable, potentially crowding out important other household consumption and exposing households to an increased risk of impoverishment. The ability of a household to maintain overall consumption at constant levels is relevant because a failure to 'smooth' consumption (through formal means or, as in most developing countries, informally) is traditionally considered a welfare loss that justifies public-policy intervention from an economic perspective. Some argue, however, that even if households succeed in smoothing consumption immediately after a health shock, long-term costs may still be incurred, depending on the means that have been used to hold consumption constant.

Medical care expenditures

Experiencing chronic disease is costly because treating chronic diseases, once they are expressed clinically, is expensive. Chronic diseases, by definition, require drug or inpatient treatment over a much longer period than acute communicable diseases. Given existing health financing patterns, in many low- and middle-income countries the costs associated with chronic disease are likely to weigh more heavily upon those least able to

afford them, increasing the risk of economic loss and impoverishment for the families concerned.

The poorer a country is, the more regressive the healthcare financing system tends to be and the higher the fraction of health costs borne by patients themselves through out-of-pocket payments (Gottret and Schieber 2006).

Direct quantitative evidence showing that specific chronic diseases have pushed households or individuals below the poverty line, in a strict causal sense, is missing. What several studies have done, however, is to assess whether medical expenditures

for chronic disease are high in proportion to, for instance, overall household expenditures.²¹

For example, medical costs of diabetes care for those who visited private healthcare providers totalled between 15% and 25% of household income in India (Shobhana et al. 2000) and 25% of the minimum wage in Tanzania (Neuhann et al. 2001; see Web-Annex, Table A 11). A study on the costs of cancer in China shows that the costs for an average hospital stay amounts to more than annual per-person income (Popkin et al. 2001). For Indonesia it was found that half of patients have no option but to finance the prohibitively costly

Box 2 Methodology – measuring chronic disease and assessing its causal impact in micro data sets

Correctly assessing causality is crucial for deciding what policies to enact. Policies will be effective only if they are targeted towards the true cause of an outcome that should be changed. Determining causality depends, among other factors, on how health (here, specifically chronic disease) is measured.

Typically, chronic disease or adult health status is measured using surveys, which may gather the following kinds of data:

- **Self-assessed overall health status** is the most general health indicator. Respondents are asked how they rate their health, from 'very bad' to 'very good'. This may be the only indicator available, and the researcher must decide if it represents a reliable chronic disease proxy in the given population.
- **Self-reported morbidity indicators** ask respondents whether they were ill or disabled in the past generally, or whether they were so ill they could not work for a certain number of days. The latter is generally considered a good proxy of adult ill health (and therefore potentially also for chronic diseases).
- **Functional limitations in activities of daily living (ADL)** are less subjective than the first two indicators, and are particularly appropriate for the assessment of health and chronic diseases among the elderly.
- **Direct measurement of health outcomes** ask about medically diagnosed diseases or – less often – directly measure health indicators such as BMI or blood pressure. This is the most direct and specific assessment of health.

Surveys used to assess the microeconomic impact of ill health must contain, at a minimum, both health and economic variables. The surveys commonly used for assessing the chronic disease impact have generally had more of an economic focus, including fewer health indicators than might be desirable. These surveys are thus limited in their ability to accurately capture the chronic disease status of an individual or assess causality. Self-reported

measurements are especially likely to be imprecise because respondents often understate or overstate the importance of their symptoms, or they are unable to correctly interpret the message the symptoms convey.

Such distortions crucially depend on individual characteristics, such as education and wealth (which affect the propensity to seek medical assistance) or psychology (for example, the degree of optimism), which are difficult to observe. Errors in measurement are thus unlikely to be random, because they depend systematically on individual characteristics. This complicates the assessment of how much health causes specific economic outcomes, because the health variable captures elements beyond health. A further complication arises from the reciprocal relationship between chronic disease and economic factors – each, in some way, causes the other. For instance, health has an impact on how much time an individual can work and, conversely, the length of the work time can negatively affect health if the workplace is unhealthy. Finally, there could be unobservable third factors that might influence both chronic disease and economic outcomes.

These three problems – non-random measurement errors, reverse causality and omitted variables – lead to what econometricians call 'endogeneity' of the health or chronic disease proxy. The most common statistical technique for estimating impact (ordinary least squares, or OLS, estimation) relies on the absence of endogeneity. If OLS is adopted, and endogeneity is not corrected for, the estimated relationships will be biased in an unpredictable way.

Statistical methods exist to correct endogeneity and to assess the net causal impact of chronic disease on economic outcomes, despite the above challenges. The most commonly used approach consists of a two-stage method – a procedure that allows economists to 'purify' the chronic disease variable from its correlation with the error term of the regression (see, for example, the results in Tables 5 and 6, which were derived from studies that have applied versions of this two-stage approach).

expense of lung-cancer treatment completely on their own (Jusuf et al. 1993).

A further study on Tanzania found that in the early 1990s the cost of insulin (then \$156 for a one-month supply) was well beyond 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, syringes and support infrastructure.

A concept that has been increasingly applied in the literature is that of 'catastrophic expenditures' for health care, sometimes also called 'impoverishing medical expenditures'.²² Expenditures for medical care are defined as financially catastrophic when they endanger a household's ability to maintain its customary standard of living. Catastrophic expenditures are not always synonymous with high healthcare costs. A large bill for surgery, for example, might not be catastrophic if a household does not bear the full cost because the service is provided free or at a subsidised price, or is covered by third-party insurance. On the other hand, even small costs for common illnesses can be financially catastrophic for poor households with no insurance cover. The threshold at which a level of expenditure becomes financially catastrophic relative to a household's 'capacity to pay' (the income that remains after basic consumption needs have been met) must then be defined. Studies have typically set the threshold at between 5% and 20% of total household income.

One comprehensive study on the subject (Xu et al. 2003) uses a threshold of 40% of capacity to pay and finds that the share of households with catastrophic health expenditures in 59 developed and developing countries varied between 0.01% (France) and 10.45% (Vietnam). As expected, the risk of catastrophic expenditures in any given country increases with the share of total health spending that is paid out of pocket (with, however, notable variation around this trend). As a recent cross-country study on a set of developing countries in Asia showed, while many of the poor are pushed further into poverty, on the whole it is the better-off that are more likely to spend a large fraction of total household resources on health care (van Doorslaer et al. 2005).

This somewhat surprising result may be explained by the inability of the poor to divert resources from basic needs (thereby simply foregoing health care), and by some protection of the poor from user charges.

Unfortunately, catastrophic expenditure studies rarely specify the disease-specific cause of the expenditures incurred. One exception is a recent study from Burkina Faso (Tin Su et al. 2006). The authors find that when a household member has a chronic illness, the probability of catastrophic consequences increased by 3.3 to 7.8 times (depending on the threshold selected and taking into account other determinants such as economic status, household characteristics and various illness indicators).

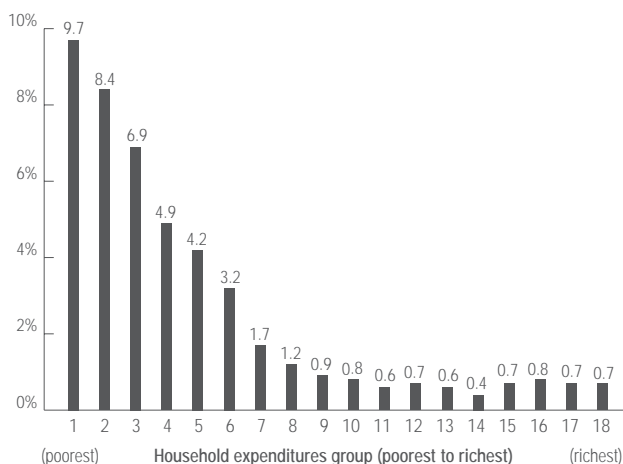
It is hard to tell to what extent chronic diseases actually contribute to catastrophic spending, given the relative lack of studies directly assessing the relationship.²³ Nevertheless, it is reasonable to expect that a large share of expenditures is related directly to chronic disease. The evidence that, at least in the above-mentioned study on Asia, a high share of catastrophic expenditures is due to spending on medicines (either through self-medication or prescription) may be indicative of chronic disease treatment.

Expenditure on tobacco and alcohol

Consumption, saving and investment can be affected by the disease condition itself, as well as by the behaviours that give rise to the disease. **The available evidence suggests that expenditures on addictive goods such as tobacco and alcohol can end up being particularly costly to households (Esson and Leeder 2004). In addition, the poor tend to spend a disproportionate share of income on these behaviours, potentially substituting for food purchases or investment in human capital, such as health and education.**

Household studies in Bangladesh in the 1990s found that on average people spend more than twice as much on cigarettes as on housing, clothing, health and education combined. The poorest households spend close to 10 times as much on tobacco as on education (see Figure 9). Another study considers the opportunity costs of smoking for poor households in Bangladesh by comparing the amount of money spent on tobacco to the calories that could be 'bought' with the foregone money (Ali et al. 2003). According to the authors, 'The average amounts spent on tobacco each day would generally be enough to make the difference between at least one family member having just enough to eat to keep from being malnourished' (*ibid.*, p. 12).

Figure 9 Ratio of expenditures on tobacco versus education in Bangladesh, 1995–1996



Source Efraymson et al. (2001)

A study in rural China found that tobacco spending negatively affected spending on health and education, farming equipment and seeds (and thus future productivity), as well as savings and insurance (Wang et al. 2006a). Every 100 yuan spent on tobacco was associated with declines in spending on education by 30 yuan, on medical care by 15 yuan, on farming by 14 yuan and on food by 10 yuan. It is noteworthy that alcohol expenditures increase with tobacco expenditures: the two are complements, potentially aggravating the extent to which each ‘crowds out’ other spending. Another study found that in Egypt, people spend 10% more on cigarettes than on food, and expenditures for tobacco range from 2% to 6% of household spending and income, and up to 10% in the most impoverished households (Esson and Leeder 2004).

In India, the risk of distress borrowing and distress selling increases significantly for hospitalised patients if they are smokers (Bonu et al. 2005). Surprisingly, the risk is even higher for those that do not smoke themselves but belong to households in which other people smoke and/or drink (see Table 4). A potential explanation might be that smokers who are hospitalised are more likely to stop smoking (thereby saving money), while household members that are not hospitalised are less likely to kick their habits.

Similar results are likely to apply to heavy alcohol consumption, although the existing evidence appears to be more qualitative than the evidence presented above for smoking (data is from a small set of respondents, selected without representative sampling criteria). One study compared two groups of 98 families living in Delhi, India (Saxena et al. 2003). In the first group, at least one adult from each family consumed three or more drinks per week over the course of a month. In the second group, no one

Table 4 Risk of distress borrowing and selling during hospitalisation in India, 1995–1996

Risk of distress borrowing/selling...	Odds ratio
...for individuals who use tobacco	1.35
...for individuals who do not use tobacco but belong to households that do	1.38
...for individuals who do not use tobacco but belong to households that both use tobacco and alcohol	1.51

Source Bonu et al. (2005)

Note Odds ratios are adjusted and statistically significant at the 5% level.

consumed more than one drink over a month-long period. Families in the first group spent almost 14 times more on alcohol each month than those in the second group, resulting in fewer financial resources available for food, education and daily consumables. In addition, 54 families in the first group were in debt, compared with 29 in the second. For similar evidence on the costs of heavy alcohol consumption in India, see Benegal et al. 2000.

In Botswana, participants in a qualitative study of alcohol use stated that since a significant proportion of household income was spent on liquor, less cash was available for food, clothing and other essential items (Molamu and MacDonald 1996). Similar conclusions have been drawn by Samarasinghe (1994) for Sri Lanka and Marshall (1999) for Papua New Guinea. While the crowding-out effect associated with tobacco or alcohol expenditures is likely to be more significant for developing countries, some recent research indicates that to some extent similar effects may be observed among low-income groups in rich countries (Busch et al. 2004).²⁴

Can households ‘insure’ consumption against chronic disease?

Households do not react passively to chronic disease. When faced with a severe illness, families adapt to offset the costs of medical expenses or lost income, with the objective of maintaining overall consumption levels. From an economic perspective, consumption is of the utmost significance, as this is what ultimately confers utility to individuals. A utility-maximising person seeks to ‘smooth’ consumption evenly over time, possibly using a credit market (if available) and, in case of unexpected events, insurance mechanisms. **In low- and middle-income countries formal insurance is scarce, so people are left with informal ways of insuring themselves, such as selling assets, using savings or borrowing from neighbours.** The extent to which individuals fail in ‘smoothing’ consumption against shocks is traditionally considered a justification for additional insurance to be provided by a third

party. (A recent qualification of this traditional view is presented below.²⁵)

The inability to insure against major²⁶ chronic illness has recently been confirmed in the case of China (Gertler 1999), Indonesia (Gertler and Gruber 2002), Vietnam (Wagstaff 2005) and rural Pakistan (Kochar 2004). Gertler and Gruber (2002) use panel data from Indonesia and define the 'health shock' as a marked decrease in the ability to perform activities of daily living (ADL). They find that when the ability to perform all ADLs is lost, consumption decreases by almost 20%. A shift from being able to perform one ADL to being unable to perform that single activity lowers consumption by 1.8%. The authors conclude that public disability insurance or subsidies for medical care may improve welfare by providing households with the means to smooth consumption.

Wagstaff (2005), using a very similar approach, finds that Vietnamese households have not been able to hold their food and non-food consumption constant in the face of income reductions and extra medical care spending. For the sample as a whole, both food and non-food consumption are found to be responsive to health shocks (defined as BMI decreases), indicating an inability to smooth non-medical consumption. Further analysis reveals some interesting differences across different groups within the sample. Somewhat counterintuitively, richer households – including insured households – are worse at smoothing their non-medical consumption in the face of health shocks than poorer households, despite the fact that insured households generally pay less for medical bills than the uninsured. (Indeed, the authors found that only those without formal health insurance increased spending on medical care.) One reason the poor rely on dissaving and borrowing, and do not apparently reduce their food and non-food consumption following illness while the better-off do, may be because their levels of consumption are simply too low relative to basic needs to enable them to cut back in the face of a health shock.

Key Overall, the amount of research on consumption smoothing in response to chronic disease is restricted to only a few existing studies. An ongoing debate about consumption smoothing in developing economies more generally questions whether consumption fluctuations in response to shocks give an accurate measure of the welfare costs of risk. The criticism rests on the idea that while current consumption can be held steady during shocks, maintaining smooth consumption can be very costly over medium- and long-term periods for households in developing countries (Morduch 1995). The insights of this debate may be of relevance to any

future assessment of the true costs of chronic illness in developing countries.

The long-term costs of successful consumption smoothing are perhaps most obvious in the case of households living close to subsistence levels and without access to sufficient means of formal insurance. Those households will be very reluctant to cut consumption when their income is falling due to some external shock. In response, they will use whatever means they can to avoid reducing consumption to below subsistence levels (which is consistent with Wagstaff's results, showing that the poor achieved better consumption-smoothing results than the rich). This may involve, for example, taking children out of school or selling important assets, with considerable long-term effects for the household. In such instances – when high risk aversion is coupled with a lack of formal insurance – a public intervention in the form of social insurance could yield important welfare gains. The reduction of costly consumption-smoothing mechanisms could lead to welfare improvements such as greater education attainment levels by children (Chetty and Looney 2006).

It is important therefore to explore precisely how households cope with illness in order to smooth consumption. A number of studies – focused on unexpected events other than chronic disease – have shown that households resort to particularly costly consumption-smoothing strategies (Chetty and Looney 2006, Dercon 2002, Frankenberg et al. 1999) and that the consequences of doing so may particularly affect children's health and education (Behrman 1988, Foster 1995, Jacoby and Skoufias 1997, Rose 1999). While it is not hard to imagine similar effects in the case of chronic disease, direct empirical research is only just emerging.

Kenjiro (2005), for instance, compared the economic impact of illness versus crop failure (commonly thought a major cause of economic damage) for households living in rural Cambodia in 2002. The author found that Cambodian households can cope rather well with crop failure by earning additional income. But to raise the lump-sum costs of treatment quickly, households are bound to borrow money or sell their assets. The harsh conditions of credit markets (with high interest rates, strict debt collection and credit rationing) and weak risk-sharing among households contributed to a large number of land sales in the surveyed villages.

Bogale et al. (2005) found that there were three central strategies used by rural households in a coffee-growing district of south-west Ethiopia to cope with the financial and time costs of adult illness: seeking

waiver privileges (16.8%), selling valuable household assets (13.3%) and using up savings (13.1%). Sick individuals and their carers lost an average of 9.23 days and 7.38 days of work per month, respectively. The division of labour among healthy household members was used for compensating for the loss of working time by the sick adult(s) and for taking care of the sick household member(s).

Kabir et al. (2000) used mainly qualitative information from urban slums in Dhaka, Bangladesh, to describe 'socio-cultural' coping strategies among the urban poor, such as the merging of urban households (particularly when illness strikes the woman in charge of household and childcare management), joining another household in the city (for families who have better-off relatives living in the city), or even returning to the rural home.

Kochar (2004) examined the effects of adult illness on household savings or the mix of assets that households own in Pakistan. This relatively uncommon research topic is important because understanding investment decisions of households contributes to a better understanding of poverty. The complete lack of disability insurance in rural areas implies that a few days of illness can result in a significant loss in current income. Moreover, much of adult illness is persistent, caused by respiratory disease, which continuously weakens the body over time. The consequent deterioration in health has the potential to affect not just current and future income, but also the profitability of investments in farm capital.

Kochar found that ill health increases household savings, and that this increase is primarily a consequence of the loss in income that accompanies illness. The overall increase in savings is, however, accompanied by significant portfolio changes: the expectation of a continued illness causes households to reduce investments in productive assets used in farm production. The author finds that this is primarily because of the effect of illness on the rate of return on productive assets. Since a household's stock of productive assets is an important determinant of income, this result provides a potential link between adult ill health and poverty via household savings.

Key To summarise, although there is no specific evidence showing that an individual or household has fallen into poverty because of chronic disease, there is a fair amount of evidence highlighting very feasible mechanisms by which this could happen. Expenditures for chronic disease treatment as well as for the consumption of addictive goods leading to chronic disease are likely to impose a substantial (and possibly impoverishing)

economic burden on the individuals or households concerned. Unexpected 'health shocks' due to chronic disease may impair a household's ability to maintain its overall consumption levels – a type of insurance deficit that typically justifies government intervention. More research, however, is needed to quantitatively and qualitatively assess the long-term implications of household coping strategies.

3.2.2 Effects on labour supply and labour productivity

Chronic diseases and related risk factors may affect labour productivity and labour supply, which have important consequences for individuals and households. The theoretical underpinning of these effects stems from the concept that healthier individuals can produce more output per hour worked (i.e. increased labour productivity) because healthy people have better physical and mental capacities. In addition, more physically and mentally active individuals can make better and more efficient use of technology, machinery and equipment. Counterintuitively, however, economic theory predicts a more ambiguous effect of health on labour supply. The ambiguity results from two effects working to offset each other. If the consequence of poor health is to reduce wages through lower productivity, this would lead to more leisure and therefore lower labour supply as the economic return from work diminishes (a substitution effect). On the other hand, to avoid a reduction in lifetime earnings from lower productivity, the individual seeks to compensate by increasing labour supply (an income effect). The income effect is likely to gain importance if the social-benefit system fails to cushion the effect of reduced productivity on lifetime earnings. The net impact of the substitution and income effects thereby ultimately becomes an empirical question (Currie and Madrian 1999).

The effects of illness on labour-market outcomes have been widely assessed in high-income countries, showing that chronic diseases affect wages, earnings, workforce participation, hours worked, retirement, job turnover and disability (see Suhrcke et al. 2005b, and Currie and Madrian 1999 for a review of the evidence more specifically related to high-income countries). Although a fair and increasing amount of evidence exists from low- and middle-income countries,²⁷ the high-income country evidence is not without relevance for poorer countries. If a negative labour-market effect can be detected in wealthy nations that are commonly equipped with functioning social insurance systems, it is reasonable to expect that in poorer countries (where formal insurance systems are underdeveloped and informal insurance may not be a perfect substitute) there will be an even more important effect of ill health.

Table 5 Change in wages associated with changes in indicators of chronic disease

Country	Chronic disease indicator	Wage elasticities (%)		Source
		for females	for males	
Colombia	Days unable to work	0.04	0.07	Ribeiro and Nuñez (1999)
Colombia	Unable to work	0.10	0.017	Ribeiro and Nuñez (1999)
Peru	Days sick	0.04	0.07	Murrugarra and Valdivia (1999)
Peru (urban only)	Days sick	0.10	0.20	Cortez (1999)
Mexico (elderly)	Days sick or injured in last 180 days	NS	0.81	Parker (1999)
Nicaragua	Days sick	0.16	NS	Espinosa and Hernandez (1999)
Ghana	Days unable to work	—	0.11 – 0.24	Schultz and Tansel (1997)
Côte d'Ivoire	Days unable to work	—	0.09 – 0.28	Schultz and Tansel (1997)
Mexico (elderly)	Number of ADLs for workers > 60 years of age	NS	0.38	Parker (1999)

Source Savedoff and Schultz (2000)

Note NS = not statistically significant; ADL = activity of daily living.

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 (see Web-Annex, Tables A 9 and A 10 for a summary of the studies reviewed).²⁸ Few studies exist assessing the labour-market impact of chronic illness in a comprehensive set of low- and middle-income countries. Two exceptions are Savedoff and Schultz (2000) for Latin America²⁹ and Suhrcke et al. (forthcoming 2006) for Eastern Europe and Central Asia.

The volume by Savedoff and Schultz (2000) shows that, in several Latin American countries, the effects of adult illness on productivity are generally statistically significant. The magnitude of the effect suggests that earnings may be quite sensitive to small but consistent improvements (or declines) in health. For example, in Colombia, when the number of missed days of work increased by 1% for men, wages decreased by 0.7% (see Table 5). The various studies measured health status using widely different criteria, yet all of them corrected for endogeneity (see Box 2 for an explanation of how endogeneity can bias results).

Suhrcke et al. (forthcoming 2006) provide evidence that adult illness lowers labour-market participation in a representative set of low- and middle-income countries from Eastern Europe and Central Asia. Given the fact that this region faces a particularly high chronic disease burden, it may serve as a useful testing ground for determining the economic impact of

chronic disease. The survey on which the study results are based was relatively rich in health indicators, though it was rather short on labour-market indicators, except for information on labour-market participation.³⁰ The presence or absence of limitations to activities of daily living was used as the proxy for ill health (see results in Table 6).

The expected negative impact of illness on economic outcomes was confirmed for all countries in the survey. The probability that individuals with limited activity will participate in the labour market is at least 6.9% lower than for individuals without limitations on their activity in Georgia, rising to 30.4% in Kazakhstan. This is again the impact of health on participation after potential feedback effects of participation on health (for example due to stress or unhealthy working conditions), as well as potential measurement bias, have been filtered out (see Box 2).³¹

Overall, there is a fair amount of evidence on the impact of chronic disease on both labour supply and labour productivity, and since the labour market is a key vehicle for economic development at large, the weight of this evidence should not be underestimated. At the same time, there remains scope for more work of this kind, which at present is limited by the lack of survey data that combines both relevant chronic disease proxies and the usual socioeconomic and demographic data.

3.2.3 Effect on education and human-capital accumulation

There are different ways in which chronic disease or the related risk factors can affect educational attainment and performance, not all of which have been researched in depth yet, in particular as far as developing countries are concerned. The previous section has already discussed selected

Table 6 Change in the probability of labour-market participation in response to limited ADL among countries in the Commonwealth of Independent States

Country	Change (%) in the probability of labour-market participation
Armenia	-16.3
Belarus	-25.1
Georgia	-6.9
Kazakhstan	-30.4
Kyrgyzstan	-18.8
Moldova	-22.3
Russia	-23.0
Ukraine	-16.7

Source Suhrcke et al. forthcoming 2006

Note Results are based on marginal effects; all results are significant at least at the 5% level. ADL = activity of daily living

evidence indicating the possibility that household expenditures for either chronic disease treatment or for addictive goods (tobacco and alcohol) may crowd out expenditures that could otherwise be invested in children's education (e.g. Efrogmson et al. 2001, Bonu et al. 2004). Since education is a powerful determinant of future earnings (and of future health), a full assessment of the costs of chronic disease would take the impact on education into account. This is, admittedly, a challenging task, and current research – especially for developing countries – has not assessed all of the potential impacts of chronic disease on educational performance and attainment. The lack of research on the subject contrasts with the well-established literature showing the impact of malnutrition on education (Strauss and Thomas 1998).

Parents engaging in unhealthy behaviours related to chronic disease may affect a child's ability to perform academically. Several studies have, for instance, documented an association between smoking while pregnant and impaired cognitive and behavioural development (Ernst et al. 2001). Consequently, nicotine exposure *in utero* may be related to lowered human capital formation and productivity in adult life. Hay (1991) estimates that the cost of reduced lifetime productivity of nicotine-exposed children is about \$4 per pack. Despite the plausibility of the hypothesis, proving causality remains a challenge in many of the existing studies (Torelli 2004).³²

Obviously, the death of a parent from chronic disease will have many negative consequences for children. A comprehensive study by Gertler et al. (2004) has examined how the loss of a parent affects children's school enrolment in Indonesia. Carefully handling the econometric challenges involved, the researchers found that a child whose parent has recently died is on average two times more likely to drop out of school than children with living parents. This effect is highest for youth at the transitions between primary and junior secondary and between junior secondary and senior secondary levels. Contrary to expectations, the authors found little differential treatment based on the gender of either the child or of the deceased parent. Although causes of death were not specified, the results are potentially relevant to the assessment of the economic impact of chronic diseases. Indonesia has experienced a marked increase in the prevalence of chronic disease over the past decades (see Ng 2006), so that one can probably assume that many of the observed deaths were indeed caused by chronic disease. Moreover, the impact of parental death may be considered a 'lower bound' of the combined impact of death and ill-health, in cases where death is preceded by long periods of illness.

Alcohol abuse by adolescents is correlated with various indicators of inferior academic performance in a considerable number of studies in developed countries, where binge drinking is rather widespread among teenagers.³³ Most studies do not, however, specifically address causality, and studies that correct for endogeneity are needed to clarify the causal relationship between alcohol use and school achievement.³⁴ Clinical studies have shown that heavy drinking impairs brain functioning (Deas et al. 2000, DeBellis et al. 2000, Nordby et al. 1999). Heavy drinking may also take time away from studying and class attendance (Cook and Moore 1993, Williams et al. 2003), diminish academic reputation among teachers and peers, and lower motivation and attachment to school (Chatterji and DeSimone 2005, DeSimone and Wolaver 2005).

The impact of overweight or obesity on educational outcomes has not been fully studied, but has potentially important effects. Overweight or obese children may be more likely to miss school or suffer from lower self-esteem, greater shame and perceived teasing compared with their peers, as a consequence of stigmatisation (Latner and Stunkard 2003, Hayden-Wade et al. 2005). Any of these issues around self-esteem could decrease the incentives for children to invest in additional schooling. While there is some support for such an empirical link among girls, the existing evidence is too limited to draw major conclusions (see Datar and Sturm 2006 for a rare longitudinal study on the subject; see Taras and Potts-Datema 2005 for a review of the existing evidence). It is also important to note that in those developing countries where a high BMI is still considered a positive signal of social status, the negative effects of stigma will not be at work (Faber and Kruger 2005, Mvo et al. 1999).

Overall, the existing evidence on the influence of chronic disease and related risk factors on educational performance and attainment points to different channels – the death of parents can reduce school enrolment, maternal smoking can impair cognitive development, alcohol abuse is related to inferior performance, and obesity may reduce the incentive to invest in education. Given the importance of education in determining psychosocial development and future earnings potential, it is likely that effective programmes to prevent chronic disease will have broad positive effects beyond the (no doubt worthwhile) improvement of health. More research that seeks to ascertain causality in the relationship between risk factors and educational outcomes is, however, needed to guide policy intervention.



3.3 Macroeconomic consequences of chronic disease



Health in general – measured as life expectancy or adult mortality – is a robust and strong predictor of economic growth.³⁵ Since chronic disease constitutes a major part of the global health burden and accounts for a major part of reduced life expectancy and adult mortality, it would be expected to have a negative impact upon economic growth. Quantifying this impact is a difficult task, however, and is fraught with methodological challenges.³⁶

One study estimated that a five-year increase in life expectancy will give a country a 0.3–0.5% higher annual GDP growth rate in subsequent years (Barro 1996), a result that could in principle be used to infer a relationship between chronic disease mortality and growth. Other studies have assessed the impact of specific diseases – such as malaria (Gallup and Sachs 2001), HIV/AIDS (Dixon et al. 2001), malnutrition (Weil 2005) and tuberculosis (Delfino and Simmons 1999) – on growth, controlling for a set of other standard determinants of growth. One recent study assesses the impact of chronic disease – here, CVD mortality among the working-age population – on economic growth (Suhrcke and Urban 2006). Since this seems to be the only study on the subject, the paragraph below elaborates on its approach and findings.

Suhrcke and Urban used a worldwide sample of countries for which data was available and noted that the influence of working-age CVD mortality rates on growth was dependent on the level of initial per-person GDP. They therefore split the sample into (broadly) low- and middle-income countries on the one hand, and high-income countries on the other. In one estimate, a 1% increase in the mortality rate was found to decrease the growth rate of per-person income in the subsequent five years by about 0.1% in the high-income country sample. The result is based on a panel of five-year intervals between 1960 and 2000, and includes a set of standard controls (including initial income, openness, secondary schooling, etc.). The authors used a dynamic panel growth regression framework, taking into account potential endogeneity problems from reverse causality or omitted variables, which might determine both CVD mortality and growth simultaneously (see Box 2 for discussion of similar econometric challenges in micro data). While 0.1% is a small amount in growth terms, it is much larger in absolute money terms when summed up over many years. The authors did not find a significant influence of CVD mortality on growth in the low- and middle-income country sample.

The results have to be interpreted with great caution, in particular as they relate to the low- and middle-income country sample, where cause-specific adult mortality data is usually of very limited quality and completeness. At the same time, the insignificant results for this country group are plausible because CVD only began to develop into sizeable proportions toward the later part of the period observed (1960–2000), arguably in response to economic progress, rather than it being a determinant thereof. If the results for high-income countries are any guide, CVD may assume more of a role as a determinant of economic growth as the chronic disease burden in developing countries progresses further.

3.4 Conclusions

This chapter has provided an overview of the existing evidence on the economic consequences of chronic disease, with a primary focus – wherever the data allowed – on low- and middle-income countries.

Overall, a fair amount of evidence exists to conclude that there are important economic consequences of chronic disease – important for the individual and his/her family but also potentially important for the economy at large. At the same time, there are severe gaps in the evidence that call for more research into the economic consequences of chronic disease, in particular for developing countries. It is obvious that the economic consequences of chronic disease in developing countries have not figured prominently on the research agenda, especially when compared with the existing research on communicable diseases (especially HIV/AIDS) (see Behrman et al. 2006).

Although cost-of-illness studies are a popular instrument for highlighting the economic importance of chronic disease (and risk factors) in the developed world, and as an input into economic evaluations of interventions, it is not always possible to perform them in developing countries. Proper COI methodology requires a comparatively sophisticated breakdown of cost information by diseases and services, which may be beyond the reach of the poorest countries at present.

Assessing the economic consequences at the individual and household level is a particularly promising alternative to COI studies, especially for developing countries, in that it requires ‘merely’ the presence of appropriate household survey data and allows – at least in principle – causality to be established between the health proxy and economic outcomes. The available studies have shown that chronic disease and related risk factors affect consumption and saving decisions, labour-market performance and human-capital



accumulation. Nevertheless, evidence gaps and barriers to more research exist (see Chapter 6 for a call to research). Demonstrating the microeconomic costs is important because individuals, in particular adolescents, may not always be aware of the costs incurred by behaviour, since the costs will not have to be confronted until later in life.

While it is highly plausible to assume that chronic diseases might affect economic growth, given that health in general affects growth and that chronic diseases account for a major part of the global health burden, the question has hardly been addressed by the research community. One study indicates that reductions in cardiovascular disease mortality at working age might well have been a significant contributor to economic growth over the past decades in high-income countries. If this result points to the current or future role of chronic diseases in developing countries, this evidence could spur policymakers to stem the fast-growing burden of chronic disease in order to promote future economic growth.

The economic costs of failing to prevent chronic disease are not necessarily a justification for public-policy intervention. Whether existing costs – and in particular what type of costs – can justify public-policy intervention, under what conditions, is the subject of the following chapter.

4. The economic rationale for public-policy intervention against chronic disease

Key Given the magnitude of the burden of chronic disease, is there a justification – from a liberal economic perspective characterised by a firm belief in consumer sovereignty – for public policies to prevent disease? A rationale for intervention based on the economic perspective differs markedly from a public health rationale, and while there is reason to believe that such an economic rationale exists, it is, of necessity, more nuanced. The public health rationale considers government intervention to be justified whenever the health of the population can be improved. The former, by contrast, sees health as only one of several objectives within the overall goal of maximising ‘utility’ and typically has severe reservations about any sort of government interference, except for the (probably rather few) cases in which governments can do better than markets.

In principle, the economic rationale for intervention in health can be formulated on both efficiency and equity grounds. Public intervention is justified when private markets fail to function efficiently, or when the social objectives of equity in access or outcomes are unlikely to be attained. 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). In what follows, the focus is on the efficiency-based rationale, as it is less normative than the equity argument and space is limited. This is not to imply that there is no scope for the equity rationale to apply to chronic diseases. Given the evidence on the negative economic effects of chronic disease (presented in Chapter 3), coupled with the observation that a high share of the burden of disease is carried by the poor (see Chapter 2), the equity rationale may well be relevant for the case of chronic disease intervention in low- and middle-income countries.³⁷

Key At first glance, it is far from clear that an efficiency-based rationale for government intervention in chronic diseases, or in health in general, exists (see e.g. Lal 2000, for a particularly critical economic perspective). **In standard economic reasoning, government intervention is merely an afterthought – market forces are usually considered to work best (or at least better than governments) in achieving the optimal allocation of resources from a social perspective. In liberal societies, consumer sovereignty is valued and government interference in the private sphere is not. There are, however, conditions under which the market fails to achieve optimal outcomes if left alone. In these cases,**

economists advise policy interventions to correct for the ‘market failure’.

Under ideal conditions, the free coordination of individuals produces an outcome that is not only in the best interest of the individual but represents at the same time the best possible outcome for society. The neoclassical economic model, on which this ideal view is based, posits the following central assumptions:

1. All costs and benefits are ‘internal’ (or ‘private’): all the costs and benefits associated with a given choice are taken into account and borne by the person making that choice.
2. Rationality: Individuals maximise some objective function (e.g. their utility function) under the constraints they face, weighing the cost they would expect to incur with the expected benefits of the choice in question. The decision ultimately taken is the one that maximises net benefits (or utility).
3. Perfect information: Individuals have complete information about the expected consequences of their actions.
4. Preferences are ‘time-consistent’ (or put simply: individuals face no serious self-control problems; see further explanation in section 4.4).

If these assumptions are met, there is no justification for public-policy intervention. In other words, none of the (potentially huge) costs associated with chronic disease will be relevant for public policy. In reality, however, one or more of the above assumptions often do not hold true, with the result that the market – left alone – does not achieve the outcome most desirable for society. In this case at least some of the costs of chronic disease do gain public-policy relevance, either because they are not carried by the individual directly concerned (section 4.1) or because they are incurred privately, but as a result of non-rational behaviour (section 4.2), out of imperfect information (section 4.3) or because of intra-personal conflicts (section 4.4). The higher the share of the public-policy-relevant internal or external costs, the more likely is a justification for government to step in to improve net social welfare (if it can). In addition, knowing the size of the costs is useful because it can assist in determining optimal taxation levels, and in determining the maximum expected benefits that might be derived from public health programmes to prevent the adverse health consequences.

Key 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.³⁸ This chapter examines when and if the first condition applies in the case of the risk factors that give rise to chronic diseases (smoking, obesity and alcohol consumption). The focus is on the rationale for the prevention of chronic diseases. Previous literature has dealt comprehensively with the case for government action in the areas of infectious, childhood and maternal diseases, and on the health system more generally (see Arrow 1963, Musgrove 1996). As far as the rationale for *treatment* is concerned, there are unlikely to be major differences between chronic and communicable diseases. The same applies to the rationale for health insurance.

4.1 Externalities

While it remains true that most of the costs associated with ill health are carried by the individual directly concerned, it is also true that there may be situations in which an individual making a specific choice does not bear all the costs or receive all the benefits associated with his or her choice. Rather, some of the costs or benefits are borne by others or by society at large. This is the concept of external costs or benefits (or 'externalities'). **External costs or benefits are not automatically factored into the consumption choices of individuals. In this case, individual levels of consumption (e.g. of tobacco, alcohol or unhealthy foods) can be higher or lower than is beneficial to society as a whole. Externalities are a form of market failure, justifying – in principle – a public-policy intervention with the aim to improve social welfare.**

A persistent difficulty for those interested in assessing externalities associated with chronic disease in low- and middle-income countries is that almost all of the existing studies on the subject have focused on high-income countries.³⁹ In light of these limitations, this section focuses on giving a generic overview of the main categories of external costs and benefits that have been empirically examined in the literature, as distinguished from internal costs (section 4.1.1). The most commonly researched externalities are those associated with collectively financed programmes (health insurance, pensions, sick leave, etc., which are discussed in section 4.1.2), but – depending on where one draws the boundary between internal and external costs – there are also potentially significant external costs borne by other household members (section 4.1.3). Although most of the empirical findings discussed do not come from developing countries,

tentative conclusions are drawn about the relevance of externalities in the developing-country context, taking into account some of the differences in institutional, policy and epidemiological characteristics.

4.1.1 Tabulating the internal and external costs of poor health habits

Drawing the line between internal and external consequences is of critical public-policy relevance. As mentioned above, internal costs are the 'private' costs borne by the individual, knowingly or not, and are generally irrelevant to an argument for government intervention within the efficiency rationale. The most obvious internal costs associated with a disease resulting from unhealthy behaviour are the morbidity and mortality suffered by the individual, which account for – by far – the greatest share of the costs of disease if translated into monetary values (this can be determined, for instance, using the concept of the value of a statistical life, or VSL).

External costs begin where internal costs end, and comprise all those costs that are not borne by the individual taking the decision. Taken together, internal and external costs make up the total or 'social' costs associated with a disease or a risk factor. Traditionally, costs borne by other members of the same household have been considered 'internal' (for example, the health consequences to children of parents who smoke are considered internal, even though the children themselves are not engaging in the unhealthy behaviour).

Table 7 summarises various examples of economic consequences of chronic disease, explicitly separating costs into internal and external categories. In addition, the table includes a third, intermediate category: quasi-external consequences, that captures the costs borne by household members. The broad categories of costs are the same as those discussed in Chapter 3 (consumption and saving, labour productivity and supply, and education and human-capital accumulation), adding a category for the immediate health costs of mortality and morbidity. The COI studies presented in Chapter 3 typically cover social costs, the sum of internal and external costs, but do not differentiate between these two types of costs – a distinction that is important from a policy standpoint, as this chapter argues.

4.1.2 'Classical' externalities from collectively financed programmes

'Classical' externalities are derived from collectively financed programmes, such as health insurance, pensions, sick leave, disability insurance and group

Table 7 Examples of internal, quasi-external and external costs (and benefits) of chronic disease and unhealthy lifestyles

TYPE OF COST OR BENEFIT		
INTERNAL	QUASI-EXTERNAL (costs to other household members)	EXTERNAL
Consumption and saving		
Medical expenditures: treatment for illness (user-paid insurance, out-of-pocket payments, co-payments) or substance abuse Expenditure on addictive goods Lost future income or other forgone long-term benefits from selling assets or from dissaving Criminal justice response: unreimbursed property damage (e.g. due to fires caused by smoking) Uncovered sick loss Foregone income not replaced by disability insurance Defined pension contribution plans	Lost future income or other foregone long-term benefits from selling assets partly owned by other household members, or from dissaving (from common household resources) Property damage (e.g. fire due to smoking) Reduced household investment in productive assets	Research, training, prevention, welfare Increased insurance premiums for those with healthy lifestyles Health insurance reimbursements Property damage (if other property affected) Covered sick loss Disability insurance Retirement pension and defined-benefit plans (+) Taxes on earnings (+) Group life insurance (death benefit)
Labour productivity and supply		
Diminished productivity and decreased wages Work absenteeism Early retirement Foregone income net of taxes Reduced labour supply (work absenteeism, early retirement, unemployment)	Intra-household reallocation of labour (e.g., reduction in spouse's labour supply in order to care for sick partner)	Productivity losses of the worker's company due to absenteeism caused by premature deaths or illness
Education and human-capital accumulation		
Reduced educational performance and attainment	Reduced educational and health attainment of those caring for the sick or substituting labour to compensate for income loss Crowding out of financial resources that could be invested in education and health of children Low birthweight of newborns with potential impact on cognitive development (e.g. through tobacco consumption in pregnancy) Reduced schooling through alcohol abuse in youth	
Health costs / morbidity and mortality		
Healthy life years lost Pain and suffering	Health of household members Pain and suffering of household members Domestic violence (alcohol) Health effect on the newborn child through maternal health behaviour and nutritional status	Co-workers and others (e.g. environmental tobacco smoke in public places) Victims of alcohol-related traffic incidents Alcohol-related violence

Source Modified based on Manning et al. (1991), Single et al. (2003) and UK Cabinet Office (2003)

Note The examples listed represent 'costs' to the individuals or society, except for two cases marked with '+', where the effects are external benefits. In the case of retirement pension that the individual paid for while working but cannot collect because he or she died prematurely, external benefits result – from a narrow public budget perspective (not from an overall social perspective that would consider internal costs, too).

life insurance. These programmes are financed by taxes and premiums that do not differentiate between those that engage in unhealthy behaviour and those that do not. From a broad, societal perspective some of these programmes tend to incur external costs and others external benefits, so that the issue of whether smokers, heavy drinkers or those engaging in poor health habits 'pay their way' becomes an empirical question.

Other things being equal, there is no doubt that individuals engaging in unhealthy behaviours incur higher healthcare expenditures while they are alive than those who do not. Because those individuals tend not to pay higher premiums for health insurance,

which would reflect their higher healthcare costs, many of the added costs are borne by the other contributors to the insurance fund (and thus become external costs).

However, those with poor health habits also tend to die earlier and, hence, require financial support through collectively financed programmes for fewer years than others. Several studies have shown this effect to be a potentially large one, which can more than outweigh the external costs represented by increased health insurance costs. It can also outweigh the loss of tax and premium payments (which finance many collectively financed programmes) resulting from an individual's early

key death. On a net financial basis – contrary to popular assumptions – it is not always self-evident that people with poor health habits are ‘subsidised’ by society at large.

Indeed, studies assessing the net external costs have found mixed results. One prominent, early study in the United States, for instance, found that smokers – according to some of the scenarios applied in the study – could in fact be subsidising non-smokers (meaning that smokers more than ‘pay their way’), but that heavy drinkers and those leading a sedentary lifestyle impose a net cost on society (Manning et al. 1991).⁴⁰ The authors attributed the finding that a sedentary lifestyle and heavy drinking entail higher external costs than smoking to the observation that the risk of early death associated with smoking is higher than for the other two behaviours. The results for smoking have been confirmed by Viscusi (1999b).⁴¹

In addition, in the specific case of heavy drinking, the value of lives lost due to victims of alcohol-related accidents or violence added significantly to the external costs estimates. Even so, none of these studies take into account the critical costs that occur to other household members – costs (discussed below) that, if added to the external estimate, could substantially increase overall costs.

Although the narrower framework of classic externality studies may underestimate the costs of chronic disease, it is instructive to consider some of the factors that drive their estimates:

- the extent to which a given health habit creates the need for health care;
- the extent to which the health services used by unhealthy individuals are paid for by some form of collectively financed health insurance;
- the extent to which health insurance premiums vary with the health risk of the insured; and
- the effect of the risk factor on mortality.

While the first two tend to increase external costs, the latter two tend to reduce them. These drivers are particularly relevant if the intention is to assess or to speculate about the relative size of external costs across different health behaviours (nearly all of the existing studies have focused on smoking). Unfortunately, there are cost-of-illness studies for many risk factors (see Chapter 3), but those studies do not separate internal from external costs, which is what matters from a public-policy perspective. For developing countries, the classical external cost

estimates will depend on the coverage of collectively financed systems, such as health insurance, of which there is commonly little.

4.1.3 Externalities within the household

The consequences of an individual’s poor health decisions that affect his/her family members can be manifold. Traditionally, economists have considered these costs to be private and, hence, not public-policy-relevant, and each member of the family is implicitly assumed to have identical preferences, or the household head is assumed to have incorporated all preferences of other family members into his or her behaviour and consumption choices (other household members are assumed to have ‘bargaining power’ to ensure that their preferences are considered). Yet children and women frequently have little or no bargaining power within a household, even where the costs they bear are high. In many countries, particularly less-developed ones, wives with low earnings potential may have few options outside of their current marriage. In such cases, engaging in household bargaining may not be possible or may violate social norms and therefore be too ‘costly’ for the partner.⁴²

A different, more recent view is that costs borne by household members other than the one(s) engaging in unhealthy behaviours should be considered as external. Because a large share of the costs of smoking and other unhealthy behaviours occur within households, adding these costs to any external cost estimate will greatly increase the size of the external costs, and thereby reinforce the rationale for government intervention. Only very few studies (and only from high-income countries), however, have taken this cost component into account (Sloan et al. 2004).

Before the costs of intra-household effects can be tabulated, it is important to identify what the effects

Table 8 Percentage of students exposed to tobacco at home and outside the home

Region	Exposed to smoke in home (%)	Exposed to smoke outside home (%)
Africa	30.4	46.3
America	41.6	63.0
Eastern Mediterranean	37.6	46.3
Europe	78.0	84.8
South-East Asia	37.0	49.4
Western Pacific	50.5	53.6
TOTAL	43.9	55.8

Source GTSS Collaborative Group 2006

Note The data presented is from the Global Youth Tobacco Surveys (GYTS) conducted in 132 countries between 1999 and 2005. The regional data is based on the population-weighted averages in 25 countries in the African region, 37 countries in the Americas, 21 countries in the Eastern Mediterranean region, 26 countries in the European region, 7 countries in the South-East Asian region, and 16 countries in the Western Pacific region.

are to begin with. Some are obvious and have been well documented, while others clearly need more research. Second-hand smoke is perhaps the best example of the former (US Department of Health and Human Services 2006), and a prime example of how estimates of harmful effects can increase as knowledge and research accumulate. Recent data from the Global Youth Tobacco Survey (see Table 8), which included predominantly low- and middle-income countries, shows a large proportion of young people in all WHO regions is exposed to tobacco smoke in the home. (For comparative purposes, data on exposure outside the home is also presented.)

There is also considerable evidence about the harmful health effects transmitted from mothers to their offspring *in utero*, with potential long-term economic effects. The impact of smoking while pregnant on low birthweight, with the attendant potential consequences for future human-capital accumulation, has already been discussed in section 3.2.3 (Ernst et al. 2001, Torelli 2004). Other recent studies suggest that maternal nutritional status in pregnancy matters for the development of obesity in children. Obese mothers appear more likely to have children with high birthweight, which in turn tends to predict

obesity in adolescence (Johannsson et al. 2006). Underweight children are also particularly susceptible to weight increases. The initially underweight babies of undernourished mothers may experience rapid weight gain during early childhood as a consequence of increasingly poor diet in many developing countries (Baird et al. 2005, Delisle 2002). Recent evidence also suggests that failure to breastfeed may increase the risk of childhood overweight and obesity (Harder et al. 2005). More work is needed to develop a scientific consensus on obesity-related effects. This is not surprising since obesity has only recently become a major policy concern.

Chronic disease risks, and associated costs, are also transmitted from parents to children via social mechanisms. Parental behaviour and education are perhaps the most important predictors of child health and behaviour. A similarly important social transmission occurs via 'peers' inside or outside the household (see Box 3). Whether these effects can be considered (quasi-)external is still being debated.

One might hypothesise that the consequences of chronic disease and risk factors within households may be of particular relevance and size in developing

Box 3 **How communicable are non-communicable diseases?**

The very communicability of *communicable* diseases undoubtedly justifies public-policy intervention through, for example, immunisation. When an individual is immunised, benefits accrue to that person (who now has a lower chance of contracting disease) and to others (because others are also less likely to become ill). The latter are thus 'external benefits', and the utility-maximising individual will not take them into account when deciding whether to receive immunisation shots. The result is a lower than socially optimal uptake of immunisation, thus justifying policy intervention.


The term '*non-communicable*' suggests that similar 'spill-over' effects do not exist for non-communicable conditions, thereby greatly downplaying their public-policy importance. Recently, a small but growing amount of research has pointed out that while biological transmission usually does not occur for non-communicable diseases, risk factors may well be transmitted socially. In particular, it has been shown that peers (broadly defined as classmates, friends, siblings, even to some extent parents) influence people's health behaviour. The evidence of 'peer effects' appears strongest in the case of adolescent substance abuse (Case and Katz 1991, Norton et al. 1998, Gaviria and Raphael 2001, Lundborg 2006), but evidence has also emerged in the area of diet and physical activity (Costa-Font and Gil 2004).

The presence of peer effects can be interpreted as a 'social externality': in contemplating whether to give up poor health habits, individuals only take into account the health benefits to themselves that would derive from quitting. They do not consider the health benefits to peers, who may be more likely to quit when they see that their friend has done so. (On the other hand, peers make the decision to quit harder, because of the risk of exclusion from the social network.) For policy purposes, the magnitude of a peer effect is important because it may amplify the success of interventions: a price increase will not only affect an individual's decision to smoke, but indirectly also those of his/her friends. This is called a 'social multiplier' effect – it indicates that a price increase will have a larger aggregate effect than the sum of the effects on each individual separately. The fact that youth substance abuse is more price sensitive than it is among adults is consistent with evidence that peer effects among adolescents are comparatively bigger.

As a further qualification of this research, one recent US study has shown that peer effects of smoking may be asymmetric: the pro-smoking influence of a fellow smoker markedly exceeded the deterrent effect of a non-smoking peer. This indicates that the absolute size of the price increase it would take to reduce youth smoking prevalence by a given amount would have to be larger than the price decrease that would achieve the same absolute smoking increase (Harris and López-Valcárel 2004). This literature has so far focused exclusively on high-income countries.

countries. Average household size is larger in developing countries (meaning that more people will be affected), and the bargaining power of women is not comparable to developed societies (thereby making it less likely that the household head truly incorporates women's preferences).

In addition, in the low- and middle-income country context, 'social security' is often provided by informal social networks (mainly extended families). Consider a breadwinner's illness or disability: within his or her household, over and above the costs of care, lost labour earnings might have substantial repercussions for family members, especially children. In the absence of formal social insurance, they might be required to abandon their education in order to supply additional income, with negative consequences on human capital accumulation (see section 3.2.3). Moreover, several studies (discussed in section 3.2.1) have demonstrated how spending on alcohol and tobacco might be crowding out more productive uses of limited household budgets. Empirical work has not yet established whether these effects are *causing* long-term economic impacts.

 **The externality argument represents a straightforward, powerful rationale for public-policy interventions. There is, however, conflicting or a lack of evidence about whether it is a convincing argument in the case of chronic disease, and in particular as far as developing countries are concerned (where the evidence is very scarce indeed). A large share of the existing studies – which unfortunately focus almost exclusively on high-income countries – consider the net external costs associated with unhealthy behaviour as not very large. Those costs, however, appear to be much higher (at least in the case of smoking) when intra-household effects are considered to be external instead of internal costs (see Sloan et al. 2004). More work is needed to assess the extent to which this result carries over to other risk factors and to developing countries.**

4.2 Departures from rationality

The assumption that people act rationally (in other words, they maximise their expected utility) represents a core pillar of economic thought that is particularly useful when compared to other, less structured assumptions. It makes the analysis of individual behaviour a good deal more tractable, and allows economists to derive 'optimal' behaviour in a normative sense. Models of rational behaviour can also be used to explain and predict actual behaviour. Dismissing the rationality assumption altogether is not a line that the majority of economists would approve of,⁴³ not least because it would open the way to paternalism in

a broad range of areas – under the pretext of 'helping people do what is best for themselves'.

Bearing in mind these concerns, it is widely recognised among economists and others that in the specific case of children and adolescents, the rationality assumption does not hold true (Chaloupka and Jha 2000). **Children and adolescents tend not to take the future consequences of their choices into account, irrespective of whether they have information about those future consequences. As such, they act myopically⁴⁴ and, hence, non-rationally. The result of their choices may well differ systematically from their long-term best interests. This provides – in principle – a justification for government intervention to help them make better choices.** In other words, part of the privately borne costs do become public-policy relevant. (While it is uncontroversial to maintain that children are not the rational consumers that economic theory assumes, unambiguously determining the age at which young people start to act sufficiently rationally is likely to remain impossible.)

The rationale is reinforced further in light of the lasting impact that health and health behaviours in childhood and adolescence are known to have over a lifetime. This is most obvious in the consumption of addictive goods, particularly tobacco. Smoking behaviour is overwhelmingly established in adolescence. In the United States, for instance, some 80% of adult smokers reportedly started smoking before the age of 18 (US Department of Health and Human Services 1994). Young people do not take into account the risk of becoming addicted to nicotine because they act myopically (again, this occurs even if they have been informed that there will be future consequences). It has been shown that the longer the onset of smoking is delayed, the less likely a person is to become addicted (*ibid.*). Even in the absence of addiction, empirical evidence strongly suggests that health behaviours adopted while young are reliable predictors of health and health behaviours in adulthood, for example concerning diet and physical activity (Case et al. 2005, van Dam et al. 2006, Whitaker et al. 1997).

Based on this justification, governments in many (mainly high-income) countries have banned the sale of cigarettes and alcohol to minors in order to prevent them from damaging their health. Similarly, there is growing support and recognition in many of those countries for stronger regulation of advertising and sales of unhealthy foods to children (Ofcom 2006).

While this market failure is focused on children and adolescents, some of the most promising measures to remedy the situation are much harder to target exclusively to this group. For instance, tobacco

taxation unavoidably reduces not only adolescent but also adult consumption. And in any case, since parents have a major influence on the health behaviour of their children, it is difficult to change children's behaviour in a way that circumvents the parents (Hardy et al. 2006).

The following section turns to potential violations of the 'perfect information' assumption. Although this is independent from the idea of rationality, the examples above have already shown that, at least in the case of children, non-rationality and imperfect information may well come together.

4.3 Insufficient and asymmetric information

There are typically good reasons to believe that markets fail to produce optimal outcomes because of informational problems. It is, however, important to distinguish between problems due to insufficient and those due to asymmetric information – despite the interrelations between the two. Asymmetric information occurs when one party to an exchange has private information that it does not share with the other party. Insufficient information is information that is not deliberately hidden, but which some individuals cannot use or interpret 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.

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

- insufficient awareness about health risks involved in consumption choices; and
- inadequate information about the addictive qualities of unhealthy goods.

The former potentially applies to all unhealthy behaviours, while the latter is more relevant to smoking and alcohol consumption than to diet and physical inactivity (see, however, Cawley 1999 for a treatment of the 'addictive' aspects of diet).

The costs in terms of health consequences for the individual must be separated into one part the individual has foreseen and has, hence, deliberately incurred, and another part that he/she did not anticipate. Both consequences are borne by the individual, but the unforeseen consequence did not enter the utility-maximising decision. These

unknowingly incurred internal costs then become relevant to public policy.

Whether consumers in a given country are sufficiently informed about the health consequences of risky behaviour is an empirical question.⁴⁵ Insufficient and/or asymmetric information is more likely to prevail under certain circumstances, such as among children and teenagers. Imperfect information is also more common:



- where the health effects of a behaviour are insufficiently understood and researched (for example, because of the long time-lag between behaviour and outcome). It has taken decades for the health effects of smoking to be gradually understood by scientists, and a similarly advanced understanding of obesity may take more time to materialise; and
- where industry's marketing efforts distort information, intentionally or otherwise (the history of the tobacco industry, recently revealed in several studies, offers plenty of examples of a concerted effort to conceal information about the negative health impacts of smoking).⁴⁶

In addition, living in a developing country may convey information disadvantages. 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). Kenkel and Chen (2000) provide a more comprehensive review of the evidence of the lack of information on the consequences of tobacco use worldwide. Peck et al. (2000) provide an indirect approach for evaluating the welfare loss associated with imperfect information about the health consequences of smoking.

Results for developed countries appear mixed. Viscusi (1992, 1999a) found that smokers in the United States over-estimated the health risks associated with smoking, while Schoenbaum (1997) found the opposite.⁴⁷ In a recent study, Cutler and Glaeser (2006) concluded that higher smoking levels in Europe (compared with the United States) are largely explained by a continuing lack of information about the health consequences of smoking, even after a range of other determinants of smoking are taken into account. If insufficient information does have a noticeable effect in Europe, it is likely to matter even more in many low- and middle-income countries.

There has been comparatively little work assessing whether lack of awareness of risks is a predictor of obesity. The evidence available, however, suggests that knowledge about the risks of a poor diet is low compared with smoking. In the United States, for instance, it was found that people tend vastly to underestimate the amount of calories and fat they are being served in restaurants (Burton et al. 2006). This is an important finding for high-income countries more generally, where the share of food consumed in restaurants has been steadily increasing.

A recent longitudinal study from Taiwan (Kan and Tsei 2004) investigated in detail the shape and significance of the relationship between knowledge and obesity (measured by BMI), finding mixed results. For male individuals, a statistically significant negative relationship – better knowledge producing lower BMI – shows up only for individuals who are extremely overweight (BMI > 29.41, according to the authors' definition). This might suggest that men do not think mildly overweight individuals will experience adverse health outcomes. In contrast, among women, knowledge of obesity's detrimental consequences on health has no discernible effect on BMI at all. The study controlled for a set of other determinants and used two-stage estimation to overcome econometric challenges that complicate the relationship. More research is needed to assess the role that information plays in determining diet, in particular in developing countries where obesity is rising fast.

On the whole, government intervention in the form of the provision (and production⁴⁹) of health information is in principle justifiable, as information is a public good, which leads to it being under-supplied in the absence of government intervention. (A pure public good is a good for which consumption by one individual does not reduce someone else's consumption – it is 'non-rival' – and a consumer cannot be excluded from consuming the good either by having to pay or through some other mechanism – it is 'non-excludable'). **The public provision of information can in principle take many forms, including product labelling, comprehensive or targeted public-information campaigns, or restricting the marketing of unhealthy food. In particular in developing countries, where the awareness about the health consequences of smoking, alcohol, poor diet and physical inactivity are low, there is an obvious case for more information.** Perhaps the best example of the benefits of information is the sudden and sustained reduction in smoking that occurred in the United States after the publication of the Surgeon General's Report on the health risks of tobacco consumption in 1964.⁴⁹

However, even where the information deficit is reduced, there is mixed evidence as to how far this will actually change people's behaviour. Some evidence from controlled experiments on the provision of nutrition information showed no effects on overall energy and fat intake (Kral et al. 2002, Stubenitsky et al. 2000). Even perfectly informed people might decide to consume unhealthy goods if the pleasure derived from consumption exceeds the short- and long-term costs, particularly if the private costs do not fully account for the costs to society. In this case, simply providing more or better information will not produce the desired change in behaviour.

4.4 Time-inconsistent preferences or 'internalities'

A potentially powerful justification for government intervention to prevent chronic diseases caused by unhealthy lifestyles comes from the recently proposed hypothesis of time-inconsistent individual preferences. Behavioural economists, in particular, argue that in some situations individuals give in to the temptation to accept immediate gratification at the expense of their long-term best interests.⁵⁰

This feature characterises only the shape of individual preferences, while the other standard assumptions of economic theory remain in place: individuals continue to be considered perfectly rational, forward-looking, fully informed consumers.

In this model, a commitment made today – by a perfectly informed and rational individual who has time-inconsistent preferences – to act in a particular way in the future will be reneged upon at the point when the commitment should be respected. For example, a smoker asked today to stop smoking immediately will probably answer no, but might agree to stop smoking in one year. One year from now, if asked again to quit smoking, the smoker might prefer to continue smoking rather than adhere to the previous commitment to quit.⁵¹ 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 or her future 'self'. Since the decisions of the present self do not take into account the consequences of its actions on the future self, it imposes a type of externality on the future self. This is typically called an 'internality' (or 'intra-personal externality') because the consequences remain 'inside' the individual.

There is some empirical evidence from the United States to support the idea of time-inconsistent preferences. Within the smoker community, 8 out of 10 smokers express the desire to stop, but many fewer than that actually quit. Gruber (2002) reports

that over 80% of smokers try to quit in a typical year, and the average smoker tries to quit every eight 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 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.'

According to Cutler et al. (2003) a further confirmation of the theory derives from the fact that desired weight rises only slightly as actual weight rises, particularly for obese people, resulting in an increasing disparity between how individuals actually are and how they would like to be.

It is difficult to assess the size of internalities, as they depend on the not-directly-observable degree of time inconsistency displayed by the individual. The upper limit is given by the total health costs that the individual imposes upon him/herself. Gruber and Koszegi (2001 and 2002), using the value-of-life valuation method, estimated that the total harm that smokers do to themselves equals \$35 per pack of cigarettes – a very high figure. Out of that amount, the internal costs for 'modest' degrees of time inconsistency (below the assessments of most laboratory experiments) would be between \$1 and \$2 per pack. For more severe time inconsistency (still consistent with experimental evidence) the internal costs are estimated to be on the order of \$5 to \$10 per pack of cigarettes.

Some argue that if individuals have time-inconsistent preferences, there may be a case for an intervention (e.g. a tax) that stimulates them to do what they would like, but are unable to do without external help. In these cases, the size of the internal costs can be used to determine the size of an optimal tax, on top of any tax that might be justified by the presence of external costs. Gruber (2002), for instance, estimates that external costs would translate into a tax of \$0.40 per pack or lower – much less than internal costs of US\$35.

Time-inconsistency can be easily confused with insufficient information (or with myopic behaviour),

especially in the case of addictive goods. When taking up consumption, individuals – especially young people – might have insufficient information to assess precisely the addictive power of the good and may think that they will be able to commit themselves to quit in the future. Yet the individual may never have enough self-control to quit the addictive behaviour. This produces the same result as time-inconsistent preferences, but time-inconsistency occurs only when individuals are otherwise fully informed about the consequences of their actions (while also being aware of their contradictory behaviour attributable to problems of self-control).

The outcomes of these 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. For example, 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. Unfortunately, such devices are weak because they cannot be externally enforced.

Given their enforcement power, governments are generally in a good position to provide fully effective commitment devices. Per-unit taxes are one example of an effective government intervention.⁵² Taxes increase the immediate cost of unhealthy behaviours, thereby lowering the enjoyment (or present benefit) of the individual. Taxes that adjust for time-inconsistent preferences may be considered as welfare improving because they provide individuals who have little self-control with an effective commitment device and a way to increase their utility surplus. At the same time, if the proceeds of the tax are returned evenly to everyone in society, individuals with high self-control are compensated for their loss of enjoyment, providing a further incentive for self-control (O'Donoghue and Rabin 2006).

Taxation addresses the internality problem in a manner similar to the way in which traditional economic models respond to externalities. The smoker's response to the price increase will be the same in both the standard model and in the case of time inconsistency: he or she will reduce smoking. However, a crucial – and in principle empirically testable – difference is that in the case of time-inconsistent preferences, smokers will be better off



because they are 'forced' to do what they ultimately want (namely, to give up smoking). By contrast, the standard model predicts that smokers will be worse off because the government is constraining their choice of a rational activity. Gruber and Mullainathan (2002) have found some support for the time-inconsistency model in that higher cigarette taxes were associated with higher levels of self-reported well-being among smokers, in both the United States and Canada.

As is the case with market failures caused by non-rational behaviour (discussed in section 4.2 above), there is potential for paternalistic abuse of the time-inconsistency argument. It could be used under the pretext of helping those who suffer from 'self-control problems' to impose laws or rules that restrict the choices of individuals (such as any kind of total ban on certain consumer goods).⁵³ This is a legitimate concern, although it is not an argument against the relevance of the time-inconsistency rationale per se. Nevertheless, it does suggest that if a time-inconsistency argument is invoked, the welfare costs and benefits of the interventions on these grounds should be carefully examined.

Gruber (2002) suggests that taxes should be accompanied by a portfolio of other measures to decrease present enjoyment associated with smoking, such as banning smoking in public places or the workplace. This suggestion can be generalised to cover the full set of unhealthy behaviours by 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, which achieves the same effect as 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, immediate and future costs can both be manipulated to make healthy choices easy choices. Wider use of standardised nutritional certification programmes would reduce the time costs of gathering nutritional information, at least among those in a position to act upon the given information. Wide availability of running lanes, gym facilities, swimming pools and cycle paths would reduce the immediate cost of physical activity (for instance, by reducing search and transportation costs) – although these examples obviously have more direct relevance for high-income countries. Price policies may also in principle be an option to influence food choices, by reducing the relative price of healthier foods through subsidisation or by taxing unhealthy goods. This requires, however, a careful analysis of the

welfare implications involved, especially in developing countries (see e.g. Schmidhuber 2004).

Overall, while the idea of time inconsistency as a market failure is highly plausible, more research is needed to establish an empirical basis for the argument in the specific case of chronic disease risk factors. It remains, however, an argument that can in principle justify an acceptance of some of the substantial internal costs incurred through poor health habits as relevant to public policy. In doing so, it can significantly reinforce the case for government intervention.

4.5 Conclusions

There are good reasons to believe that conditions exist in which intervention to prevent chronic disease may be justified from an efficiency perspective: people act non-rationally and against their own desires for their future selves, they are frequently imperfectly informed about the health risks of their choices, and their actions may have significant negative consequences for others or for society at large. When such market failures exist, interventions are called for to move people closer to a social optimum in an efficient manner.

Many issues relating to the economics of prevention could not be explored in this chapter due to the immense scope of this area of study. This includes whether the 'free market outcome' produces too low a level of prevention in general, irrespective of the type of disease or risk factor, as some have argued (Kenkel 2000). A related question not covered is whether there is too little research on prevention compared to the 'social optimum'. Private industry generally does not invest money into the development of non-clinical preventive interventions, in part because such interventions cannot be easily patented, meaning companies are not guaranteed a return on their investment (Dranove 1998).

Overall, there is little work that has directly examined the rationale for intervention to prevent chronic disease in developing countries. One is left to draw instead on existing evidence for high-income countries, and to discuss ways in which the findings are applicable to developing countries. Further research should address this major evidence gap.

It is important to re-emphasise that the largest burden associated with chronic disease and related risk factors is carried by the individual directly concerned, and is represented by the loss of quantity and quality of life years, measured in monetary values. If individuals are indeed the rational actors assumed by standard economic

theory, then these costs will be matched by benefits (such as the 'good feeling' derived from smoking) that are at least as high as these costs. If the individual unknowingly or unwillingly incurs these costs – because he/she simply did not consider the future consequences of the action, because he/she was not aware of the consequences, or if he/she is facing serious self-control problems – then some of these 'private' costs become relevant to public policy, adding important weight to the argument for public-policy intervention.

This chapter has discussed only whether there are market failures that would – in principle – justify a public-policy intervention. This by itself says nothing about whether in reality governments would have the means to correct the market failure at a cost that is worth the return. Many interventions might not fulfil this criterion, in which case the optimal choice is to try to live with the status quo. The following chapter reviews the evidence on the cost-effectiveness of interventions to prevent chronic disease. As such, it seeks to complete the economic rationale argument. The link between the market-failure discussion and the cost-effectiveness evidence also runs the other way round: evidence of cost-effectiveness on its own is not a sufficient argument to justify a role for public policy. This is because, in the absence of a market failure, a highly cost-effective intervention offers a strong private rationale to undertake the intervention.

5. Cost-effectiveness of interventions to prevent chronic diseases

Many interventions have been proposed for preventing or reducing the incidence of chronic diseases, yet few of them have been analysed to determine how much health improvement can be gained per dollar spent, especially in developing countries. Cost-effectiveness is a widely used measure to allow policymakers and others to decide among possible interventions to improve public health (section 5.1). There are difficulties, however, in measuring both the costs and the effectiveness of health interventions, complicating efforts to determine which will be most appropriate for specific diseases or risk factors (section 5.2). These complications mean that evidence reviewed for this report, especially as it concerns developing countries, relies heavily on modelling and estimation, and borrowing data from developed-country experiences (section 5.3).

Key The review of interventions undertaken below indicates that cost-effective interventions to prevent many chronic diseases in developing countries exist, but have not been widely applied. Specifically, population-wide and community-based interventions appear to be highly cost-effective when they reach large populations, address high mortality and morbidity diseases, and are multi-pronged, integrated efforts.

Interventions targeting individuals can also be cost-effective, but may require clinical involvement (which can be more difficult to come by in the developing-country context (section 5.4).

Key Based on epidemiological trends in developing countries, proven interventions are likely to become more cost-effective over time as population ageing and increased globalisation put societies at greater risk of chronic diseases. However, this is not an argument for waiting for the disease burden to worsen before intervening. Some interventions need time to take full effect, and many interventions become more effective over time (for example, the 'bandwagon effect' of reduced smoking). The purpose of prevention is to reduce the amount of damage that could occur, and for many chronic diseases this may mean 'unlearning' unhealthy behaviours.

Two conclusions useful for policymakers emerge: further study of promising interventions is needed; and interventions that appear to be cost-saving or low-cost can and should be implemented on a wider scale where the disease burden warrants, even while cost and effectiveness data continue to be refined. Economists have a role to play in helping policymakers choose which of the two avenues will improve public health at the lowest cost.

5.1 What is cost-effectiveness?

Economists have developed several methods for evaluating the way in which a policy or programme is conducted, and how efficiently it achieves its purpose. The best known of these are cost-effectiveness and cost-benefit analysis (CEA and CBA). CEA shows how much it costs to obtain a certain amount of a health improvement, while CBA allows comparisons of the costs with the benefits of taking a specific action. Both types of analysis are carried out through standard methods, but CEA is more common. While CEA alone cannot indicate the economic desirability of a given intervention (it does not provide an absolute measure of 'efficiency' in a welfare sense), properly done, it does allow for comparisons among interventions because it provides a basis for ranking them.

Cost-effectiveness analysis relies on two pieces of information: the results of an intervention in actual health units (such as mm mercury for blood pressure, BMI change for obesity, etc.), and the dollar costs of carrying it out. It is relatively simple to calculate, but it is often difficult to gather adequate data to do so. Cost-effectiveness is defined as the cost per unit of health benefit (measured primarily in DALYs or in years of life saved) from carrying out a specific health intervention. A lower cost-effectiveness ratio implies a less expensive improvement in health, and a higher ratio implies a more costly improvement. It is important to recognise that many interventions that have high cost-effectiveness ratios may be economically justified if the demand for them is high and where diseases impose a high burden of mortality and/or morbidity on a population. In determining cost-effectiveness, care must be taken to include the full array of actual costs, to discount both the costs and health impact that occur in the future, and to have reliable information about health impacts at the individual level.

5.2 Barriers to measuring cost-effectiveness

Key Calculating cost-effectiveness demands substantial data, and these demands are seldom fully met.

Difficulties arise both in assessing whether a specific programme is effective from a health perspective, and in measuring the costs of conducting the programme.

Although there are standard measures (such as DALYs) that describe the health outcomes of specific interventions, measures of effectiveness often vary across studies and cannot be compared. Another significant problem is that many prevention efforts have not been properly evaluated for effectiveness, including many physical activity and nutrition

programmes that have not yet been widely tested (such as changing the fat content of manufactured foods). Obviously, very little can be said about the cost-effectiveness of unproven interventions.

It is also difficult to measure the effectiveness of interventions at a population-wide level. There are several reasons for this. Randomised controlled trials are the gold standard for determining the effect of a given intervention, but they are rare. When they are available, they can easily face contamination between control and experimental groups due to the difficulty of preventing information flows between study populations. Another significant barrier comes in defining the intervention itself. For instance, some of the potential interventions described in this chapter involve simultaneous policy, regulatory and manufacturing changes, and it is not easy to disentangle the effects that are due to each part of a comprehensive intervention. Finally, many chronic diseases arise from social, cultural, economic and legal conditions that vary across countries. Similarly, community and population-based interventions to address those diseases often require location-specific changes in underlying conditions or behaviours. This specificity makes comparisons across countries or groups extremely difficult (see the discussion in Nissinen et al. 2001). Additional factors that complicate cost-effectiveness measurement are the size of the community where the intervention is applied, the 'dose' of the intervention across the community, lack of controls, and underlying trends – all of which have an impact upon the effectiveness of the outcome.

In addition to problems in measuring the health outcomes of a given intervention, determining the cost of that intervention is not necessarily straightforward. The broad range of interventions against chronic diseases include some for which the costs are relatively easy to estimate, such as familiar public health education and promotion programmes. More difficult to calculate are the costs of environmental changes, such as those to encourage physical activity. Most difficult are the regulatory, industrial or policy changes that may create hidden costs (or benefits) and have other unintended consequences. Costs will also vary depending on where the intervention is being implemented.

Many cost-effectiveness studies are based on actual information gathered on-site during an intervention. These observational studies are limited by small population samples and site-specific conditions, but they can still be useful beyond their immediate application for meta-analyses or site-to-site comparisons. Studies that include comprehensive cost information and involve multiple sites, common

protocols and randomised study arms are preferable for setting policy or generalising conclusions. However, studies meeting these conditions are not common in either developed or developing countries. Therefore, the results reported in this and other papers rely heavily on modelling or estimation, using data extrapolated from small-scale interventions, or borrowed from interventions not specific to chronic disease or the developing-country experience.

5.3 Gathering information about intervention cost-effectiveness

Because of the difficulties in calculating cost-effectiveness, some of the conclusions of this report are based on limited information derived from disparate experiences in developing and even developed countries. To evaluate what is known about interventions to prevent chronic diseases in developing countries, the field was surveyed through searches of electronic journal databases, including PubMed, EconLit and Web of Science, using multiple key words.⁵⁴ The relevant publications of international organisations were reviewed, including those of the World Bank, the World Health Organization and the Pan-American Health Organization. In addition, experts in chronic diseases and health economics were consulted in an effort to locate evaluation studies and other 'grey' literature, and to identify highly effective interventions in developing countries even where systematic cost analyses have not been performed. The search revealed an extensive literature addressing interventions against cancer, particularly smoking-related, but a paucity of literature describing interventions that included cost data for many other chronic diseases.

5.4 Cost-effectiveness of interventions to prevent chronic diseases

This section summarises what is known about cost-effectiveness for several interventions, nearly all of them primary prevention efforts, to prevent or reduce chronic disease prevalence and associated risk factors. Primary interventions occur prior to the diagnosis of disease and take place largely outside the clinical realm (or with minimal clinical involvement).

The need for non-clinical intervention is likely to be more acute in developing countries, where high prevalence of some risk factors and chronic diseases overwhelm already weak health systems, and some (although not all) disease screening can be expensive. Secondary prevention can, of course, be achieved through pharmacological approaches (aspirin, statins, beta-blockers, ACE inhibitors) with minimal screening and low-cost techniques (such as blood pressure and cholesterol testing) for those who



are at high risk or have already developed chronic diseases. There is some evidence to suggest that these interventions are in fact more cost-effective than primary-level interventions because they are more narrowly targeted to high-risk populations (Gaziano et al. 2006). However, it is also possible that inexpensive, readily available drugs increase the likelihood that people will engage in unhealthy behaviours because cheap interventions make it seem like the costs of their behaviour are lower than they really are. Therefore, the focus in this paper is on primary prevention interventions because they can be implemented immediately in developing countries, and require less of the healthcare system.

Broadly speaking, interventions can occur at the individual, community and society levels (the last two are also referred to as 'population' interventions). Individual interventions include actions of healthcare providers or an individual to improve their own health, including education and behaviour change approaches, such as smoking-cessation tools or weight-loss programmes. Education and information campaigns directed at specific communities, such as schools or the workplace, are a common approach to prevention of disease. Such campaigns are often accompanied by environmental changes intended to encourage healthier behaviour. Examples are signs pointing to the location of stairs in buildings and menu changes in workplace and school cafeterias. Other community-level approaches include exercise programmes at community facilities, and policy changes that restrict smoking or alcohol consumption.

Society-wide efforts include yet broader-reaching educational efforts, changes in industrial processes, and regulatory and policy actions such as labelling requirements, taxes and subsidies, and restrictions on product use and marketing. Education at the society level has been used in many countries to change the dietary, smoking and physical activity behaviour of populations, using a wide range of informational products disseminated in various ways. Once again, both costs and health impact are much easier to measure at the individual level than at the community and society levels.

This survey of published cost-effectiveness studies and expert opinion points to the conclusion that some individual and population-wide interventions to prevent chronic disease can be highly cost-effective, but that results depend heavily on regional differences in costs and the burden of chronic diseases. Sensitivity analysis done as part of the CEA modelling for the Disease Control Priorities Project (DCPP) showed that the cost-effectiveness of public education campaigns at the population level could be very good or far less

favourable depending on how much it cost to reach people using a reasonable range of costs. Similarly, even a very inexpensive intervention may not be worth implementing if it targets a chronic disease with low prevalence in a given country or region. For many of the interventions discussed below, cost-effectiveness is difficult to determine because there is not enough experience of chronic disease interventions in developing countries.

There is no 'too high' or 'right' cost-effectiveness ratio – what is acceptable to health and finance decision-makers depends on the country context. The DCPP has identified several chronic disease interventions as cost-effective at a cost of below \$1,000 per DALY (Jamison 2006). However, the affordability of interventions will vary significantly across countries, even among a group of interventions believed to be cost-effective in the global sense.



Because many of the interventions discussed here can address multiple diseases and/or risk factors simultaneously, interventions are not associated with specific disease targets. However, as obesity is a risk factor for multiple chronic diseases, most of the interventions discussed could address obesity and its consequences.

5.4.1 Individual lifestyle interventions

Smoking cessation, dietary changes, increasing physical activity, and moderation in alcohol consumption are all largely achieved at the individual level by behaviour modification. This can arise from education efforts or simply the desire to be healthier. Smoking cessation is likely to be very cost-effective if all the various health benefits are considered, and because prevalence is high in developing countries. The primary individual approach to reducing tobacco use is through prescribed or over-the-counter nicotine-replacement therapy, which has been used in both developed and developing countries for a number of years with good success (Jha et al. 2006). The effectiveness of nicotine-replacement therapy appears to be relatively constant across settings and delivery systems, although it is possible that nicotine-replacement therapies are not widely available in some developing countries (*ibid.*).

There is evidence to suggest that 'self-management diabetes education' is cost-effective for prevention of diabetes (Narayan et al. 2006). Some research also points to diet and physical activity (lifestyle) changes as very cost-effective for prevention of diabetes (*ibid.*); however, the lack of trials in developing countries makes it difficult to reach strong conclusions.

Observational and developed-country experience shows it can be very difficult to change eating and exercise habits in a sustainable manner.

In addition, lifestyle interventions to change diet, reduce alcohol consumption, take aspirin and engage in routine physical activity can control or reduce the incidence of CVD in people at high risk. Eating more fruits and vegetables, switching to unsaturated fat, reducing salt intake and weight loss can reduce the risk of CVD by reducing high blood pressure, cholesterol levels and body mass index (BMI). Some studies find that dietary interventions for reducing cholesterol are also cost-effective, with ratios as low as \$2,000 per quality-adjusted life year (QALY) (Prosser 2000). These lifestyle changes require education and monitoring to be effective in preventing disease. No conclusive data are available about the cost-effectiveness of these interventions.

5.4.2 Individual pharmacological interventions

Pharmacological interventions can in principle achieve many of the same results for blood pressure and cholesterol reductions as lifestyle changes, but generally with a higher likelihood of success, as far as existing evidence suggests. Strong evidence exists that medications that lower blood pressure reduce the risk of stroke, ischaemic heart disease and heart failure (Rodgers et al. 2006). Similarly, statins reduce cholesterol in many people at risk of heart disease and stroke. Aspirin is also protective against coronary artery disease.

Key Results based on developed-country experience show that primary prevention of CVD using drugs to control blood pressure and serum cholesterol are highly cost-effective for those with risk factors, and sometimes cost-effective for the general population.

For adults over 45 years with high blood pressure (over 105 mmHg), drug treatment costs a few hundred dollars per life year gained. For the general population, drug treatment costs \$4,600 to \$100,000 per life year gained. The cost difference is due to differences in underlying risks, age and costs of medication (Rodgers et al. 2006). Cost-effectiveness ratios for cholesterol-lowering medications are becoming more favourable with the expiration of many patents on statins, and also vary significantly by risk level and age.

Murray et al. (2003) modelled the effects of blood pressure and cholesterol-lowering medications in the epidemiological contexts of developing countries. The authors found that individual-level interventions, including medication, were less cost-effective than some population-based interventions, but still had low

cost per DALY averted (ranging from \$610 for high-risk populations receiving combination treatment in Africa to \$4,030 for low-risk populations receiving treatment in the Middle East and North Africa).

Drugs for weight loss do not have a strong success record, particularly over the long term.

5.4.3 Physical activity intervention

Although there is one very promising example from Brazil, there is little basis for formulating a conclusion about the cost-effectiveness of physical activity interventions to prevent chronic diseases in developing countries. Even in the United States, the data are too weak to draw conclusions. With a modelling approach, one US study found that people who walk save significantly on health care. They compared these savings to the costs of running shoes, time spent walking, and occasional injuries for different age groups and both sexes. The results were greater savings than costs. The model did not include other potential health benefits from walking although it is likely that multiple chronic disease risk factors (such as lower blood pressure and cholesterol or improved mental health) would be affected by a regular and rigorous walking regime.

Some studies suggest that although the relative risks of a sedentary lifestyle are likely to be similar in developed and developing countries, people in developing countries face substantial barriers to implementing physical activity initiatives. In South Africa, lack of widespread access to exercise infrastructure (such as gyms or trails), high prevalence of urban violence, and a focus on primary healthcare delivery all impede effective physical activity interventions, especially in urban environments (Lambert et al. 2001). The authors report a low-to-moderate level of physical activity for the majority of South Africans, and suggest that these barriers are typical of many developing countries. Sobngwi et al. (2002) find a similar inverse relationship between walking and the level of urbanisation in Cameroon.

A well-known counter-example is the Agita São Paulo programme. It is a longstanding, multi-level, community-based physical activity intervention designed to reduce obesity and CVD in a large urban population (Matsudo et al. 2002). The programme's goals are to increase knowledge about the benefits of physical activity by 50%, and to increase physical activity by 20% in 10 years. Two aspects of the Agita São Paulo programme make it remarkable: the large scale and the multi-pronged intervention approach. Agita São Paulo targets the entire 35-million-person population of São Paulo state, with emphasis on

teenagers, the elderly and workers. The programme works through community organisations, mass media, government and non-governmental organisations, private industry and schools. The interventions include delivery of messages about physical activity, cultural mascots, attention to specific settings that provide opportunities for activity (especially dance, because it was particularly appealing to Brazilians), educational materials, education for health professionals, mega-community events such as parades and workplace activities, and appealing promotional materials.

Economic evaluation of the programme conducted in 2004 (World Bank 2005a) demonstrated that the programme is highly cost-effective, and in fact cost-saving when major health outcomes are considered. Modelling of the possible scale-up of the programme showed a cost-effectiveness result of \$247 per DALY saved. This implies that such a programme could be applied to a very large population – perhaps even on a national level – and still be cost-effective. One reason for the positive results for the Agita programme is a high level of participation. A random sample of homes showed that 56% recognised it after four years of implementation, and 55% of the sample participated in physical activities, with a much higher level of activity among those showing awareness of the programme.

5.4.4 Comprehensive community intervention

The effectiveness of community interventions depends heavily on two factors: the 'dose' of the intervention to which people are exposed and the consistency of the intervention, particularly if it is reinforced across different spheres of people's lives. In the case of education and information, the dose refers to the frequency and strength of exposure to the educational messages. For environmental interventions, it could mean how easily people come into contact with the healthier environment, such as stairs or improved food choices. Consistency is increased if similar healthy messages or environmental conditions are present at work and home for adults or school and home for children, and are not drowned out by advertising with contradictory messages or a less healthy environment.

The CORIS (Coronary Risk Factor Study) in South Africa found that community-based information and behaviour-change interventions were very effective in reducing overall chronic disease risk factors in the experimental communities at low cost. Evidence from the CORIS study is particularly valuable because of the experimental approach used, testing interventions at different levels of intensity in two communities with a third control community (Rossouw et al. 1993). The study suggests that a low-

cost, less-intensive education effort is just as effective as a higher-cost, more intensive programme if it is broad-based and comprehensive. In this instance, the interventions included public health messages in different delivery forms (including mass media and home mailings) and community activities, such as organised walks, public meetings, involvement of community-based organisations, free screening for blood pressure, small-group personal interventions and encouragement of food substitution in stores and restaurants.

5.4.5 Society-level interventions

The results of society-level interventions have been mixed, with the greatest success attributable to programmes with long-term, multi-sectoral, collaborative approaches that engage different parts of society – especially the public and private sectors together – and reinforce key messages through multiple outlets.

Changes in industrial processes to reduce unhealthy food components – such as the amount of trans fat or salt in manufactured food – can have a substantial impact on people's diets (although the effect depends on wider consumption habits and the ease of obtaining unhealthy substitutes). These changes can be implemented relatively quickly if the private sector and/or governments are supportive. For example, in Mauritius and Poland, changes in manufacturing processes appear to have reduced risk factors for chronic diseases (Zatonski et al. 1998).

Policy changes, including regulation of food content and marketing, smoking restrictions, dietary guidelines, transportation alternatives, and even trade policy, can all affect people's knowledge of and behaviour involving chronic disease risk factors. The full range of potential policy influences on behaviours and conditions that lead to chronic disease is almost unlimited, and includes zoning restrictions, tax policy, drinking-age laws, advertising prohibitions, and many others. Most of these have not yet been tested as interventions to prevent chronic diseases.

Fiscal approaches, such as taxing tobacco or subsidising exercise equipment, have been of limited use, but results from taxing tobacco are promising. Taxes on tobacco in high-income countries clearly reduced smoking and other tobacco use (Jha et al. 2006). Experts believe that even greater reductions in smoking could be achieved by imposing taxes in developing countries, because populations tend to be more responsive to price increases. Jha et al. (2006) modelled the cost-effectiveness of tax increases globally. The authors found that a 33%



price increase would reduce deaths from smoking by 22 million to 65 million – a figure equal to 5–15% of all deaths from smoking in 2000. Of the deaths averted, 80% would be male and the largest effect would be seen among the young, who are presumed to be more price-sensitive than older smokers. The cost-effectiveness of the 33% price increase would range from \$13 to \$195 per DALY averted across the world, with more favourable cost-effectiveness ratios coming from lower-income countries.



Not surprisingly, legislated measures are more cost-effective than voluntary measures due to greater compliance. In general, a combination of regulatory measures combined with mass-media campaigns achieves the greatest health gains for a given level of resources. The authors of a World Bank study in the Pacific Islands conclude that mass media education is cost-effective compared to secondary prevention of obesity if the intervention reaches a large enough population and if the prevalence of obesity and other targeted diseases is high (World Bank 2003).

A good example of CEA for societal interventions, based on extrapolated data and modelling, was carried out by Murray et al. (2003) using WHO data from 14 different regions. Four different types of society-wide chronic disease prevention interventions to lower blood pressure and reduce serum cholesterol were tested:

1. Health education through the mass media focusing on blood pressure, cholesterol concentration and body mass
2. Voluntary industry reduction in salt content of processed foods and labelling of salt content
3. Legislation requiring reduction in salt content of processed foods and labelling of salt content
4. A combination of (1) and (3).

The CHOICE programme at the WHO allowed the authors to compare the costs and effects of these interventions across regions.⁵⁵ Cost-effectiveness ratios are shown in Table 9 roughly according to country income.⁵⁶

The health effectiveness information used by Murray et al. has been the subject of criticism because it is based on very few studies which themselves differ significantly. Nonetheless, the authors assert that the health benefits are sufficiently large to support the cost-effectiveness conclusions, even with large margins of error taken into account.

Table 9 Cost per DALY saved for interventions to reduce blood pressure and serum cholesterol by country income group

Intervention	Cost per DALY saved (\$) by country group		
	Very low income	Low income	Medium income
Education and mass media	50–57	19–92	12–54
Voluntary salt reduction	26–30	10–92	6–27
Legislated salt reduction	34–78	14–114	9–14
Education and legislated salt reduction combined	31–48	31–48	7–23

Source Adapted from Murray et al. (2003)

Substantially higher costs per DALY averted are reported by Willett et al. (2006) for similar interventions across developing-country regions. The authors modelled the cost-effectiveness of several society-wide interventions, including sensitivity analysis. Thus, best-case (high effectiveness coupled with low costs) and worst-case (low effectiveness coupled with high costs) scenarios are provided. The costs per DALY averted from Willett's 'best-case' scenario are very similar to Murray's figures, although the authors examine somewhat different outcomes (coronary events in the former, and blood pressure and cholesterol in the latter). Both studies show the society-wide interventions to be extremely cost-effective if the costs of implementing the intervention are low.

5.4.6 Inferring cost-effectiveness from studies without actual costs


Emphasis is placed in this chapter on two risk factors for multiple chronic diseases – obesity and overweight and lack of physical activity – to make the point that many potentially effective interventions exist and patchy evidence suggests that some would also be cost-effective. Many studies have described the epidemiological trends in obesity and overweight in developing countries. Some have further described interventions that promise to reverse or ameliorate those trends. Few include results of applying the interventions to population groups (in part because such population-wide interventions are not amenable to randomised controlled trials) and fewer still include data on the costs of the interventions. However, there is some useful information contained in these studies that provide clues to the cost-effectiveness of interventions, or at least assertions based on expert experience and belief. This section draws from those to provide additional indications for reducing death and illness from lifestyle factors related to obesity and overweight.

Estimates of cost-effectiveness are extremely sensitive to a population's risk of mortality and



the size of the community at risk. Jha et al. (1998) examined 40 health interventions in Guinea, mostly unrelated to chronic diseases. The authors used actual costs and a combination of local and published information about the general efficacy of the interventions to estimate cost-effectiveness. If one accepts that costs to carry out some of the society-level interventions mentioned in this chapter are the same in a given country setting, regardless of the actual target disease, Jha's work implies that society-level interventions are likely to be cost-effective in all cases where disease prevalence and burden are high, and the intervention works.

For example, Jha et al. examined the cost-effectiveness of two population-wide regulatory actions to address public health problems: anti-tobacco legislation and warnings, and seatbelt legislation and fines. They determine that the cost per person is \$0.01 for both programmes and both are found to be reasonably cost-effective (at \$77 and \$80 per life saved, respectively). In these two instances, the risk of death from smoking or car accidents is low, therefore the health benefit of the intervention is assumed to be relatively low. On the other hand, AIDS education via the media is even less costly (\$0.005 per person) and its cost-effectiveness is among the best of the 40 interventions examined in the study (at \$12 per life saved) because – although the risk of death from AIDS is still low in the general population – the target population of the intervention is large.

 This example illustrates the sensitivity of cost-effectiveness estimates to the size of the target population, the risk of mortality from a specific disease, the actual costs of the intervention, and the time horizon of expenditures on the intervention compared to timing of the expected health benefit (a longer wait for health benefits makes the cost-effectiveness ratio less favourable because of discounting). **In the case of chronic disease risks, a gathering body of epidemiological evidence suggests that the size of target populations and the risk of mortality are growing in most developing countries.** In a survey of chronic disease trends in sub-Saharan Africa, Unwin et al. (2001) point out that age structure of a society is important in determining the relative risk of chronic disease, and that more people will be at risk in developing countries as populations age (in other words, the target population is growing). In addition, while percentages of total deaths from chronic diseases in the poorest countries are lower than in developed countries, mortality rates from chronic diseases are higher. This implies that the cost-effectiveness of population-based interventions in developing countries is likely to rise (Goldman et al. 1996).

5.5 Conclusions

The lack of cost-effectiveness studies for many chronic disease interventions in developing countries is a notable feature of any discussion of the economics of prevention. The costs of primary prevention are under-researched even in developed countries because of inherent biases in medical provision and research funding and the fact that private industries generally do not invest in prevention studies. The gap in the literature as it relates specifically to chronic disease in developing countries is due to several additional factors, including:

- newness of the appearance and awareness of certain chronic diseases in developing countries;
- for prevention in particular, a lack of potential profit for suppliers of the intervention;
- the multitude of possible interventions because of multiple health outcomes to examine;
- multi-sectoral sources of the problem complicate the design of possible solutions;
- few randomised clinical trials testing interventions.

These conditions are recalled here because they individually and collectively present serious obstacles to comparing cost-effectiveness of interventions addressing chronic diseases.

As a result of the breadth of possible actions countries could take, and the simultaneous lack of experience in taking action against chronic diseases, it is not feasible to single out specific interventions as the most cost-effective in developing countries. Unwin (2001) explains: 'There are no "off-the-shelf" interventions for changing lifestyle [that can be assumed to be effective within sub-Saharan Africa], or indeed any other low- or middle-income countries, when implemented.'

Over time, a consensus will point toward specific approaches that can be studied and perhaps even standardised in some ways. Until then, most of the data that can be drawn upon to select chronic disease interventions is partial, imperfect or merely suggestive.

In the meantime, chronic disease prevention can occur even without public health interventions. Municipalities can build more pedestrian and bicycle lanes by changing urban design plans. Companies can manufacture and market their products with different strategies. Agricultural policies that subsidise excess

production of unhealthy foods can be terminated. These possibilities raise important questions: How does one calculate the costs of each of these behaviour and policy changes? Do they cost nothing, or are they extremely costly in terms of lost freedoms, lost property values and lost market choices? How should these costs be counted? Evidence of any 'spin-off benefits' to society (for example, decisions to reduce children's television viewing could easily improve school outcomes as well as reduce childhood obesity) should be sought so that the costs of broad-based interventions can be put in perspective.

Although the evidence presented in this chapter is not robust, it is suggestive of favourable cost-effectiveness across a range of interventions and settings. Where cost-effectiveness can be achieved, the economic rationale for intervening to prevent chronic disease is completed. Continued study of the costs and health outcomes of interventions in different settings is called for, so that more robust cost-effectiveness results can be obtained and disseminated.

6. Further research needs and concluding remarks

This report has addressed several economic aspects of chronic disease, with a focus on developing countries and on prevention. The aim was to develop an overview of the *existing* knowledge, as published in the scientific literature or in reports by international organisations. Only very few prior attempts to do so have been made, and, hence, the concentration on a critical review of the available evidence was considered a necessary and useful first step before major new research efforts are undertaken.

Despite the insights gained on the basis of existing studies, there remain significant gaps in the evidence for essentially all the areas discussed. The following is a necessarily subjective list of proposed research priorities:

-  **1. The most common household surveys used by researchers do not routinely include a set of chronic disease or risk factor proxies** (e.g. Demographic and Health Surveys (DHS), Living Standard Measurement Surveys (LSMS), Multiple Indicator Cluster Surveys (MICS)⁵⁷). This has been a significant impediment to further in-depth research on many of the issues covered in this report. As chronic diseases already represent a sizeable health challenge in low- and middle-income countries (with important economic consequences – as indicated by much of the evidence presented here), there is ever less justification for these omissions in surveys undertaken to assess living conditions in those countries. The inclusion of such components into already well-established surveys would be a highly cost-effective way of filling in current research gaps.
-  **2. Better assessment and explanation of the within-country distribution of chronic disease risk factors by socioeconomic status is needed, particularly in low- and middle-income countries.** The availability of more surveys that can be matched with socioeconomic data would increase understanding of the patterns of risk-factor distribution, as well as assist with predicting future patterns. From a policy perspective, the ability accurately to anticipate the shape of the risk-factor burden will enable more reliable prevention efforts for the groups of society expected to be most at risk.⁵⁸
-  **3. More complete survey data will also improve assessments of the microeconomic impact of chronic disease and related risk factors, in particular if longitudinal datasets become increasingly available.** Properly accounting for causality was stressed throughout the report as an important component of studies that seek to inform policy development. In particular, the ability to determine causality addresses the following issues:
 - a more specific assessment of the link between medical expenditures for chronic disease treatment specifically (as opposed to medical expenditures in general) and their impoverishing effects;
 - a more complete assessment of the labour-market impact of chronic disease (which could be improved by enriching existing household surveys with chronic disease information);
 - a better understanding of how individuals and households cope with chronic diseases in order to maintain consumption levels – in particular, there is a need to understand whether some coping strategies are more costly than others, especially when viewed over the long term (it is important to note here that nationally representative studies are not the only way of addressing this issue, as more limited but potentially richer qualitative studies can offer a useful complement or alternative (see e.g. Russell 2005));
 - improved evidence as to how human-capital accumulation is affected by obesity and the consumption of addictive goods in youth.
-  **4. Determining the macroeconomic impact of chronic diseases in developing countries (and even in developed ones) remains a challenge, given the notorious difficulty of disentangling the factors driving economic growth.** Worthwhile alternatives to the growth regression approach described in section 3.3 include the attempt to more explicitly model and then calibrate the effects of chronic disease for a given country, or more qualitative approaches that discuss the sources of economic growth in a given country and the role that chronic disease may (or may not) have played in this context.
-  **5. Valuing the macroeconomic losses incurred by chronic disease with a broader measure than per-person GDP would explicitly recognise that the ‘true’ purpose of economic activity is to maximise social welfare.** This concept begins with the uncontroversial premise that GDP is an imperfect measure of social welfare: it fails to incorporate the value of health. One such broad approach is the willingness-to-pay (WTP) method, which makes it possible to determine an approximate monetary value for changes in mortality. Extending the approach to chronic diseases would be a fairly straightforward and instructive exercise (see e.g. WHO 2005 for an illustrative example), the results

of which may contribute to a new understanding of the importance of chronic disease.



6. To the extent that there continues to be a debate about whether governments are justified in intervening to prevent chronic disease, a thorough examination of potential market failures should be higher on the agenda than it currently is. Of the four potential market failures discussed in this report, there is a particular need for more tangible evidence on the type and size of externalities associated with risk factors in the developing country context because externalities – where they exist – are in principle the most widely accepted rationale for intervention. There also remains a need to further cement the empirical validity of ‘internalities’ in both poor and rich countries, and the extent to which they apply to factors responsible for obesity. Overall, the extent to which obesity is driven by existing market failures should also be on the research agenda.



7. Despite the available evidence on cost-effectiveness, there is an urgent need for more (and better) economic evaluations of interventions to prevent the growing chronic disease burden in developing countries. Unless there are proven ways of improving health, neither the presence of economic costs of chronic disease, nor the presence of market failures, will be sufficient fully to justify government action. Since cost-benefit and cost-effectiveness analysis require evidence of effectiveness as an essential input, there is first of all a need for carefully designed and conducted intervention trials in developing countries for chronic diseases. In addition to randomised controlled trials – the gold standard in intervention research – other types of effectiveness evaluations have to be applied. This is needed because many of the most effective preventive interventions are population-based, and are not amenable to testing by trials with randomised designs. Advanced and innovative evaluation techniques (e.g. propensity score matching) should be explored as a serious alternative to randomised trials so that observational studies can be evaluated (if certain quality criteria are observed). There is also a need to ensure more comparability across studies through more standardisation and better transparency of methods.



8. Given the evidence that the burden of chronic disease is shifting toward the poor in developing countries, interventions need to be evaluated for how well they succeed in actually reaching the poor. This remains a formidable challenge of health interventions more broadly (Gwatkin et al. 2005).

So far, little is known about how preventing chronic disease in developing countries affects different parts of society.

Inevitably, many important issues could not be covered within the limited scope of this report. For instance, this report did not explicitly include the growing and largely unrecognised problem of mental health in developing countries (see Frank and McGuire 2000 for an economic perspective on mental health, and Hyman et al. 2006 for a public health perspective on mental disorders in developing countries). Further, a detailed discussion of the economic *determinants* of chronic disease could not be included in the report. Knowing the determinants of chronic disease and related risk factors is important for targeting interventions, and for economically evaluating those interventions. (See Philipson 2001 for related work on obesity.) Ideally, both the consequences and determinants of chronic disease should be considered within one framework and, hence, in one report.

This report has also put strong emphasis on the role of *government* (especially in Chapter 4). The implicit assumption is that governments are in the position to effectively and efficiently implement recommended interventions. In many instances, especially where government capacity is weak (as is the case in many developing countries), this becomes a questionable assumption. The focus on government intervention should in no way downplay the potential need for or importance of a wide range of possible private-sector initiatives. Many, of course, already exist, although the bulk of these programmes are in developed countries (see for example the evidence on the economic and health success of workplace health promotion (Goetzl et al. 1999)). Nor should the potential for philanthropic action be under-estimated (see Quam et al. 2006 for a most recent initiative), even though thus far the bulk of private donor efforts has been almost exclusively directed towards communicable, perinatal and maternal conditions.

It is also important to emphasise that the focus on *prevention* rather than treatment should not be interpreted as a depreciation of the usefulness of medical treatment (or that of secondary prevention, which has not been dealt with extensively either). There is considerable scope to assess the potential for more and better medical care interventions to control and manage chronic disease in developing countries. However, the gaps in knowledge and evidence appear far greater in the realm of primary prevention, and the role of government (at least in research on prevention) is a particularly straightforward one (Kenkel 2000).

Finally, it has not been the intention of the paper to present the comparison between chronic disease and communicable disease as a choice between *either* one *or* the other. On the contrary, there are good reasons to suggest that a strict separation between the two is of limited use, and may even be counter-productive. Increasingly, both disease categories coexist in many developing countries. Perhaps the strongest example of such coexistence – and, hence, of the need to consider both health challenges as interrelated – is the increasing occurrence of both under- and overweight people in the same households (Doak et al. 2005). Similarly, at the level of the health system, more systematic approaches to illness – irrespective of specific diseases – could lead to successful, synergistic improvements in health worldwide.

It bears re-emphasising that there is substantial scope for expanding and strengthening the economic research on chronic disease, in particular for developing countries – a conclusion that is strongly confirmed by other recent work (Behrman et al. 2006). With a better understanding of chronic disease, the appropriate roles for government and the private sector, and the viability of interventions to prevent disease, should come more and better policy-making to improve the quality of life of millions of people worldwide. It is hoped that this report has been a first step in this direction.

Endnotes

- ¹ Exceptions are Leeder et al. 2004 and WHO 2005.
- ² It is important to distinguish between the risk factors as proximate causes of disease and death, and the more underlying causes – e.g. socioeconomic or environmental factors – affecting health outcomes either directly or indirectly via their influence on risk factors.
- ³ The project is an undertaking of the WHO, in conjunction with the World Bank and the Harvard School of Public Health, to estimate the total deaths and death rates (among other measures) for over 130 causes of death throughout WHO member nations. For more information see <http://www.who.int/healthinfo/bodproject/en/index.html> (accessed 30 September 2006).
- ⁴ It is important to bear in mind that the GBD data are estimates based on survey and vital registration data and, as such, have limitations (for example, the data for entire regions may be extrapolated from a single country if there is not data available for other nations in that region). In addition, in developing countries it is difficult to measure the adult health burden in general and due to chronic diseases in particular. The dramatic lack of relevant data in some places (for example, sub-Saharan Africa) may well contribute to an underestimation of the actual chronic disease burden in those areas. Vital registration systems are generally underdeveloped, if they exist at all. As a substitute source of health information, the national representative surveys carried out (mostly) with the support of international organisations typically focus on the assessment of child and reproductive health issues. A few of the main and fairly regular surveys carried out with the active support of international organisations include: Demographic and Health Surveys (DHS), Living Standard Measurement Surveys (LSMS), Reproductive Health Surveys (RHS) and Multiple Indicator Cluster Surveys (MICS). The fact that epidemiological information on chronic disease is limited in developing countries also severely limits the amount of research that can be done on the economic impact of chronic disease. The availability of country-specific survey data would allow a more detailed and accurate examination of the exact shape of the link between the level of economic development and disease profiles but, currently, such information is not available. In the face of these large gaps in the knowledge base, the GBD data is the best available for examining the overall burden of disease.
- ⁵ An alternative way of looking at the question would be by only considering the cause-specific shares of 'avoidable' or 'premature' mortality. This is done below in section 2.2. A further option would be to 'standardise' the level of cause-specific mortality in developing countries by the levels achieved in high-income countries (Smith 2006).
- ⁶ Available at www.who.int/ncd_surveillance/infobase (accessed 3 August 2006).
- ⁷ Available at <http://www.who.int/whosis/whostat2006/en/index.html> (accessed 8 September 2006).
- ⁸ Available at <http://www3.who.int/whosis/menu.cfm?path=whosis,topics,alcohol&language=english> (accessed 3 August 2006).
- ⁹ These results are consistent with the results from a widely regarded recent paper (Ezzati et al. 2005). This study in addition considers cross-country data on mean cholesterol levels in the population, but also on this indicator they fail to find a major wealth gradient.
- ¹⁰ While the findings discussed in the present paper are indirectly relevant for the more general debate about whether or not chronic disease should figure more prominently in the MDGs than it currently does, the issue is not specifically addressed here. For an in-depth examination in the context of the Eastern European and Central Asian countries, see Rechel et al. 2005.
- ¹¹ This result should be qualified by the fact that the data used by the World Bank comes from different surveys with different methodologies and definitions.
- ¹² The World Health Survey is a nationally representative household survey that was carried out by the WHO in 70 countries in 2002 in order to compile comprehensive baseline information on the health of populations; outcomes associated with investment in health systems; baseline evidence on the way health systems are currently functioning; and ability to monitor inputs, functions, and outcomes. For more information, see <http://www.who.int/healthinfo/survey/en/> (accessed 1 August 2006).
- ¹³ Although the observed patterns appear more straightforward for high-income countries, they are not without complication in this case either, especially when the data is further disaggregated by race (see e.g. Ayala et al. 2005).
- ¹⁴ Highly indicative of the fast-changing pattern of obesity within countries, the Monteiro et al. (2004) finding contrasts significantly with that of a much earlier literature review (Sobal and Stunkard 1989), which found a positive relationship between socioeconomic status for all 15 developing countries it reviewed.
- ¹⁵ Only limited data is available that shows the evolution of the poor/rich differences in chronic disease risk factors over time. Some data exists for tobacco consumption in high-income countries, for example for Norway (Lund et al. 1995) and Germany (Schulze and Mons 2006). This data tends to support the hypothesis referred to in the text.
- ¹⁶ To be more precise, the health improvement represents a net utility improvement, if the utility costs of achieving the improvement are less than the additional utility benefits gained through a longer life.
- ¹⁷ There is also a broader measurement of the macroeconomic effect (not covered here) that involves interpreting, and hence measuring more directly, the contribution of chronic disease-related health loss to social welfare (the utility of people considered in aggregate). See e.g. Nordhaus 2003. Utility gains from better health are considered by some to represent a 'true' economic gain, recognising that the purpose of economic activity is to maximise social welfare. See WHO 2005 for an initial application of the approach to the measurement of the welfare loss associated with chronic disease.
- ¹⁸ The costs associated with a disease or a behaviour can be measured either by the 'prevalence approach' (assessing costs at a single point in time) or the 'incidence approach' (assessing the costs over a lifetime). The former is by far the most common. The more data-extensive incidence or 'life-cycle' approach estimates the present value of the cost of adding a person to society who contracts a specific disease or takes up a certain unhealthy behaviour (Rice 1994). As such, it assumes a forward-looking view, which is useful for some important policy applications, such as for determining the optimal excise tax rate for cigarettes. The lifetime perspective also helps account for the mortality effects of unhealthy behaviours – a feature that the cross-sectional approach fails to capture, thereby commonly overstating the costs. If individuals die prematurely, this affects the participants in several public or private programmes, especially those for the elderly. (The fact that mortality influences the cash flow of these programmes is a factual matter, not a moral one!) Sloan et al. (2004) and Manning et al. (1991) have used the life-cycle approach. Another important parameter in measuring the costs of disease is whether the study uses an 'epidemiological' or an 'econometric' approach. The former apportions a fraction of overall medical costs to either a disease or a risk factor (using methods very similar to those that quantify mortality attributable to a specific disease or risk factor). The econometric approach uses regression analysis to quantify (direct and indirect) costs while controlling, to the extent possible, for other observable characteristics that are likely to affect cost and be correlated with the disease or the risk factor. Taking the example of smoking, this methodology in principle allows an assessment of the costs exclusively attributable to smoking – that is, for smokers who are identical to non-smokers in all but their smoking habit (the 'non-smoking smoker' or the 'counterfactual never smoker') (Sloan et al. 2004). The studies presented in Box 1, for instance, have used this increasingly popular approach.
- ¹⁹ This criticism applies specifically to the epidemiological approach of COI measurement, which becomes clear from the way the costs are derived. An estimate of the costs of hospitalisation directly related to, say, physical inactivity, is calculated by multiplying the following three components: the percentage out of each disorder that can be attributed to physical inactivity, the number of

hospitalisations by disorder, and the average cost per hospital stay. Attribution of the percentages is not always straightforward, particularly so for the attribution of a given disorder to a specific risk factor (Sindelar 1998).

- ²⁰ A further limitation – already mentioned in the text above – is the limited comparability of the results across different studies of the same disease/risk factor or across different diseases/risk factors. Although such comparisons are tempting, given the seemingly similar categories used, the details of each study in most cases differ too much to allow that (Godfrey 2004).
- ²¹ See e.g. Chale et al. 1992, Fall 2001, Neuhann et al. 2001, Savage 1994, Shobhana et al. 2000, Wilkes et al. 1997 and Yudkin 2000.
- ²² A further, increasingly applied alternative for capturing the poverty impact of healthcare spending is by calculating the difference between poverty estimates derived from household expenditures gross and net of out-of-pocket expenditures (see e.g. Wagstaff and Van Doorslaer 2003).
- ²³ One study on that examines medical expenditures after a dengue epidemic in a poor rural area of Cambodia finds out-of-pocket expenditures for medical care to often exceed 50% of yearly per-person income. Dengue is of course not a chronic disease, but interestingly – for the present purposes – the authors conclude that if these worrying effects occur ‘for a short episode of dengue fever, needing a relatively simple treatment, the picture will certainly be gloomier for chronic diseases’ (Van Damme et al. 2004).
- ²⁴ Other recent microeconomic studies relevant in the context of this section and not discussed in the text are Liu et al. 2003, Liu et al. 2006 and Wang et al. 2006b.
- ²⁵ If informal insurance worked well, there would be – in mainstream thinking – no specific rationale for formal insurance, as this would potentially crowd out well-functioning private market mechanisms.
- ²⁶ Gertler and Gruber (2002) make this important qualification: previous studies that largely seemed to find a remarkable ability of households to insure against disease commonly focused on the presence or occurrence of minor illness.
- ²⁷ There are a significant number of studies on the effects of ‘developing country diseases’ on the labour market from low- and middle-income countries, in particular malnutrition (see e.g. Strauss and Thomas 1998).
- ²⁸ 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.
- ²⁹ This collection of studies includes both chronic disease indicators and more traditional ‘developing country’ health indicators.
- ³⁰ See www.lh.at for background information on the survey.
- ³¹ For similar recent evidence from the European low- and middle-income countries see e.g. Favaro and Suhrcke 2006, Suhrcke et al. 2005a and Suhrcke et al. 2006.
- ³² Mothers who smoke may have unobserved characteristics, such as lower intelligence and poor unobserved health habits, so that studies that cannot control for those factors tend to overstate the role of smoking (Torelli 2000).
- ³³ In the United States, for instance, a study monitoring drug abuse by adolescents in 2004 found that 22% of 10th graders binge drank in the two weeks preceding the survey. Binge drinking was defined as having at least five drinks in a single episode (Johnston et al. 2005).
- ³⁴ In the present example, the observed correlation could, for example, arise from reverse causality if students drink as a way to cope with academic under-performance.
- ³⁵ 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 2001, Levine and Renelt 1992, Sachs and Warner 1995, Sachs and Warner 1997 and Sala-i-Martin et al. 2004.
- ³⁶ These include a persistent problem of multi-collinearity, the difficulty of disentangling symptoms from causes, a wide divergence from more robust microeconomic analyses, and the limited utility of results based on cross-country averages for inferring country-specific lessons. See Pritchett 2006 for a more extensive discussion of the limits of cross-country growth analytics.
- ³⁷ Although this section does not specifically address the equity justifications for public-policy intervention, it is clear that the traditional division between efficiency and equity in economics is at least partly misplaced, and may even be counterproductive, in the light of more recent evidence on potential ‘complementarities’ between the two (World Bank 2005b). This issue should be developed in further research. The present chapter also ignores the rationale for public intervention based on grounds of revenue generation, although this is a potentially important motivation, given that at least in principle ‘sin taxes’ could provide a double dividend by both improving population health and increasing fiscal revenues that can in turn be used to finance other public goods (see e.g. Abedian and Jacobs 2001 for an illustrative application to South Africa).
- ³⁸ Evidence on the cost-effectiveness of interventions is presented in Chapter 5. It should be noted here, however, that the cost-effectiveness of a given public intervention is not identical to it producing a net social welfare benefit. To assess this, a cost-benefit analysis would be needed. Yet, for a number of reasons discussed in Chapter 5, there are very few cost-benefit studies to evaluate health interventions. A further important issue not covered here is the possibility of government failure, as opposed to market failure.
- ³⁹ An exception is Lal et al. 2003, who have assessed the net economic welfare effects of taxation of cigarettes for five regions, including three developing countries: India, South Korea and South Africa. The study, financed by the tobacco industry, finds substantial economic welfare losses resulting from existing tobacco taxation in those countries. The study heavily criticises earlier World Bank estimates, which also assessed the welfare implications of tobacco and tobacco taxation, focusing on the welfare costs that derive from a lack of information instead of externalities (Peck et al. 2000).
- ⁴⁰ To be precise, the results depend on the discount rate applied to future pension and tax ‘savings’. The higher the discount rate (i.e. the less future external benefits are valued in today’s dollars) the lower the discounted external ‘benefits’ associated with smoking. Manning et al. (1991) used a discount rate of 5% instead of the generally assumed 3%, giving a net external cost estimate for smoking (see also Keeler et al. 1989).
- ⁴¹ Box 2 in Chapter 3 also compared the cost of different ‘poor health habits’. The studies reported in Box 2 considered total costs, while Manning et al. (1991) only looked at external ones.
- ⁴² There are empirical ways of assessing whether the assumption of a ‘unitary’ preference for a household describes decision-making in households sufficiently well. Perhaps the simplest is by assessing whether household income matters more for individual consumption than individual income does. The results in the literature are mixed (see e.g. Schultz 1990).
- ⁴³ This is not to overlook the relatively new and growing strand of economics that deals with the issue of ‘bounded rationality’. The term ‘bounded rationality’ is used to designate models of rational choice that take into account the limitations of both knowledge and cognitive capacity. Bounded rationality is a central theme in behavioural economics, and it is concerned with the ways in which the actual decision-making process influences the decisions that are eventually reached.

To this end, behavioural economics departs from one or more of the neoclassical assumptions underlying the theory of rational behaviour.

- ⁴⁴ Consumers are considered myopic if they ignore the effects of current consumption on future utility when they determine the optimal or utility-maximising quantity of an addictive good in the present. In technical terms, their discount rate is infinite. Some authors define myopic individuals as those that have a very high discount rate and attribute very little value to future consumption. In that definition, myopic behaviour can still be rational (as long as the discount rate does not become infinitely high).
- ⁴⁵ Two persistent difficulties in assessing the extent to which information about health risks matches the 'true' health risks are that the latter are ultimately unknowable, and that the state of scientific knowledge changes over time (Kenkel 2000). Therefore any assessment of people's information status can only occur relative to the current 'best consensus' among the independent scientific community.
- ⁴⁶ See Diethelm et al. 2005. For the effect of food promotion on the dietary or lifestyle behaviour of children, see also Hastings et al. 2003.
- ⁴⁷ This is a contradiction that might be resolved by knowing the precise questions people were asked. Viscusi's findings relied on the perceived risk in a hypothetical population of smokers, which may be different from the risks that smokers expect for themselves directly (which was the focus of Schoenbaum).
- ⁴⁸ This includes the role for government to engage in research about the health consequences of unhealthy behaviour. Many issues are only imperfectly understood, even on the scientific side. The history of smoking has shown how better research has improved and expanded the evidence about the health consequences of smoking. The surveillance of risk factors can also be considered to fall under the information production role of governments, given that private actors, left alone, could not coordinate to provide this service.
- ⁴⁹ Similar effects have materialised in other countries over the past decades (see Kenkel and Chen 2000 for an overview).
- ⁵⁰ 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'.
- ⁵¹ 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.
- ⁵² 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).
- ⁵³ No doubt the justification of paternalism based on time-inconsistency is a significantly more subtle and therefore more tempting one than that based on non-rational behaviour.
- ⁵⁴ Key words were chronic disease, non-communicable disease, obesity, physical activity, all jointly with cost-effectiveness, economic evaluation and cost-benefit. Articles since 1995 were searched.
- ⁵⁵ The population health effects are derived from modelling the results of randomised trials and/or meta-analyses of studies across specific population age and sex characteristics and known risk profiles. Further modelling is done to translate health effects into DALYs with and without the stated interventions.

(Murray et al. 2003 acknowledge that assumptions about behaviour changes are extrapolated from the scarce evidence that exists in a few developed-country settings and are conjectural.) Costs of implementing the interventions are derived from actual quantities and prices for each programme intervention as submitted by WHO programme staff in various parts of the world. Information about the specific types of costs allocated to each intervention was not provided. Costs are converted to 2001 PPP (purchasing power parity) dollars and discounted at 3% across the board.

- ⁵⁶ The country income groupings are converted from the mortality groupings presented in Murray et al. (2003) but do not perfectly correlate.
- ⁵⁷ For DHS, see www.measuredhs.com; for LSMS, see www.worldbank.org/lsmis; for MICS see www.childinfo.org.
- ⁵⁸ This is not to say that survey data is the only necessary information to assess socioeconomic inequalities in chronic disease. To some extent, more extensive use of existing vital registration and death certification data can also help fill gaps, at least as far as the monitoring of inequalities in chronic disease-related mortality is concerned. However, these systems are not widely in place in all developing countries.

References

- Abedian I and R Jacobs, 2001. 'Tobacco taxes and government revenue in South Africa', *Journal of Economic Studies* 28(6): 397-407.
- Ali Z, A Rahman and T Rahman, 2003. 'Appetite for nicotine: an economic analysis of tobacco control in Bangladesh', HNP Discussion Paper, Economics of Tobacco Control Paper No. 16. Washington DC: World Bank.
- Arrow KJ, 1963. 'Uncertainty and the welfare economics of medical care', *American Economic Review* 53(5): 941-973.
- Ayala GX, M Lewis, K Perreira and M Cohen, 2005. 'Gender differences in overweight and obesity-related behaviors among immigrant Latinos', *Obesity Research* 13: A156-A156.
- Baird J, D Fisher, P Lucas, J Kleijnen, H Roberts, and C Law, 2005. 'Being big or growing fast: systematic review of size and growth in infancy and later obesity', *British Medical Journal* 331: 929.
- Barcelo A, C Aedo, S Rajpathak and S Robles, 2003. 'The cost of diabetes in Latin America and the Caribbean', *Bulletin of the World Health Organization* 81: 19-27.
- Barro R, 1991, 'Economic growth in a cross-section of countries', *Quarterly Journal of Economics* 106(425): 407-443.
- Barro R, 1996. 'Health and economic growth', Pan American Health Organization (PAHO). Available at <http://www.paho.org/English/HDP/HDD/barro.pdf> (accessed 3 October 2006).
- Barro RJ and JW Lee, 1994. 'Sources of economic growth', *Carnegie Rochester Conferences Series on Public Policy* 40: 1-46.
- Barro R and X Sala-i-Martin, 1995. *Economic Growth*. New York: McGraw-Hill.
- Behrman J, 1988. 'Intrahousehold allocation of nutrients in rural India: are boys favored? Do parents exhibit inequality aversion?' *Oxford Economic Papers* 40(1): 32-54.
- Behrman J, J Behrman, and N Perez, 2006. 'Where should UNU-WIDER place their bets? Some considerations for prioritizing economic research on health and economic development'. Paper prepared for the UNU-WIDER conference on 'Advancing Health Equity', 29-30 September 2006, Helsinki.
- Benegal V, A Velayudhan and S Jain, 2000. 'Social costs of alcoholism: a Karnataka perspective', *NIMHANS Journal* 18 (1&2): 67.
- Bhargava A, DT Jamison, L Lau and C Murray, 2001. 'Modelling the effects of health on economic growth', *Journal of Health Economics* 20: 423-440.
- Bobak M, P Jha, S Nguyen and M Jarvis, 2000. 'Poverty and smoking', in *Tobacco Control in Developing Countries*. World Bank Development Group.
- Bogale T, DH Mariam and A Ali, 2005. 'Costs of illness and coping strategies in a coffee-growing rural district of Ethiopia', *Journal of Health, Population and Nutrition* 23: 192-199.
- Bonu S, M Rani, P Jha, DH Peters and S Nguyen, 2004. 'Household tobacco and alcohol use, and child health: an exploratory study from India', *Health Policy* 70: 67-83.
- Bonu S, M Rani, D Peters, P Jha and S Nguyen, 2005. 'Does use of tobacco or alcohol contribute to impoverishment from hospitalisation costs in India?' *Health Policy and Planning* 20: 41-49.
- Burton S, E Creyer, J Kees and K Huggins, 2006. 'Attacking the obesity epidemic: the potential health benefits of providing nutrition information in restaurants', *American Journal of Public Health* 96(9): 1669-1675.
- Busch SH, M Jofre-Bonet, TA Falba and JL Sindelar, 2004. 'Burning a hole in the budget. Tobacco spending and its crowd-out of other goods', *Applied Health Economics and Health Policy* 3(4): 263-272.
- Case A, A Fertig and C Paxson, 2005. 'The lasting impact of childhood health and circumstance', *Journal of Health Economics* 24: 365-389.
- Case AC and LF Katz, 1991. 'The company you keep: the effects of family and neighborhood on disadvantaged youths', National Bureau of Economic Research Working Paper No. 3705.
- Cawley J, 1999. 'Obesity and addiction'. PhD Dissertation, Department of Economics, The University of Chicago.
- Chale S, A Swai, P Mujinja and D McLarty, 1992. 'Must diabetes be a fatal disease in Africa? Study of cost of treatment', 304: 1215-1218.
- Chaloupka F and P Jha, 2000. *Economics of Tobacco: Tobacco Control in Developing Countries*. World Bank Development Group.
- Chatterji P and J DeSimone, 2005. 'Adolescent drinking and high school dropout', National Bureau of Economic Research Working Paper No. 11337.
- Chetty R and A Looney, 2006. 'Income risk and the benefits of social insurance: evidence from Indonesia and the United States', National Bureau of Economic Research Working Paper No. 11708.
- Chinese Academy of Preventive Medicine, 1997. *Smoking in China: 1996 National Prevalence Survey of Smoking Pattern*. Beijing: China Science and Technology Press.
- CMH 2001. *Macroeconomics and Health: Investing in Health for Economic Development. Report of the Commission on Macroeconomics and Health*. Geneva: World Health Organization.
- Cook PJ and MJ Moore, 1993. 'Drinking and schooling', *Journal of Health Economics* 12: 411-419.
- Cortez R, 1999. 'Salud y productividad en el Perú, Un análisis empírico por género y región', Working Paper Series R-363. Washington DC: OCE, Inter-American Development Bank.
- Costa-Font J and J Gil, 2004. 'Social interactions and the contemporaneous determinants of individuals' weight', *Applied Economics* 36: 2253-2256.
- Currie J and BC Madrian, 1999. 'Health, health insurance and the labor market' in O Ashenfelter and D Card (eds), *Handbook of Labor Economics*, Vol. 3, Chapter 50. Amsterdam: Elsevier Science BV.
- Cutler DM and EL Glaeser 2006. 'Why do Europeans smoke more than Americans?' NBER Working Paper No. 12124.
- Cutler DM, EL Glaeser and JM Shapiro, 2003. 'Have Americans become more obese?' *Journal of Economic Perspectives* 17(3): 93-118.
- Datar A and R Sturm, 2006. 'Childhood overweight and elementary school outcomes', *International Journal of Obesity* 30: 1449-1460.
- Deas D, P Riggs, J Langenbucher, M Goldman and S Brown, 2000. 'Adolescents are not adults: developmental considerations in alcohol users', *Alcoholism: Clinical and Experimental Research* 24: 232-237.
- DeBellis MD, DB Clark, SR Beers, PH Soloff, AM Boring, J Hall, A Kersh and M Keshavan, 2000. 'Hippocampal volume in adolescent-onset alcohol use disorders', *Journal of American Psychiatry* 157: 737-744.

- Delfino D and PJ Simmons, 1999. 'Infectious disease and economic growth: the case of tuberculosis', University of York Discussion Papers in Economics No. 1999/23.
- Dercon S, 2002. 'Income risk, coping strategies, and safety nets', World Bank Research Observer 17: 141–166.
- DeSimone J and A Wolaver, 2005. 'Drinking and academic performance in high school', National Bureau of Economics Research Working Paper No. 11035.
- Delisle H, 2002. 'Programming of chronic disease by impaired fetal nutrition. Evidence and implications for policy and intervention strategies', WHO Report. WHO/NHD/02.3. Geneva: World Health Organization.
- Diethelm P, J Rielle and M McKee, 2005. 'The whole truth and nothing but the truth? The research that Philip Morris did not want you to see', *The Lancet* 366(9479): 86–92.
- Dixon S, S McDonald and J Roberts, 2001. 'AIDS and economic growth in Africa: a panel data analysis', *Journal of International Development* 13(4): 411–426.
- Doak CM, LS Adair, M Bentley, C Monteiro, and BM Popkin, 2005. 'The dual burden household and the nutrition transition paradox', *International Journal of Obesity* 29(1): 129–136.
- Dranove D, 1998. 'Is there underinvestment in R&D about prevention?', *Journal of Health Economics* 17: 117–127.
- Easterly W and Levine R, 1997. 'Africa's growth tragedy: policies and ethnic divisions', *Quarterly Journal of Economics* 112: 1203–1250.
- Efroymsen D, S Ahmed, J Townsend, SM Alam, AR Dey, R Saha, B Dhar, AI Sujon, KU Ahmed and O Rahman, 2001. 'Hungry for tobacco: an analysis of the economic impact of tobacco consumption on the poor in Bangladesh', *Tobacco Control* 10: 212–217.
- Ernst M, E Moolchan and M Robinson, 2001. 'Behavioural and neural consequences of prenatal exposure to nicotine', *Journal of the American Academy of Child Adolescent Psychiatry* 40: 630–641.
- Espinosa J and C Hernández, 1999. 'Productividad de la inversión en salud de los hogares en Nicaragua', Working Paper Series R-362. Washington DC: OCE, Inter-American Development Bank.
- Esson K and SR Leeder, 2004. 'The Millennium Development Goals and tobacco control: an opportunity for global partnership', World Health Organization, Geneva. Available at: http://www.who.int/tobacco/publications/mdg_final_for_web.pdf (accessed 25 September 2006).
- Ezzati M, S Vander Hoorn, CM Lawes, R Leach, WP James and AD Lopez, 2005. 'Rethinking the "diseases of affluence" paradigm: global patterns of nutritional risks in relation to economic development', *PLoS Med* 2(5): e133.
- Faber M and HS Kruger, 2005. 'Dietary intake, perceptions regarding body weight, and attitudes toward weight control of normal weight, overweight, and obese Black females in a rural village in South Africa', *Ethnicity and Disease* 15: 238–245.
- Fall CH, 2001. 'Non-industrialised countries and affluence', *British Medical Bulletin* 60: 33–50.
- Favaro D and M Suhrcke, 2006. 'Health as a driver of economic development conceptual framework and related evidence for south-eastern Europe', in *Health and Economic Development in South-Eastern Europe*, WHO Regional Office for Europe and Paris, Council of Europe Development Bank: Copenhagen, chapter 4, 71–85.
- Financial Times* 2006. 'The state has no business with your plate', 3 September.
- Finkelstein E, I Flebelkorn and G Wang, 2003. 'National medical spending attributable to overweight and obesity: how much, and who's paying?' *Health Affairs* WS219–226.
- Foster A, 1995. 'Prices, credit markets, and child growth in low-income areas', *Economic Journal* 105(430): 551–570.
- Frank RG and TG McGuire, 2000. 'Economics and mental health', in AJ Culyer and JP Newhouse (eds), *Handbook of Health Economics*, Vol. 1B. The Netherlands: Elsevier Science BV, Chapter 16, 893–954.
- Frankenberg E, D Thomas and K Beegle, 1999. 'The real costs of Indonesia's economic crisis: preliminary findings from the Indonesia Family Life Surveys', Document No. DRU-2064-NIA/NICHD. Santa Monica, CA: RAND.
- Gallup JL and J Sachs, 2001. 'The economic burden of malaria'. Working Paper No. WG1:10. Commission on Macroeconomics and Health.
- Gaviria A and S Raphael, 2001. 'School-based peer effects and juvenile behaviour', *Review of Economics and Statistics* 83: 257–268.
- Gaziano TA, LH Opie and MC Weinstein, 2006. 'Cardiovascular disease prevention with a multidrug regimen in the developing world: a cost-effectiveness analysis', *The Lancet* 368: 679–686.
- Gertler P, 1999. 'Insuring the costs of illness', paper prepared for the Inter-American Development Bank Conference on social protection and poverty, Washington DC.
- Gertler P and J Gruber, 2002. 'Insuring consumption against illness', *American Economic Review* 92(1): 51–70.
- Gertler P, DI Levine, and A Ames, 2004. 'Schooling and parental death'. *The Review of Economics and Statistics* 86(1): 211–225.
- Godfrey C, 2004. 'The financial costs and benefits of alcohol', European Alcohol Policy Conference: Bridging the Gap', *The Globe* (1 & 2): 7–14.
- Goetzel RZ, TR Juday and RJ Ozminkowski, 1999. 'What's the ROI? – A systematic review of return on investment (ROI) studies of corporate health and productivity management initiatives', AWP's Worksite Health.
- Goldman L, A Garber, S Grover and M Hlatky, 1996. 'Task Force 6: Cost-effectiveness of assessment and management of risk factors', *Journal of the American College of Cardiology* 27: 1020–1030.
- Gottret P and G Schieber, 2006. *Health Financing Revisited: A Practitioner's Guide*. Washington DC: The World Bank.
- Gruber J, 2002. 'Smoking's "internalities"', *Regulation* 25(4): 25–57.
- Gruber J and B Koszegi, 2001. 'Is addiction "rational"? Theory and evidence', *Quarterly Journal of Economics* 116(4), 1261–1303.
- Gruber J and B Koszegi, 2002. 'A theory of government regulation of addictive bads: optimal tax levels and tax incidence for cigarette taxation. NBER Working Paper #8777.
- Gruber J and S Mullainathan, 2002. 'Do cigarette taxes make smokers happier?' National Bureau of Economic Research Working Paper No. 8872.
- GTSS Collaborative Group, 2006. 'A cross country comparison of exposure to secondhand smoke among youth', *Tobacco Control* 15(Suppl. II): ii4–ii19.
- Gwatkin DR, 2002. 'Who would gain most from efforts to reach the Millennium Development Goals for health? An inquiry into the possibility of progress that fails to reach the poor', HNP Discussion Paper. Washington DC: The World Bank.

- Gwatkin DR, A Wagstaff and A Yazbeck, 2005. *Reaching the Poor with Health, Nutrition, and Population Services: What Works, What Doesn't, and Why*. Washington, DC: The World Bank.
- Harder T, R Bergmann, G Kallischnigg and A Plagemann, 2005. 'Duration of breastfeeding and risk of overweight: a meta-analysis', *American Journal of Epidemiology* 162:397–403.
- Hardy LL, LA Baur, SP Garnett, D Crawford, KJ Campbell, VA Shrewsbury, CT Cowell and J Salmon, 2006. 'Family and home correlates of television viewing in 12–13 year old adolescents: the Nepean study', *International Journal of Behavioral Nutrition and Physical Activity* 3: 24, e-published ahead of print.
- Harris JE and BG López-Valcárel, 2004. 'Asymmetric social interaction in economics: cigarette smoking among young people in the United States, 1992–1999', National Bureau of Economic Research Working Paper No. 10409.
- Hastings GB, M Stead, L McDermott, A Forsyth, AM MacKintosh, M Rayner, C Godfrey, M Carahar and K Angus, 2003. 'Review of research on the effects of food promotion to children – final report and appendices'. Prepared for the Food Standards Agency. Available at http://www.ism.stir.ac.uk/pdf_docs/final_report_19_9.pdf (accessed 30 August 2006).
- Hay J, 1991. 'The harm they do to others: a primer on the external costs of drug abuse', in M Krauss and E Lazear (eds), *Searching for Alternatives: Drug Control Policy in the United States*. Stanford, CA: Hoover Institution Press.
- Hayden-Wade HA, RI Stein, A Ghaderi, BE Saelens, MF Zabinski and DE Wilfley, 2005. 'Prevalence, characteristics, and correlates of teasing experiences among overweight children vs. non-overweight peers', *Obesity Research* 13: 1381–1392.
- Hu TW and Z Mao, 2002. 'Effects of cigarette tax on cigarette consumption and the Chinese economy', *Tobacco Control* 11(2): 105–108.
- Hyman S, D Chisholm, R Kessler, V Patel and H Whiteford, 2006. 'Mental disorders', in D Jamison et al., *Disease Control Priorities in Developing Countries* (2nd edition). New York: Oxford University Press.
- Jacoby H and E Skoufias, 1997. 'Risk, financial markets, and human capital in a developing country', *Review of Economic Studies* 64(3): 311–335.
- Jamison D, 2006. 'Investing in health', in D Jamison et al., *Disease Control Priorities in Developing Countries* (2nd edition). New York: Oxford University Press, 3–36.
- Jha P and FJ Chaloupka, 1999. *Curbing the Epidemic: Governments and the Economics of Tobacco Control*. Washington, DC: World Bank.
- Jha P, FJ Chaloupka, J Moore, V Gajalakshmi, PC Gupta, R Peck, S Asma and W Zatonski, 2006. 'Tobacco addiction', in D Jamison et al., *Disease Control Priorities in Developing Countries* (2nd edition). New York: Oxford University Press, 869–886.
- Jha P, O Bangoura and K Ranson, 1998. 'The cost-effectiveness of forty health interventions in Guinea', *Health Policy and Planning* 13: 249–262.
- Johannsson E, SA Arngrimsson, I Thorsdottir and T Sveinsson, 2006. 'Tracking of overweight from early childhood to adolescence in cohorts born 1988 and 1994: overweight in a high birth weight population', *International Journal of Obesity* 30: 1265–1271.
- Johnston LD, PM O'Malley, JG Bachman and JE Schulenberg, 2005. 'Monitoring the future: national results on adolescent drug use: overview of key findings, 2004'. NIH Publication No. 05-5726. Bethesda, MD: National Institute on Drug Abuse.
- Jusuf A, A Gani, S Giriputro, A Hudoyo, A Bachtiar, F Harahap and D Anwar, 1993. 'Implikasi ekonomis kanker paru pada pekerja perusahaan' [Economic implications of lung cancer on workers], *Majalah Paru* 13(1): 2–8.
- Kabir A, A Rahman, S Salway and J Pryer, 2000. 'Sickness among the urban poor: a barrier to livelihood security', *Journal of International Development* 12: 707–722.
- Kan K and W-T Tsai, 2004. 'Obesity and risk knowledge', *Journal of Health Economics* 23: 907–934.
- Keeler EB, WG Manning, JP Newhouse, EM Sloss and J Wasserman, 1989. 'The external costs of a sedentary lifestyle', *American Journal of Public Health* 79: 975–981.
- Kenjro Y, 2005. 'Why illness causes more serious economic damage than crop failure in rural Cambodia', *Development and Change* 36: 759–783.
- Kenkel DS, 2000. 'Prevention', in AJ Culyer and JP Newhouse (eds), *Handbook of Health Economics*. The Netherlands: Elsevier Science BV, Vol. 1B, 1676–1720.
- Kenkel D and L Chen, 2000. 'Consumer information and tobacco use', in P Jha and F Chaloupka, *Tobacco Control in Developing Countries*. New York: Oxford University Press, 177–214.
- Kochar A, 2004. 'Ill-health, savings, and portfolio choices in developing economies', *Journal of Development Economics* 73: 257–285.
- Kral TVE, LS Roe and BJ Rolls, 2002. 'Does nutrition information about the energy density of meals affect food intake in normal-weight women?' *Appetite* 39: 137–145.
- Lal D, 2000. 'Smoke gets in your eyes: the economic welfare effects of the World Bank–WHO global crusade against tobacco', UCLA Department of Economics Working Paper No. 794.
- Lal D, H Kim, G Lu and J Prat, 2003. 'The welfare effects of tobacco taxation: estimates for 5 countries/regions', *Bilingual Journal of Interdisciplinary Studies* 13: 3–20.
- Lambert EV, I Bohlmann and T Kolbe-Alexander, 2001. 'Be active – physical activity for health in South Africa', *South African Journal of Clinical Nutrition* 14: S12–S16.
- Latner JD and AJ Stunkard, 2003. 'Getting worse: the stigmatisation of obese children', *Obesity Research* 11: 452–456.
- Leeder S, S Raymond, H Greenberg, H Liu and K Esson, 2004. *A Race against Time: the Challenge of Cardiovascular Disease in Developing Countries*. New York: Columbia University, The Earth Institute.
- Levine R and D Renelt, 1992. 'A sensitivity analysis of cross-country growth regressions', *American Economic Review* 82: 942–963.
- Liu Y, K Rao and WC Hsiao, 2003. 'Medical expenditures and rural impoverishment in China', *Journal of Population Nutrition* 21(3): 216–222.
- Liu Y, K Rao, TW Hu, Q Sun and Z Mao, 2006. 'Cigarette smoking and poverty in China', *Social Science and Medicine*, 5 September 2006, e-published ahead of print.
- Lund KE, A Roenneberg and A Hafstad, 1995. 'The social and demographic diffusion of the tobacco epidemic in Norway', in K Slama (ed.), *Tobacco and Health*. New York: Plenum Press, 565–571.
- Lundborg P, 2006. 'Having the wrong friends? Peer effects in adolescent substance use', *Journal of Health Economics* 25: 214–233.
- Mackenbach JP, 2005. 'Health inequalities: Europe in profile. An independent expert report commissioned by and published under the auspices of the United Kingdom Presidency of the European Union', October. Available at http://www.fco.gov.uk/Files/kfi/le/HI_EU_Profi/le,0.pdf (accessed 25 September 2006).

- Manning WG, EB Keeler, JP Newhouse, EM Sloss and J Wasserman, 1991. *The Costs of Poor Health Habits*. Cambridge, MA: London: Harvard University Press.
- Marshall M, 1999. 'Country profile on alcohol in Papua New Guinea', in L Riley and M Marshall (eds), *Alcohol and Public Health in 8 Developing Countries*. Geneva: World Health Organization, 115–133.
- Mathers CD, C Bernard, KM Iburg, M Inoue, D Ma Fat, K Shibuya, C Stein and N Tomijima, 2003. 'The Global Burden of Disease in 2002: data sources, methods and results'. GPE Discussion Paper No. 54. Geneva: World Health Organization. Available at <http://www.who.int/evidence>.
- Mathers CD and D Loncar, 2005. 'Updated projections of global mortality and burden of disease, 2002–2030: data sources, methods and results'. Geneva, World Health Organization (Evidence and Information for Policy Working Paper). Available at <http://www.who.int/healthinfo/statistics/bodprojections2030/en/index.html> (accessed 30 August 2006).
- Matsudo V, S Matsudo, D Andrade, T Araujo, E Andrade, LC Oliveira and G Braggion, 2002. 'Promotion of physical activity in a developing country: the Agita São Paulo experience', *Public Health Nutrition* 5(1A): 253–261.
- Molamu L and D MacDonald, 1996. 'Alcohol abuse among the Basarwa of the Kgalegadi and Ghanzi Districts in Botswana', *Drugs: Education, Prevention and Policy* 3: 145–152.
- Monteiro CA, MH D'A Benicio, WL Conde and BM Popkin, 2000. 'Shifting obesity trends in Brazil', *European Journal of Clinical Nutrition* 54(4): 342–346.
- Monteiro CA, EC Moura, WL Conde and BM Popkin, 2004. 'Socioeconomic status and obesity in adult populations of developing countries: a review', *Bulletin of the World Health Organization* 82(12): 940–946.
- Morduch J, 1995. 'Income smoothing and consumption smoothing', *Journal of Economic Perspectives* 9: 103–14.
- Murray CJ, J Lauer, R Hutubessy, L Niessen, N Tomijima, A Rodgers, C Lawes and D Evans, 2003. 'Effectiveness and costs of interventions to lower systolic blood pressure and cholesterol: a global and regional analysis on reduction of cardiovascular disease', *The Lancet* 361: 717–725.
- Murrugarra E and M Valdivia, 1999. 'The returns to health for Peruvian urban adults: differentials across genders, the life-cycle and the wage distribution', Working Paper Series R-352. Washington DC: OCE, Inter-American Development Bank.
- Musgrove P, 1996. 'Public and private roles in health: theory and financing patterns', Health, Nutrition and Population Discussion Paper. Washington DC: World Bank.
- Mvo Z, J Dick and K Steyn, 1999. 'Perceptions of overweight African women about acceptable body size of women and children', *Curationis* 22: 27–31.
- Narayan Venkat KM, P Zhang, AM Kanaya, DE Williams, MM Engelgau, G Imperatore and A Ramachandran, 2006. 'Diabetes: the pandemic and potential solutions', in D Jamison et al., *Disease Control Priorities in Developing Countries* (2nd edition). New York: Oxford University Press, 591–604.
- Neuhann HF, C Warter-Neuhann, I Lyaruu and L Msuya, 2001. 'Diabetes care in Kilimanjaro region: clinical presentation and problems of patients of the diabetes clinic at the regional referral hospital – an inventory before structured intervention', *Diabetic Medicine* 19: 509–513.
- Ng N, 2006. 'Chronic disease risk factors in a transitional country - The case of rural Indonesia'. Doctoral dissertation, Umeå University medical dissertations. Umeå University. Available at: www.diva-portal.org/umu/abstract.xsq?dbid=775 (accessed 30 September 2006).
- Nissinen A, X Berrios and P Puska, 2001. 'Community-based noncommunicable disease interventions: lessons from developed countries for developing ones', *Bulletin of the World Health Organization* 79: 963–970.
- Nordby K, RG Watten, RK Raanaas and S Magnussen, 1999. 'Effects of moderate doses of alcohol on immediate recall of numbers: some implications for informational technology', *Journal of Studies on Alcohol* 60: 673–678.
- Nordhaus W, 2003. 'The health of nations: the contribution of improved health to living standards', in M Moss (ed.), *The Measurement of Economic and Social Performance*. New York: Columbia University Press for the National Bureau of Economic Research.
- Norton EC, R Lindrooth and ST Ennet, 1998. 'Controlling for the endogeneity of peer substance use on adolescent alcohol and tobacco use', *Health Economics* 7: 439–453.
- O'Donoghue T and M Rabin, 2006. 'Optimal sin taxes', *Journal of Public Economics* 90(10-11): 1825–1849.
- Ofcom, 2006. 'Child obesity – food advertising in context: children's food choices, parents' understanding and influence, and the role of food promotions'. London: OfCom. Available at http://www.ofcom.org.uk/research/tv/reports/food_ads/ (accessed 9 September 2006).
- Parker S, 1999. 'Elderly health and salaries in the labor market.' Working Paper Series R-353. Washington DC: OCE, Inter-American Development Bank.
- Peck R, FJ Chaloupka, P Jha and J Lightwood, 2000. 'A welfare analysis of tobacco use' in P Jha and F Chaloupka (eds), *Tobacco Control in Developing Countries*. New York: Oxford University Press (for the World Bank and WHO), 131–151.
- Philipson T, 2001. 'The world-wide growth in obesity: an economic research agenda', *Health Economics* 10: 1–7.
- Popkin BM, S Horton and S Kim (2001). 'Trends in diet, nutritional status, and diet-related noncommunicable diseases in China and India: the economic costs of the nutrition transition', *Nutrition Reviews* 59(12): 379–390.
- Pritchett L, 2006. 'The quest continues', *Finance and Development* March: 18–22.
- Pronk NP, MJ Goodman, PJ O'Connor and BC Martinson, 1999. 'Relationship between modifiable health risks and short-term health care charges', *Journal of the American Medical Association* 282(23): 2235–2239.
- Prosser LA, AA Stinnett, PA Goldman, LW Williams, MGM Hunink, L Goldman and MC Weinstein, 2000. 'Cost-effectiveness of cholesterol-lowering therapies according to selected patient characteristics', *Annals of Internal Medicine* 132: 769–779.
- Puhl R and KD Brownell, 2001. 'Bias, discrimination, and obesity', *Obesity Research* 9: 788–805.
- Quam L, R Smith, and D Yach, 2006. 'Rising to the global challenge of the chronic disease epidemic', *The Lancet*, Comment, published online, 22 September, DOI:10.1016/S0140-6736(06)69422-1.
- Rechel B, L Shapo and M McKee, with The Health Nutrition and Population Group, Europe and Central Asia Region, The World Bank, 2005. 'Are the health Millennium Development Goals appropriate for Eastern Europe and Central Asia?' *Health Policy* 73(3): 339–351.
- Ribeiro R and J Nuñez, 1999. 'Productivity of household investment in health: the case of Colombia', Working Paper Series R-354. Washington DC: OCE, Inter-American Development Bank.
- Rice DP, 1994. 'Cost-of-illness studies: fact or fiction?' *The Lancet* 344: 1519–1521.

- Rodgers A, C Lawes, T Gaziano and T Vos, 2006. 'The growing burden of risk from high blood pressure, cholesterol, and bodyweight', in D Jamison et al., *Disease Control Priorities in Developing Countries* (2nd edition). New York: Oxford University Press.
- Rose E, 1999. 'Consumption smoothing and excess female mortality in rural India', *Review of Economics and Statistics* 81(1): 41–49.
- Rossouw J, P Jooste, D Chalton, E Jordaan, A Swanepoel and L Rossoew, 1993. 'Community-based intervention: the Coronary Risk Factor Study (CORIS)', *International Journal of Epidemiology* 22: 428–438.
- Russell S, 2005. 'Illuminating cases: understanding the economic burden of illness through case study household research', *Health Policy and Planning* 20(5): 277–289.
- Sachs JD and AM Warner, 1995. 'Economic reform and the process of global integration', *Brookings Papers on Economic Activity* 1: 1–95.
- Sachs JD and AM Warner, 1997. 'Sources of slow growth in African economies', *Journal of African Economies* 6(3): 335–376.
- Sala-i-Martin X, G Doppelhofer and RI Miller, 2004. 'Determinants of long-term growth: a Bayesian averaging of classical estimates (BACE) approach', *American Economic Review* 94(4): 813–835.
- Samarasinghe D, 1994. 'Alcohol policies – in poverty and in wealth', *Addiction* 89: 643–646.
- Savage A, 1994. 'The insulin dilemma: a survey of insulin treatment in the tropics', *International Diabetes Digest* 5: 19–20.
- Savedoff WD and P Schultz (eds), 2000. *Wealth from Health: Linking Social Investments to Earnings in Latin America*. Washington DC: Inter-American Development Bank.
- Saxena S, R Sharma and PK Maulik, 2003. 'Impact of alcohol use on poor families: a study from North India', *Journal of Substance Use* 8: 78–84.
- Schmidhuber J, 2004. 'The growing global obesity problem: some policy options to address it', *The Electronic Journal of Agricultural and Development Economics* 1(2): 272–290.
- Schmidhuber J and P Shetty, 2005. 'The nutrition transition to 2030. Why developing countries are likely to bear the major burden', *Acta Agriculturae Scandinavica, Section C – Economy Publisher*: 2(3-4): 150–166.
- Schoenbaum M, 1997. 'Do smokers understand the mortality effects of smoking? Evidence from the Health and Retirement Survey', *American Journal of Public Health* 87(5): 755–759.
- Schultz PT, 1990. 'Testing the neoclassical model of family labor supply and fertility', *The Journal of Human Resources* 25: 599–634.
- Schultz TP and A Tansel, 1997. 'Wage and labor supply effects of illness in Côte d'Ivoire and Ghana: instrumental variable estimates for days disabled', *Journal of Development Economics* 53(2): 251–286.
- Schulze A and U Mons, 2006. 'The evolution of educational inequalities in smoking: a changing relationship and a cross-over effect among German birth cohorts of 1921–70', *Addiction* 101(7): 1051–1056.
- Shobhana R, RP Rama, A Lavanya, R Williams, V Vijay and A Ramchandran, 2000. 'Expenditure on health care incurred by diabetic subjects in a developing country – a study from Southern India', *Diabetes Research & Clinical Practice* 48: 37–42.
- Sindelar JL, 1998. 'Social costs of alcohol', *Journal of Drug Issues* 28(3): 763–781.
- Single E, D Collins, B Easton, H Harwood, H Lapsley, P Kopp and E Wilson, 2003. *International Guidelines for Estimating the Costs of Substance Abuse* (2nd edition). Geneva: World Health Organization.
- Sloan FA, GP Ostermann, C Conover and DH Taylor Jr, 2004. *The Price of Smoking*. Cambridge, MA and London: MIT Press.
- Smith O, 2006. *NCDs and the Poor*. World Bank. Draft.
- Sobal J and AJ Stunkard, 1989. 'Socioeconomic status and obesity: a review of the literature', *Psychol Bull* 105(2): 260–275.
- Sobngwi E, JC Mbanya and NC Unwin, 2002. 'Physical activity and its relationship with obesity, hypertension, and diabetes in urban and rural Cameroon', *International Journal of Obesity-Related Metabolic Disorders* 26: 1009–1016.
- Stevens J, J Cai, ER Pamuk, DF Williamson, MJ Thun and JL Wood, 1998. 'The effect of age on the association between body-mass index and mortality', *New England Journal of Medicine* 338: 1–7.
- Strauss J and D Thomas, 1998. 'Health, nutrition and economic development', *Journal of Economic Literature* 36: 766–817.
- Strong K, C Mathers, S Leeder and R Beaglehole, 2005. 'Preventing chronic diseases: how many lives can we save?' *The Lancet* 366: 1578–1582.
- Stubenitsky K, JI Aaron, SL Catt and DJ Mela, 2000. 'The influence of recipe modification and nutritional information on restaurant food acceptance and macronutrient intakes', *Public Health Nutrition* 3: 201–209.
- Sturm R, 2002. 'The effects of obesity, smoking, and drinking on medical problems and costs', *Health Affairs* 21: 245–253.
- Suhrcke M and D Urban, 2006. 'Is cardiovascular disease bad for growth?' Mimeo, WHO European Office for Investment for Health and Development.
- Suhrcke M, L Rocco, M McKee, D Urban, S Mazzucco, and A Steinherr, 2005a. 'Economic consequences of non-communicable diseases and injuries in the Russian Federation'. Draft. Copenhagen, WHO Regional Office for Europe (forthcoming in Occasional Series, European Observatory on Health Systems and Policies)
- Suhrcke M, M McKee, R Sauto Arce, S Tsoolova and J Mortensen, 2005b. *The Contribution of Health to the Economy in the European Union*. Brussels: European Commission.
- Suhrcke M, L Rocco, and M McKee (forthcoming 2006). 'Health: a vital investment for economic development in Eastern Europe and Central Asia' (forthcoming in Occasional Series, European Observatory on Health Systems and Policies)
- Suhrcke M, A Vörk and S Mazzucco, 2006. 'The economic consequences of ill health in Estonia'. Copenhagen: WHO Regional Office for Europe. Available at www.praxis.ee/data/economic_consequences_of_ill_health_estonia_2.pdf (accessed 15 August 2006).
- Taras H and W Potts-Datema, 2005. 'Obesity and student performance at school', *Journal of School Health* 75: 291–295.
- Tin Su T, B Kouyaté and S Flessa, 2006. 'Catastrophic household expenditures for health care in a low income society: a study from Nouna district, Burkina Faso', *Bulletin of the World Health Organization* 84: 21–27.
- Torelli P, 2000. 'Maternal smoking and birth outcomes: a nonparametric approach.' Unpublished manuscript, UC Berkeley.
- Torelli P, 2004. 'Smoking, birth weight, and child development: evidence from the NLSY79.' Mimeo. Available at http://www.ocf.berkeley.edu/~paulto/smoke_bw_cd.pdf (accessed 15 August 2006).

- UK Cabinet Office, 2003. 'Alcohol misuse: How much does it cost?' Available at www.strategy.gov.uk/downloads/files/econ.pdf (last accessed 1 October 2006).
- Unwin N, P Setel, S Rashid, F Mugusi, JC Mbanya, H Kitange, L Hayes, R Edwards, T Aspray and KG Alberti, 2001. 'Noncommunicable diseases in sub-Saharan Africa: where do they feature in the health research agenda?' *Bulletin of the World Health Organization* 79: 947–953.
- US Department of Health and Human Services, 1994. *Preventing Tobacco Use Among Young People: A Report of the Surgeon General*. Atlanta, GA: US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.
- US Department of Health and Human Services, 2006. *The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General*. US Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Health Promotion, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.
- van Dam RM, WC Willett, JE Manson and FB Hu, 2006. 'The relationship between overweight in adolescence and premature death in women', *Annals of Internal Medicine* 145: 91–97.
- van Damme W, L van Leemput, I Por, W Hardeman and B Meesen, 2004. 'Out-of-pocket health expenditure and debt in poor households: evidence from Cambodia', *Tropical Medicine and International Health* 9(2): 273–280.
- van Doorslaer E, O O'Donnell and RP Rannan-Eliya, 2005. 'Paying out-of-pocket for health care in Asia: catastrophic and poverty impact'. EQUITAP Project Working Paper #2.
- Viscusi WK, 1992. *Smoking: Making the Risky Decision*. Oxford: Oxford University Press.
- Viscusi WK, 1999a. 'Public perception of smoking risks. Valuing the cost of smoking: assessment methods, risk perception and policy options', in C Jeanrenaud and N Soguel (eds), *Studies in Risk and Uncertainty Valuing the Cost of Smoking: Assessment Methods, Risk Perception and Policy Options*. Boston, MA: Kluwer Academic Publishers, 151–164.
- Viscusi WK, 1999b. 'The governmental composition of the insurance costs of smoking', *Journal of Law and Economics* 42: 574–609.
- Wagstaff A, 2005. 'The economic consequences of health shocks', World Bank Policy Research Paper No. 3644. Available at <http://ssrn.com/abstract=757386> (accessed 29 September 2006).
- Wagstaff A and E Van Doorslaer, 2003. 'Catastrophe and impoverishment in paying for health care: with applications to Vietnam 1993-98', *Health Economics* 12: 921–934.
- Wang H, SH Busch and JL Sindelar, 2006a. 'The impact of tobacco expenditure on household consumption patterns in rural China', *Social Science and Medicine* 62(6): 1414–1426.
- Wang H, L Zhang and W Hsiao, 2006b. 'Ill health and its potential influence on household consumptions in rural China', *Health Policy* 78: 167–177.
- Weil DN, 2005. 'Accounting for the effect of health on economic growth'. NBER Working Paper #11455.
- Whitaker RC, JA Wright and MS Pepe 1997. 'Predicting obesity in young adulthood from childhood and parental obesity', *New England Journal of Medicine* 337: 869–873.
- WHO, 2005. *Preventing Chronic Diseases: A Vital Investment*. Geneva: World Health Organization.
- Wilkes A, Y Hao, G Bloom and G Xingyuan, 1997. 'Coping with the costs of severe illness in rural China', Institute of Development Studies Working Paper 58. Available at <http://www.ids.ac.uk/ids/bookshop/wp/wp58.pdf> (accessed 30 August 2006).
- Willett W, J Koplan, R Nugent, C Dusenbury, P Puska and T Gaziano, 2006. 'Prevention of chronic disease by means of diet and lifestyle changes', in D Jamison et al., *Disease Control Priorities in Developing Countries* (2nd edition). New York: Oxford University Press.
- Williams J, LM Powell and H Wechsler, 2003. 'Does alcohol consumption reduce human capital accumulation? Evidence from the College Alcohol Study', *Applied Economics* 35: 1227–1239.
- World Bank, 2003. 'Noncommunicable diseases in Pacific Island countries: disease burden, economic cost, and policy options.' New Caledonia: The World Bank.
- World Bank, 2005a. *Addressing the Challenge of Non-communicable Diseases in Brazil, Latin America and the Caribbean Region*. Washington DC: The World Bank.
- World Bank, 2005b. *World Development Report 2006: Equity and Development*. Washington and New York: The World Bank and Oxford University Press.
- Xu K, DB Evans, K Kawabata, R Zeramdini, J Klavus and CJL Murray, 2003. 'Household catastrophic health expenditure: a multicountry analysis', *The Lancet* 362: 111–117.
- Yach D, C Hawkes, C Linn Gould and KJ Hofman, 2004. 'The global burden of chronic diseases: overcoming impediments to prevention and control', *JAMA* 291: 2616–2622.
- Yudkin JS, 2000. 'Insulin for the world's poorest countries', *The Lancet* 355: 919–921.
- Zatonski WA, AJ McMichael and JW Powles, 1998. 'Ecological study of reasons for sharp decline in mortality from ischaemic heart disease in Poland since 1991', *British Medical Journal* 316(7137): 1047–1051.

