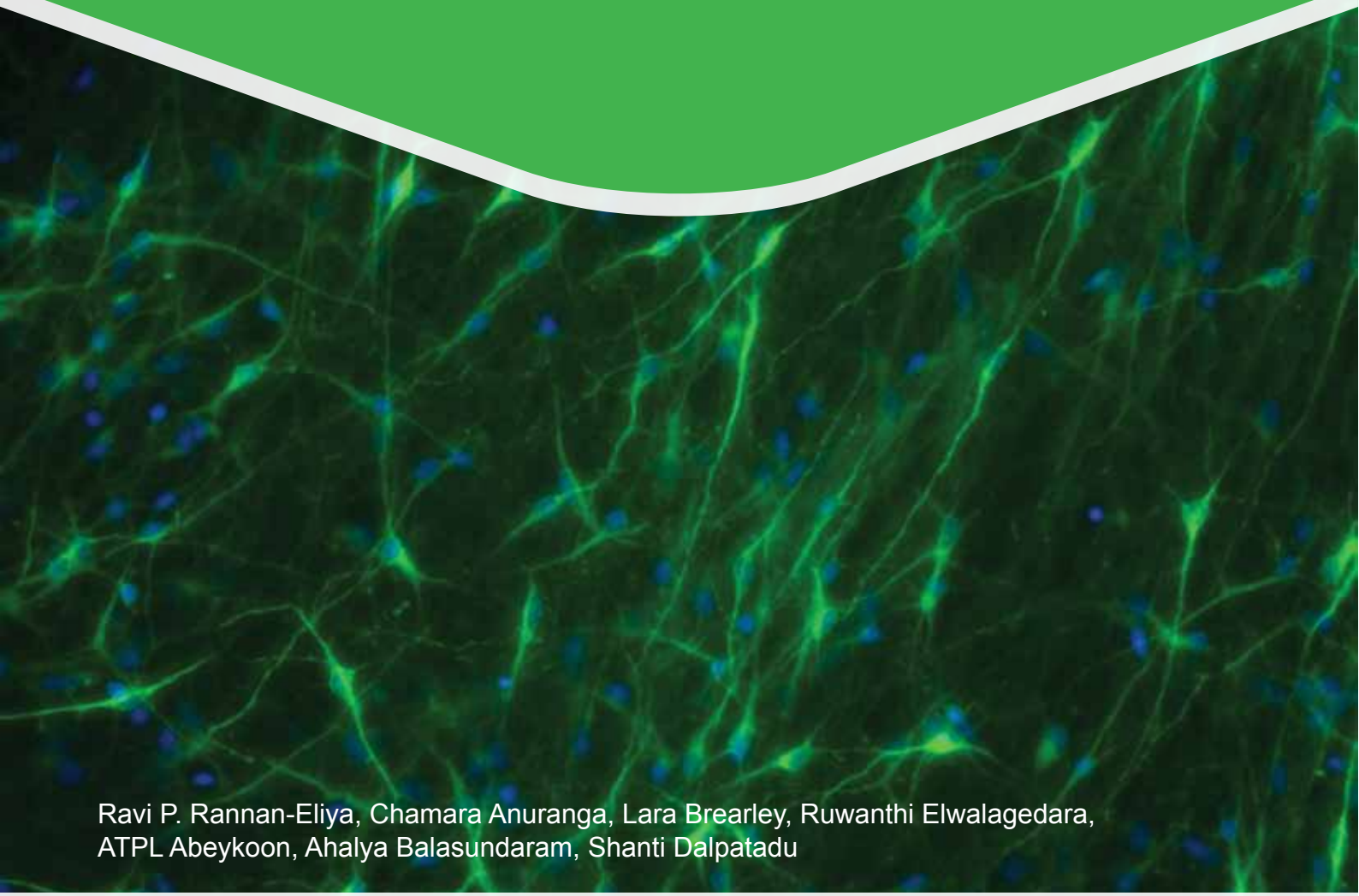
An Assessment of the Burden, Issues and Policy Options in Curative Care Services Delivery and Non-communicable Diseases in Sri Lanka

March 2010



Ravi P. Rannan-Eliya, Chamara Anuranga, Lara Brearley, Ruwanthi Elwalagedara, ATPL Abeykoon, Ahalya Balasundaram, Shanti Dalpatadu

IHP Technical Report Series, Number 1

IHP
INSTITUTE FOR HEALTH POLICY

An Assessment of the Burden, Issues and Policy Options in Curative Care Services Delivery and Non-communicable Diseases in Sri Lanka

Final Report

March 28, 2010

Ravi P. Rannan-Eliya, Chamara Anuranga, Lara Brearley, Ruwanthi Elwalagedara, ATPL Abeykoon, Ahalya Balasundaram, Shanti Dalpatadu

Institute for Health Policy

Colombo, Sri Lanka

http://www.ihp.lk

IHP Technical Report Series, Number 1

Contents

List of Tables

List of Figures

Acknowledgements

The World Bank commissioned this study, and we express our gratitude for its funding which made possible this important study. The study could not have been undertaken without also the support and cooperation of several government agencies, as well as researchers at Colombo University. We wish to thank the assistance of the Ministry of Healthcare and Nutrition, the Registrar General's Department, the Department of Census and Statistics and the Medical Statistician for their generosity in sharing data and making available necessary information, as well as facilitating the work. We also thank the many officials, particularly at the NCD Unit and the Planning Directorate who provided advice and feedback on the preliminary findings. We also thank Dr. P. Katulanda and his team at the University of Colombo for making available data from the SLDCS 2005, and for working with us on a number of important analyses of this survey.

In addition, we wish to mention the funding support of a number of other sponsors, who have funded a number of activities at the Institute for Health Policy, upon which this study draws upon. The Ministry of Healthcare and Nutrition funded the Public Facility Survey 2006 from which the estimates of drug availability in three districts are drawn. WHO funded the pilot Sri Lanka Disease Accounts project, from which were obtained the estimates of financing for major NCD disease groups. Finally, IDRC, through its sponsorship of the Equitap research collaboration, is funding the ongoing analysis of mortality data in Sri Lanka to develop estimates of socioeconomic differentials in mortality.

Abbreviations and symbols

BOD	Burden of Disease
CABG	Coronary Artery Bypass Graft
DALY	Disability Adjusted Life Year
DDD	Defined Daily Dosage
DSD	Divisional Secretariat Division
GDP	Gross domestic product
IHD	Ischaemic heart disease
LDL	Low-density lipoprotein
MOH	Medical Officer of Health
MOHN	Ministry of Healthcare & Nutrition
NCD	Non-communicable disease
OECD	Organization of Economic Cooperation and Development
PHIDS	Public Hospital Inpatient Discharge Survey
RGD	Registrar General's Division
SES	Socio-economic status
SLDCS	Sri Lanka Diabetes and Cardiovascular Survey
TB	Tuberculosis
WHO	World Health Organization

Executive Summary

1. Sri Lanka has made enormous health gains in the past half a century. These have enabled it to improve the health of its population faster than almost any other developing country, and to achieve health outcomes approaches those of developed countries. This has been achieved though reliance on public financing to expand access to basic medical services, as well as effective preventive health services. With this approach, Sri Lanka has eliminated the bulk of mortality from infectious diseases and from maternal and health problems.

2. As a consequence of these health gains, Sri Lanka's population is ageing, and will age rapidly in the years to come. In addition, as other diseases have been reduced, non-communicable diseases (NCDs) have emerged as the predominant cause of mortality, led by ischaemic heart diseases (IHD), cancers, other cardiovascular diseases, asthma and diabetes.

3. Despite being a developing country with many risk factors for NCDs still being low or increasing, the absolute risks of dying from NCDs are already higher in Sri Lanka than in developed nations. The disparities are most substantial for IHD and asthma. This is because in developed countries, mortality rates from NCDs, especially IHD, have been reduced in the past three decades at a rapid rate, whilst in Sri Lanka this has not occurred. Consequently, there is an increasing gap in performance in improving life expectancy between Sri Lanka and developed countries, and most of this is due to stagnation in older adult male mortality. The experience of other countries indicates that if Sri Lanka is to maintain its performance in improving overall health outcomes, it will need to follow the developed countries by achieving substantial reductions in NCD mortality.

4. Risk factors for NCDs in Sri Lanka range from still being low (e.g., hypertension, physical inactivity, smoking), to moderate (e.g., obesity) to high (e.g., dyslipidaemias). Most can be expected to increase in coming years. However, high mortality rates from NCDs appear to be the result not of high levels of risk factors, but the systematic under-treatment of most major NCDs. This is most marked in the case of asthma, where the mortality rate in Sri Lanka appears to be one of the highest in the world.

5. Overall mortality in Sri Lanka is higher in urban and wealthier areas. This pattern is unusual, but long standing. Mortality from NCDs is consistent with this pattern, with most NCD mortality rates increasing with socioeconomic status. This profile of mortality and risk factors increasing with socioeconomic status differs significantly with that in developed countries, where NCDs are increasingly concentrated in the poor. However, the data for Sri Lanka and the Maldives, which is epidemiologically closely related to Sri Lanka, point to the possibility that this may be changing, with future NCD mortality risks beginning to be concentrated amongst the poor. This increases the importance of NCDs in any future pro-poor health policy.

6. The main explanation for improving NCD mortality rates in developed countries has been the expansion of cost-effective treatments for many NCDs, in particular IHD, asthma and diabetes. These diseases account for the bulk of mortality that can be considered amenable through appropriate healthcare, and differences in rates of reduction in amenable mortality explain much of the difference in improvements in life expectancy in developed countries in recent decades. In the case of IHD, WHO recommends a small number of cost-effective medicines, which should be used primarily as secondary prevention to prevent

future disease in high-risk people. However, the supply and use of these medicines in Sri Lanka is far below needed levels, and this is likely to be a major reason behind Sri Lanka's poor performance in NCDs.

7. In the Sri Lankan context, NCDs are mostly managed by specialist clinics in the public sector. Primary healthcare facilities are neither equipped nor expected to manage chronic NCDs. This concentration of services in higher-level facilities is a major source of dissatisfaction amongst patients, owing to resultant difficulties in access. In addition, the public sector purchases inadequate quantities of the needed medications and medical supplies for chronic NCD care. Consequently, many patients either incur large financial costs in purchasing needed tests and medicines for their treatment, or they go without.

8. Comparison of consumption levels in Sri Lanka and OECD countries shows that overall consumption of NCD medicines in Sri Lanka is for the most part far below the levels one would expect given its NCD disease burdens. The experience of OECD countries as well as Sri Lanka's is that consumption and use of these medicines will only increase significantly with increased public financing to purchase these medicines. However, because of its ability to purchase most medicines at prices far less than those paid in the private sector, the cost to the public sector of increasing the supply of most NCD medicines to OECD levels would not only be affordable, but would also reduce the financial burden on households who would pay less in necessary taxes than they currently do purchasing the medicines privately. These results indicate that the public sector shoul take the lead role in purchasing and supplying cost-effective NCD medications, which are currently purchased in adequate quantities owing to lack of budgetary financing.

9. Analysis of recent survey data show that expanding coverage of the population with the cheapest treatments for IHD combined with adoption of international recommendations on screening to identify eligible patients based on assessment of overall risk would save over forty thousand lives in the next decade, and would have as a large, if not larger, an impact as the most optimistic expectations from other preventive health strategies. These interventions would also be pro-poor, as the marginal benefits will be greatest for those in the poorest households who currently lack access to treatment. These results indicate that Sri Lanka should supplement a strong preventive healthcare response to NCDs with a strong effort to provide all Sri Lankans who need it with cost-effective NCD treatments.

10. However, improving the curative care response to NCDs will involve more than simply purchasing more medicines. The current healthcare system was designed and remains largely structured to provide acute, episodic care for limited illnesses, or hospital care for serious sickness. Population ageing and the increase in chronic NCDs calls for development of an integrated primary care system that can provide continuity and coordination in care of a large percentage of the population.

11. Global experience indicates that systems with strong primary health care are more likely to give greater attention to the management of people with chronic conditions and to obtain better results. Sri Lanka's primary care system has served it well, but Sri Lanka now needs to redesign this to provide the care needed to manage the challenges of increasing NCDs. In doing this, it will need to maintain and build upon its tradition of public financing of healthcare.

Chapter 1: Introduction

1.1 Country background

12. The Democratic Socialist Republic of Sri Lanka is situated off the southern coast of India. With an estimated population of 20.2 million in 2008, Sri Lanka's population has grown almost eight-fold since its first national census in 1871. During the 1960s and 1970s, the country experienced rapid population growth owing to high birth rates and falling mortality. However, since the 1990s, population growth has slowed considerably as overall fertility trends have fallen to below replacement level. Owing to past population momentum, the Sri Lankan population still continues to grow (population growth rate ~0.9%), but this is expected to cease within two decades, after which the population may contract and will certainly age rapidly (De Silva, 2007).

13. The population of Sri Lanka is not evenly distributed, with some parts of the island being very densely populated, while others are less so. Until this decade, the level of urbanization in Sri Lanka remained low, with only one fifth of the population living in urban areas. However, industrialization and a migration of people in search of employment has led in recent years to increasing urbanization, concentrated in the south-western region around Colombo. Colombo is the smallest of the island's 25 districts, but has the highest population density, which is 11 times the national average (322 persons per square kilometre). Urbanization, economic changes in the nature of employment, and rising incomes and trade liberalization are causing much change in the lifestyles of the people in Sri Lanka, with impacts seen in dietary habits, the levels of physical activity, employment and travel.

14. Sri Lanka's experience is consistent with global evidence of the significant positive impact of democracy on population health (Govindaraj and Rannan-Eliya, 1994). The single most important reason why Sri Lanka's health and social trends differ from the rest of South Asia was the early introduction of democratic rule based on universal suffrage in 1931, just two years after this was attained in the United Kingdom, and almost two decades before the rest of South Asia. Although Sri Lankans already benefited in the 1920s from a high level of civil liberties and civic rights as was the case in most British Crown Colonies, it was the introduction of a political system that made government accountable to the people, and not to those outside Sri Lanka, that made the fundamental difference in enabling Sri Lankans to practically realise the benefits of their legal rights and through that to address the problems of sickness and ill-health. The role of Sri Lanka's democratic politics as the formative agent in its health development is important to understand and emphasize in any discussion of how Sri Lanka will respond to the problems ageing and non-communicable disease. It helps to explain the slowing of progress in recent decades, but also provides grounds for optimism about the likelihood of faster improvement in the coming years.

15. As a direct consequence, after 1931 Sri Lanka invested significantly in the social sector, with particular emphasis on expanding universal access to education and healthcare, through public financing and provision of universal basic education. As a result, overall literacy rates and access to primary and secondary education are high. However, limited resources were invested in tertiary education, resulting in restricted provision of tertiary education, which has been a recurring cause of social tensions. An important outcome, nevertheless, of this investment in education has been high levels of social mobilization and receptivity by Sri Lankans to health education messages.

16. Sri Lanka has prioritized access to health services since the 1930s. A consistent national policy that has emphasized universal access to public sector delivered healthcare services through public financing has been exceptionally successful in ensuring that almost all the population have good access to medical care, and high levels of use of curative and preventive services, despite limited national resources (Rannan-Eliya and Sikurajapathy, 2008). The World Bank recognizes Sri Lanka's approach to healthcare financing and delivery as being an example of global best practice for developing countries (Gottret, Schieber, and Waters, 2008). Integrated public financing and delivery of healthcare services, education and investments in a minimum level of food security have been the major factors behind a high level of life expectancy and generally good health indicators, which are better than other countries at a similar level of development (Caldwell, 1986). In combination with substantial declines in fertility since the 1970s, these have led to a process of rapid demographic ageing (World Bank, 2008).

17. Since the 1980s, further evolution of Sri Lanka's health and social policies was stalled by the debilitating impact of its internal conflicts, which subjected its democratic system and its health services to a prolonged assault unparalleled in any functioning democracy in recent decades. Two major insurgencies, by the JVP and LTTE groups, left quarter of a million Sri Lankans dead and more than two million displaced, as well as creating serious cleavages in society. These substantially slowed the country's economic and social gains, and diminished the space for debate about significant improvements in its health system. In addition, they significantly imperilled the survival and responsiveness of its political system that had been the motor of social policy, because the many years of insurgency and the necessary military response by the state inevitably diminished the rights of all Sri Lankans.

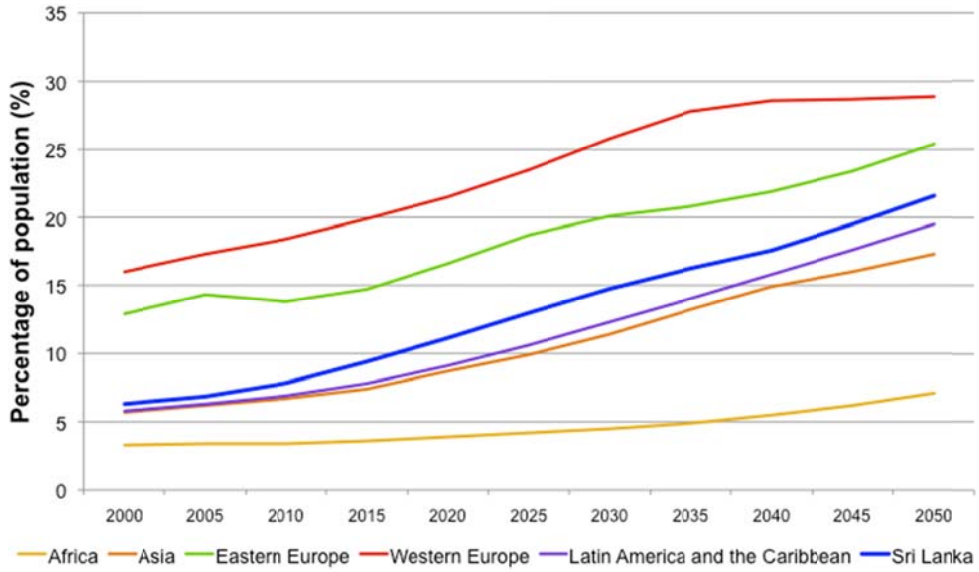
18. The ending of conflict in 2009 has, as expected by Sri Lankan observers, created significant new opportunities for the country not only to accelerate economic and social development, but also to strengthen the rights of its people and its democratic system, and through that to re-engage with its health and social challenges. Consequently, the next few years represent an opportune time for reshaping Sri Lanka's health policies and health system to meet the emerging problems of ageing and NCDs. Furthermore, given the increased sensitivity of the political system to social needs that will be inevitable with the ending of conflict, the political feasibility is likely to increase for increasing public investments in the health and social sectors.

1.2 Demographic and health trends

Population ageing

19. The most important feature of Sri Lanka's current and future demography is population ageing, due to its past rapid fertility decline and the increase in life expectancy. By 2001, life expectancy had reached 72.3 years, and the total fertility rate had declined to 2.0, which is below replacement level. Although the most recent Sri Lanka Demographic and Health Survey (SLDHS) for 2006/2007 found an increased fertility rate of 2.3, it is not evident that this indicates a major change in underlying trends, since the period covered by the SLDHS was dominated by a semi-ceasefire between the Government of Sri Lanka and the LTTE, and the increased fertility rate may have been a delayed fertility response that emerged owing to the cessation in conflict. Even if it does represent a real increase in fertility, as opposed to a transient event, this would still not be large enough to alter the dynamics of ageing in Sri Lanka substantially.

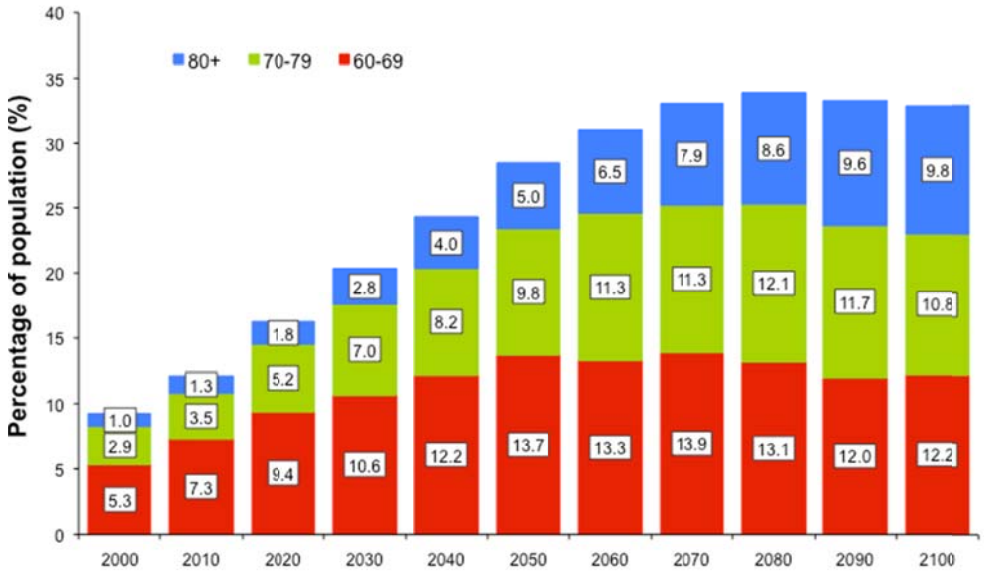
20. Sri Lanka is one of the fastest aging countries in the world. The share of the population over 60 years old in 2001 was 9.2%, which exceeded the average of all regions in the world, except OECD countries, Eastern Europe and the former Soviet Union. In the coming decades, the population will age faster than in almost all other developing countries, with the percentage of the population aged more than 65 years more than doubling by 2035 to 16.2%, a level comparable to Western Europe today (Figure 1). This rate of change is notably many times faster than was experienced by the developed economies, most of which experienced this level of ageing over periods of more than a century.



Source: De Silva (2007) for Sri Lanka; UN Population Division (2009) for other regions.

Figure 1: Growth in percentage of population aged 65 years and more, Sri Lanka and world regions, 2000-2050

21. An important feature of Sri Lanka's demographic aging is a process of aging of the old people, as the oldest old people aged more than 80 years, who are the ones most likely to be frail and dependent, will increase from one tenth of the old people population to almost one third. By 2050, the 80+ year age group will account for more than 5% of the overall national population, and represent more than one million Sri Lankans (Figure 2). The growth in this age group will pose challenges not only for health policy, but also social policy, as these Sri Lankans are likely to need extensive provision of long-term care and other services.



Source: De Silva, WI. June 2007. A Population Projection of Sri Lanka 2001-2101: Trends and Implications. IHP. Sri Lanka.

Figure 2: Share of the old people age groups, Sri Lanka 2001-2100

Health trends and gaps

22. Sri Lanka's overall health performance is undeniably superior to other comparable developing countries. In aggregate terms, whether it is overall life expectancy, or child mortality, or morbidity from diseases such as malaria or TB, Sri Lanka performs better than all or almost all other countries with similar income levels. Furthermore, despite having achieved superior health indices as early as the 1960s, it has continued since then to improve most of these at rates more rapid than most other developing countries. For example, the annual percentage rates of decline in child mortality or maternal mortality remain amongst the highest in the developing world. This performance is likely to be bolstered as the end of the three decades conflict enables reconstruction and expansion of healthcare services in the eastern and northern areas of the country.

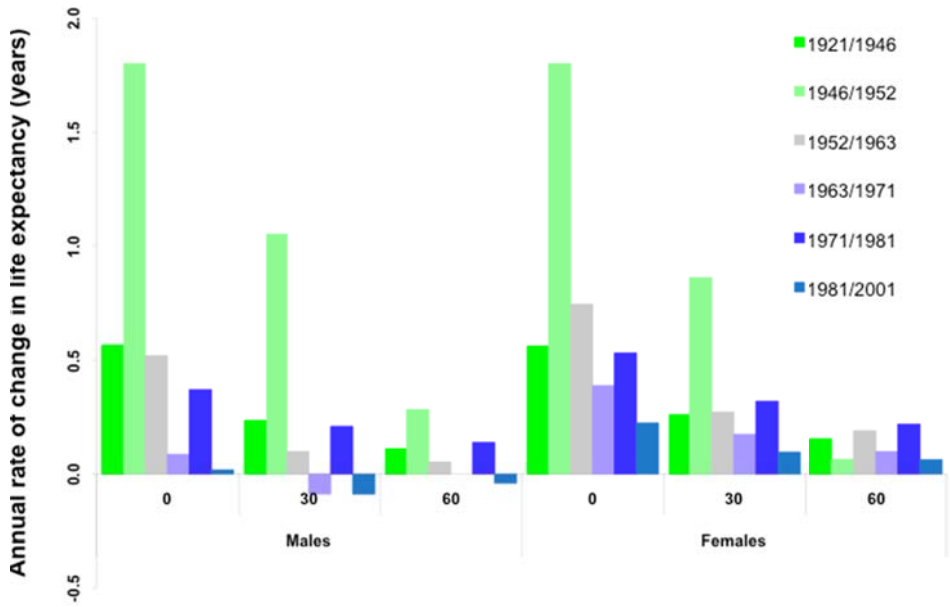
23. These achievements are well known within Sri Lanka's health policy community, and this knowledge is an important part of the context in which policy has traditionally been discussed. However, they mask the seriousness of several significant and long-standing, negative trends in Sri Lanka's health indicators. These trends have been known to demographers since at least the 1970s (United Nations Economic and Social Commission for Asia and the Pacific, 1976; United Nations, 1982), but there has been little awareness of these within the health sector, and consequently almost no discussion about their implications for future health policy. These trends are explored further in the next section.

Mortality trends and the problem of adult mortality

24. During the early part of the twentieth century, health conditions in Sri Lanka were poor and worse than in many parts of India (Langford and Storey, 1993). Sri Lanka's good health status today is the consequence of gradual improvements that started in the 1930s, and

then rapid improvements from the late 1940s (Rannan-Eliya and Sikurajapathy, 2008). However, these gains in life expectancy have not been uniformly distributed or sustained since the 1960s. Figure 3 depicts the changes in life expectancy at different ages in both sexes during the last century in Sri Lanka. Life expectancy for females has increased continuously since the 1920s, and has involved gains in all age groups, although the rates of increase have slowed since the 1980s. In contrast, life expectancy at birth (age zero) for males has shown little improvement since the 1980s, after significant gains until the 1970s. However, this minimal improvement in life expectancy at birth since the 1980s reflects a combination of both improving and deteriorating performance. Although mortality rates in children have improved, these have been accompanied by actual declines in male life expectancy at ages 30 and 60 years.

25. These trends have resulted in a substantial male-female gap in life expectancy at birth of almost 9 years (De Silva, 2007), which is one of the largest in the world. This is more than the 4-6 years seen in Europe and North America, but still smaller than the 13 years gap in the Russian Federation.

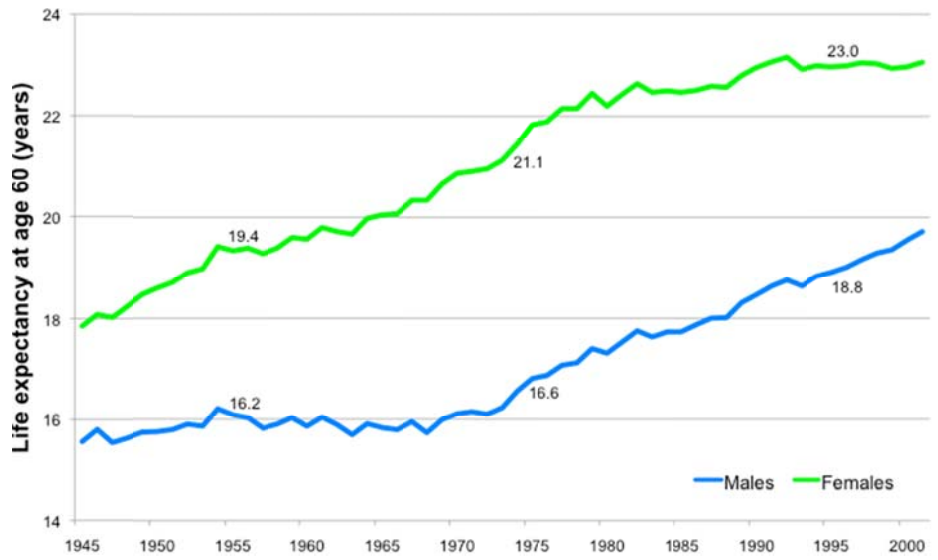


Source: Sarkar (1951), Department of Census and Statistics (1970), De Silva (2007), Gunasekera (2008) and authors computations from the same sources.

Figure 3: Annual rates of change in life expectancy at ages 0, 30 and 60 years, by sex, Sri Lanka 1921-2001

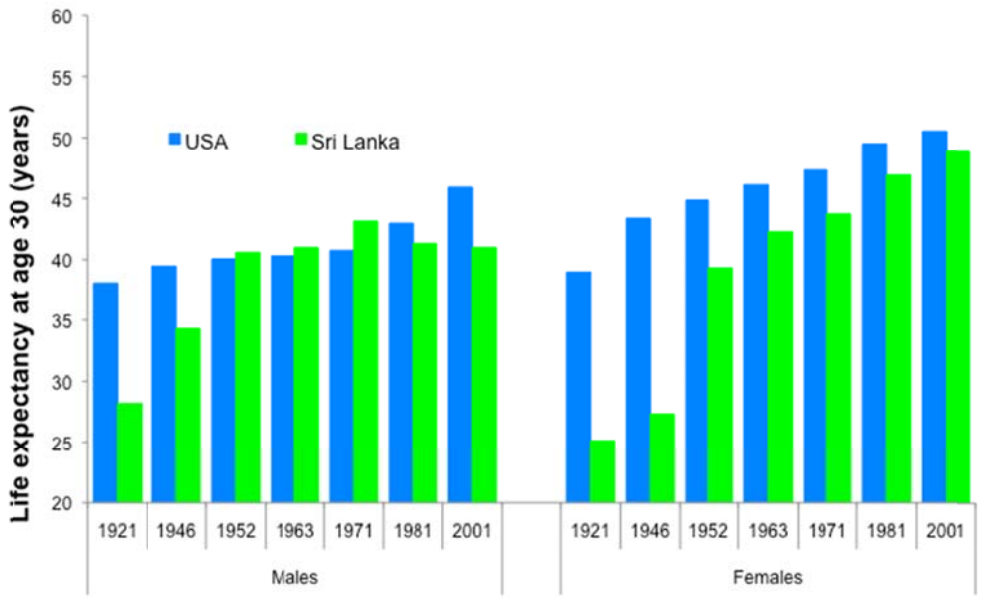
26. Although the improvement and then stagnation in adult male mortality rates was observed by Sri Lankan demographers in the 1970s, it was not explored further. However, this lack of improvement in adult male mortality rates once a certain level of life expectancy was achieved is not unique to Sri Lanka. Although a similar pattern was subsequently noted as occurring in Malaysia at similar levels of life expectancy in the 1970s (United Nations, 1982), Sri Lanka may have been the first developing country where this was reported. This phenomenon of stagnation for 20 years in older male mortality in parallel with continuing increases in female life expectancy also occurred in advanced economies. In the USA, older

adult male life expectancy stagnated from 1955, but unlike in Sri Lanka, it eventually improved from the mid-1970s, and has since kept pace with female life expectancy (Figure 4). The US experience provides important clues to the Sri Lankan situation.



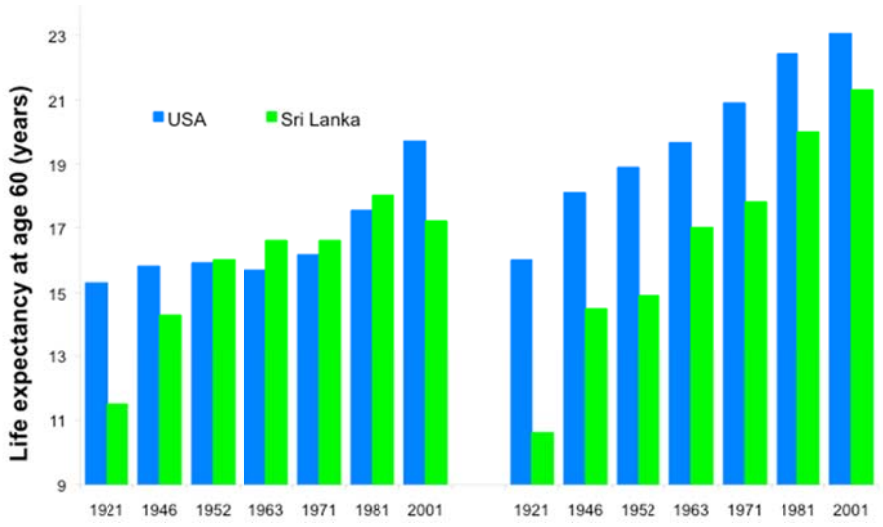
Source: Bell and Miller (2005)

Figure 4: Life expectancy at age 60, USA 1945-2001



Source: Sri Lanka from Sarkar (1951), Department of Census and Statistics (1970), De Silva (2007), Gunasekera (2008) and authors computations from the same sources, and USA from Bell and Miller (2005).

Figure 5: Changes in life expectancy at age 30 years, Sri Lanka and USA, 1921-2001



Source: See previous figure.

Figure 6: Changes in life expectancy at age 60 years, Sri Lanka and USA, 1921-2001

27. Figure 5 and Figure 6 compare the trends in life expectancy at ages 30 and 60 years in both men and women in USA and Sri Lanka since the 1920s. In the case of Sri Lankan women, the history is initially of a large gap in life expectancy in the 1920s, and then rapid gains in the 1940-50s to narrow the gap with the USA to less than 4 years by the 1950s, and then sustained, slower increases which have gradually further reduced the gap with the USA. The story with adult men is somewhat similar, with older adult male life expectancy in Sri Lanka actually catching-up with the levels in USA by the 1960s, and to some extent even surpassing them, before likewise stagnating. The critical difference is that in the mid-1970s after a twenty-year delay, mortality rates in older adult men in USA began to fall, and life expectancy started again to improve keeping pace with women, whilst in Sri Lanka this improvement has not materialized.

28. The reasons why adult male health improved, then stagnated, and finally improved again in the USA are reasonably well understood. The initial improvements in both male and female mortality in developed countries in the first half of the twentieth century were primarily due to reductions in mortality from infectious disease. Then in many of these countries, there was a slow down in mortality improvements in the 1950s-80s, owing to the persistence of mortality from non-communicable disease (NCDs), and in particular cardiovascular disease, which affects males more than females. The peaking of the smoking epidemic in the 1940s-50s was a key contributor. However, starting in the 1970s, declines in smoking and then the increasing impact of medical therapies and interventions for cardiovascular disease led to older adult mortality falling in both sexes in USA and other developed nations. Since cardiovascular disease accounts by far for the largest share of older adult mortality, these reductions in cardiovascular mortality are the principle driver today of increasing older adult life expectancy in the advanced economies (Cutler and Meara, 2001).

29. We speculate that the reason why Sri Lanka was able to match the USA in adult male life expectancy in the 1960s-70s was a combination of exceptional, for a developing country, health system effectiveness in reducing mortality from infectious disease, and the good fortune of not suffering from a significant mortality handicap due to smoking, since smoking rates remained much lower than in most developed nations. Yet, when cardiovascular mortality rates began to fall in the developed world in the 1970s, Sri Lanka was not able to keep up with these mortality improvements, largely because of its inability to apply the new medical therapies to reduce NCD mortality, and in particular cardiovascular mortality.

30. To fully establish the reasons why older male mortality in Sri Lanka has continued to stagnate since the 1960s, unlike in OECD nations, requires a more detailed analysis to quantitatively decompose the changes in life expectancy in Sri Lanka by disease and age, and to compare these to trends in the advanced economies whose life expectancy indicators were so similar to those in Sri Lanka in the 1960s. Such an analysis is critically needed for the period since the 1960s, since there do not appear to be comparable analyses for any other developing countries, from which findings could be generalized. Sri Lanka is almost unique amongst lower-income developing economies in having the detailed historical mortality data required to do this, but it would require resources beyond those available for this study.

31. Despite the lack of such an analysis, the evidence is compelling that Sri Lanka suffers from a comparatively high burden of mortality from NCDs. This is clear from comparison of mortality rates from the major NCDs in Sri Lanka with those in other countries, which is explored further in the next chapter.

Chapter 2: NCD burden and trends

2.1 Contribution of NCDs to overall mortality

Approach to assessing disease burden

32. To assess the relative disease burden of NCDs in Sri Lanka, we use mortality. This is because mortality is the only reliable metric for Sri Lanka that can be used to compare all diseases, since reliable morbidity data are lacking as in most countries.

33. We note, as have others (Jayasinghe, Mendis, and Lie, 2002), that there are frequent calls by international observers to use Disability Adjusted Life Years (DALYs) to assess disease burden in Sri Lanka. However, we do not use DALYs to assess disease burden in Sri Lanka for three reasons. The principle practical reason is that the computation of DALYs requires the availability of high quality data on an extensive range of disease parameters, including short-term and long-term health impacts, and the impact of a disease on both mortality and daily life. These are particularly important in the case of chronic NCDs. Such data are difficult to obtain even in OECD countries, including the canton of Geneva, the home of WHO (Schopper et al., 2000), thus requiring the extensive use of imputations in most DALY estimations. The World Bank's own burden of disease (BOD) study in Sri Lanka has concluded that reliable estimation of DALYs is not feasible for Sri Lanka owing to the almost complete lack of morbidity data, and that mortality data would suffice adequately. The study authors reported that (Wijewardene and Spohr, 2000):

> "*Most of the values presented here are uncertain, as data on duration of illness, degrees of disability and age of onset were estimates. State hospital inpatient data available were not comprehensive enough to assess the incidence, age of onset and duration of disability of most of the common diseases in Sri Lanka. The health statistics do not indicate the health problems of people who do not seek health care and those who seek treatment from other sources . . . Data are not collected from [sic. private sector] sources in Sri Lanka when computing national health statistics. There are also no records maintained at the outpatient departments of government hospitals to assess the outpatient morbidity . . . Another drawback is calculating incidence rates for the total population without using age specific rates . . . This study is the first attempt at quantifying BOD for Sri Lanka with available data, which, however, were not adequate for accurate calculation.*"

34. The authors of the World Bank BOD study ended with a plea that "the study indicates the need to improve existing health statistics." However, since that time, there has been no improvement in the health statistics available in Sri Lanka, nor any significant investment in information systems to track disease morbidity. In the absence of any tangible change in data availability, there is currently no basis to use DALYs as an objective measure of disease burden in Sri Lanka, if the goal is to inform evidence-based policy.

35. The second reason that we do not use DALYs is that the Global Burden of Disease unit that estimates the WHO-published DALY estimates admits that it has not had access to or used even the past decade of mortality data in Sri Lanka (Lopez, 2008), giving grounds for considerable doubt of the reliability and validity of GBD DALY estimates for Sri Lanka and other regional countries, and their superiority over the mortality data actually available in Sri Lanka. This is a critical issue since most national DALY estimations inevitably rely extensively on the GBD DALY estimates for the relevant region for imputation when data are lacking, and in the Sri Lankan context such imputations would be necessary for

estimating DALYs for most diseases. It is also noted that the official WHO estimates of DALYs in Sri Lanka provide a breakdown of the causes of death in Sri Lanka in 2002 (http://www.who.int/whosis/mort/profiles/mort_searo_lka_srilanka.pdf), which bear no relation to the actual statistics (Table 1), confirming our assessment that the DALY statistics do not reflect actual data, even on mortality.

36. Finally, we note that DALYs incorporate a set of controversial value judgements, which are both logically inconsistent and arbitrary in nature (Anand and Hanson, 2005), and which have not been shown to be consistent with the values and preferences of Sri Lankans. This is a serious deficiency given that Sri Lankan researchers have previously pointed out that the cost-effectiveness paradigm for which DALYs were developed contradicts the core motivations that influenced the development of Sri Lanka's health system (Rannan-Eliya and de Mel, 1997; Jayasinghe, Mendis, and Lie, 2002), and given the importance of rights and equity motivations in shaping overall health policy in the country.

Mortality pattern and trends

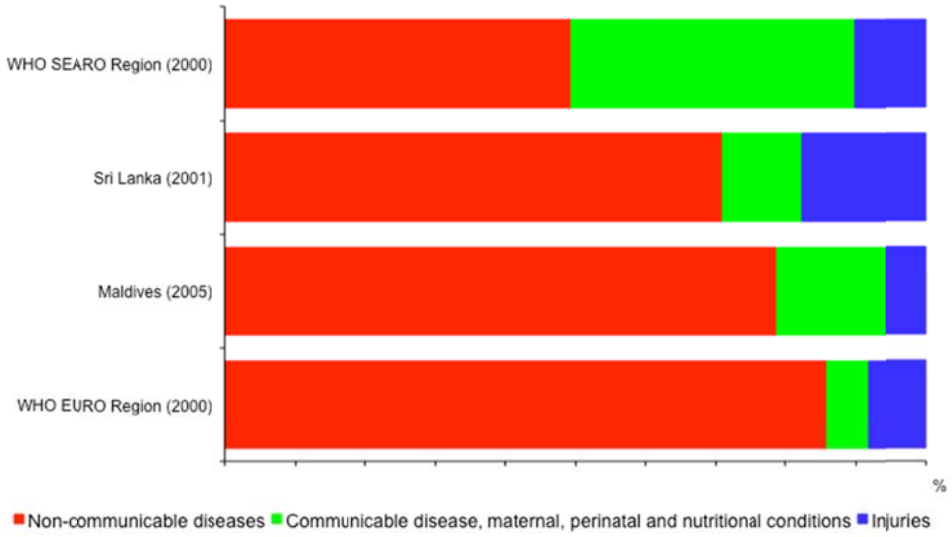
37. The mortality data indicate that NCDs are the predominant disease burden in Sri Lanka, representing the leading cause of deaths. Past reductions in mortality in Sri Lanka have come largely from the decreases in deaths from infectious disease and maternal and neonatal conditions (Table 1). At the same time, NCD mortality has increased its share. In 1945, cardiovascular disease and diabetes accounted for 3.5% and 0.5% of all deaths, but this had increased to 10.0% and 2.4% respectively by 2001. By 2001, NCDs accounted for 71% of all deaths, compared with 18% due to injuries, and 11% due to communicable disease, maternal and perinatal conditions (Figure 7). The overall structure of mortality in Sri Lanka is more akin to that in Europe than to the rest of South Asia, excepting Maldives (Figure 7). Within NCDs, heart disease (35%), cancers (12%), cerebrovascular conditions (6%) and diabetes (5%) were the leading causes in 2001.

Table 1: Composition of deaths in Sri Lanka by major causes, 1945 -2003

Cause of deaths	% Deaths				
	1945	1960	1980	2000	2003
Infectious, parasitic and respiratory diseases	23.6%	13.7%	5.6%	11.1%	12.2%
Dysentery, all forms	1.4%	0.7%	0.1%	0.5%	0.4%
Tuberculosis of respiratory system	2.3%	1.5%	1.3%	0.9%	0.9%
Typhoid	1.0%	0.2%	0.1%	0.0%	0.0%
Malaria	6.0%	0.1%	0.2%	0.2%	0.0%
Pneumonia	6.5%	6.9%	3.4%	1.9%	2.2%
Bronchitis	1.0%	1.0%	2.2%	3.4%	4.0%
Cancer	0.6%	2.6%	5.7%	6.8%	7.6%
Disease of the circulatory system	2.8%	8.6%	24.3%	21.3%	23.8%
Diabetes mellitus	0.4%	0.7%	1.1%	2.3%	3.0%
Anaemia	2.0%	3.1%	1.4%	0.4%	0.4%
Complications of pregnancy and child-birth	2.8%	1.3%	0.3%	0.1%	0.1%
Violent or accidental deaths	2.5%	5.0%	6.5%	14.3%	9.5%
All causes (number of deaths)	**142,931**	**84,918**	**91,020**	**114,554**	**104,508**

Source: Analysis by authors of data of Registrar General's Department for years 2000 and 2003; UN Economic Commission for Asia and Pacific (1976); Department of Census and Statistics (1987).

Note: Ill-defined deaths are not classified to any specific cause for the statistics in this table.



Source: Analysis of Registrar General's Department and WHO mortality data by Institute for Health Policy.

Figure 7: Composition of mortality by major cause in Sri Lanka compared to European and South-East Asian regions of WHO

2.2 Prevalence of major NCDs

Assessing NCD prevalence and trends in Sri Lanka

38. It is not easy in Sri Lanka to track the prevalence or incidence of most NCDs. This is no different to other developing countries. There are generally two approaches that are used in developed countries to measure trends in prevalence of chronic diseases: (i) using population surveys, and (ii) tracking morbidity using clinical records maintained by primary care providers. The first approach requires the undertaking of representative, population surveys, collecting data through full clinical assessments and associated laboratory and diagnostic testing. Such exercises would need to be continuously conducted to estimate incidence of most NCDs, as well as trends in prevalence, and are not currently undertaken in Sri Lanka. The second approach depends on the gate-keeper to higher-level services being an organized system of primary care, which registers the whole population and maintains detailed clinical records on the problems that patients present to the health system with. Such a system does not exist in Sri Lanka. Even if such approaches are possible, it must be noted that they can still produce different estimates of prevalence for chronic NCDs (Esteban-Vasallo et al., 2009).

39. In the absence of such information, data from the registration of deaths is the most reliable means to assess and track the prevalence of NCDs in Sri Lanka, through their impact on mortality. Sri Lanka is fortunate in that it has had an effective death registration system for many decades, which counts almost all deaths, and systematically codes the cause of death. In addition, recent upgrading of the Registrar General's Department's systems have

led to the computerization of the annual mortality statistics, which makes it easier to undertake extensive analyses.

40. Unfortunately, the Registrar General's data have not been systematically used in recent years to inform policy-making. The major reasons are: (i) a substantial delay that has built-up in the publication of the annual mortality returns, which were last published for the year 1997, and (ii) the lack of access to the more recent electronic data for domestic researchers. There are significant problems also with the quality of coding of the cause of death, particularly by non-medically qualified registrars, which leads to a significant fraction (>20%) of all deaths being coded incorrectly to invalid or indeterminate causes.

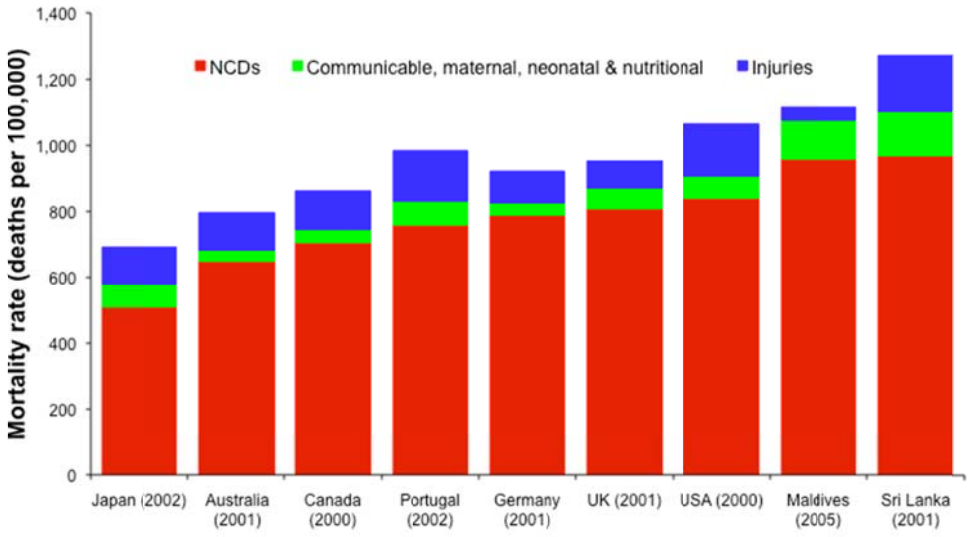
41. To overcome these limitations, IHP obtained access to the raw electronic data of the Registrar General's Department to examine all deaths registered from 1990-2003. These data were processed to overcome the problem of invalid causes of death, by reassigning such deaths in a pro-rated manner to all other causes of death, except injuries. This was done after completing an analysis of the variations in invalid coding over time and by area. This does not fully address the problem of deficiencies in the quality of coding of cause of death, but to the extent that these problems cause errors in multiple directions, they will cancel out to some extent. This database was then combined with the 2001 census estimates of the age-structure of the population to estimate standardized mortality rates for the period 1999-2003, and these statistics are the ones reported in the following sections. Standardized mortality rates were not computed for earlier years, as reliable data on the age-structure are not available. For comparisons with other countries, use has been made of the WHO Mortality Database, as well as data from the Maldives (Anurana et al., 2009).

The relative burden of all NCDs

42. Although NCDs account for the predominant share of overall mortality, it is not the case that NCD mortality rates must inevitably increase with reductions in infectious disease, or that the increase in NCD mortality rates are a corollary of economic development. As noted by Adeyi *et al.* (2007), on an age-standardized basis both NCD and communicable disease mortality rates tend to be lower the higher a country's per capita GDP.

43. Our analysis of Sri Lanka's mortality data for 1999-2003 confirms this, with age-standardized mortality rates for all NCDs in total being currently 20-50% higher in Sri Lanka than in developed countries (Figure 8). Overall NCD prevalence and mortality in Sri Lanka can thus be surmised to be high in comparative terms, and certainly higher than in developed countries.

44. We then make a more detailed international comparison by specific types of NCD. Figure 9 shows for Sri Lanka in 2001 and selected other developed countries the ratios of mortality rates from all causes, cardiovascular disease, diabetes, and injuries, in different age groups to those in Sweden. Figure 10 makes the same comparison, but for mortality from all causes for each sex. The vertical axis in each chart is the mortality rate in each country as a percentage of that in Sweden. Sweden is used as the basis of comparison owing to its low overall mortality rates, and because this comparison was previously made in the 1970s, when the stagnation in male life expectancy was first noted (UN Economic and Social Commission for Asia and the Pacific, 1976). Russia is included in the comparison, as it is the country best known for an excessive burden of NCD mortality (Suhrcke et al., 2007).



Note: Mortality rates standardized using Sri Lanka 2001 population as reference.

Figure 8: Comparison of age-standardized mortality rates by overall causes of mortality, Sri Lanka and selected countries

45. The first point to note (Figure 9, top-left panel) is that overall mortality rates in Sri Lanka are modestly higher than in developed countries, and that the ratios of mortality from all diseases to those in Sweden are only 100-200% higher. This reflects the reality that Sri Lankan's mortality patterns are almost comparable to those in developed nations. However, when overall mortality rates are examined by sex (Figure 10), it is evident that the higher mortality rates in Sri Lanka compared to developed countries are largely in men, with female mortality rates being lower at some ages than in some OECD nations, including the USA.

46. Looking more closely, cardiovascular mortality rates in Sri Lanka at all ages (Figure 9, top-right panel) are almost double those in developed countries. The burden of cardiovascular mortality in Sri Lanka is certainly not as high as that in Russia, where mortality rates are almost ten times as high as in Sweden, but they are 200-300% of those in Sweden. This demonstrates that cardiovascular disease is the major driver of the higher overall rates of NCD and all cause mortality in Sri Lanka.

47. Relative diabetes mortality rates in Sri Lanka are comparatively high and increase with age, but are not as systematically higher as in the case of cardiovascular disease, with diabetes mortality rates being similar or less than those in some OECD countries, such as USA and South Korea. Interestingly, diabetes is one NCD where Russia does not have such high relative rates. Mortality rates from injuries in Sri Lanka are also double those in Sweden, but again within the range of some OECD nations.

48. These data confirm that the major reason why Sri Lanka has not been able to improve its relative performance since the 1970s is its worse performance with respect to NCD mortality, and in particular cardiovascular disease. However, the mortality gap is not as large as in Russia, probably because Sri Lanka does not suffer from the same social pathologies that lead to high adult mortality in Russia, such as alcohol and tobacco.

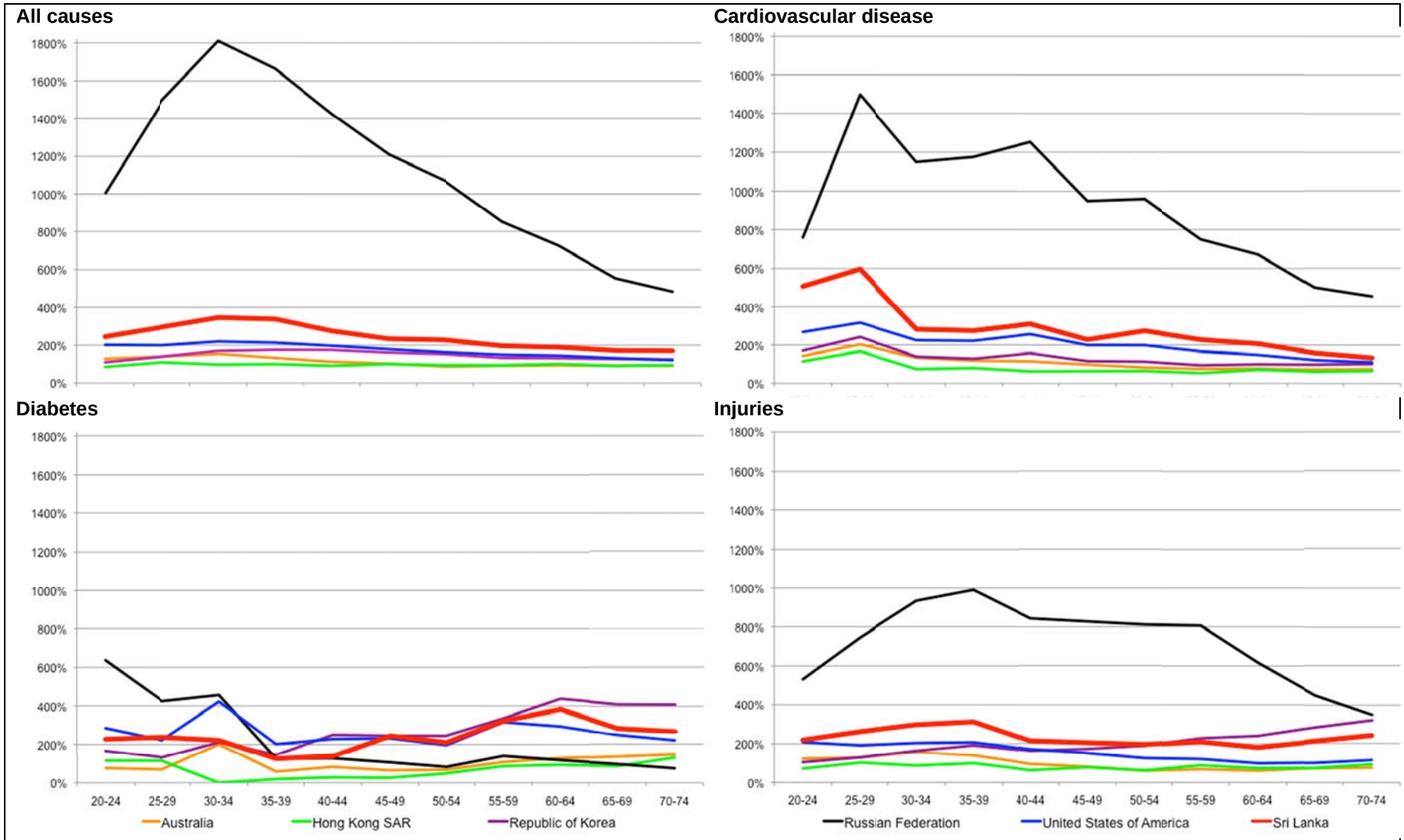


Figure 9: Age-specific mortality rates as a percentage of those of Sweden, Sri Lanka and selected other countries (circa 2001)

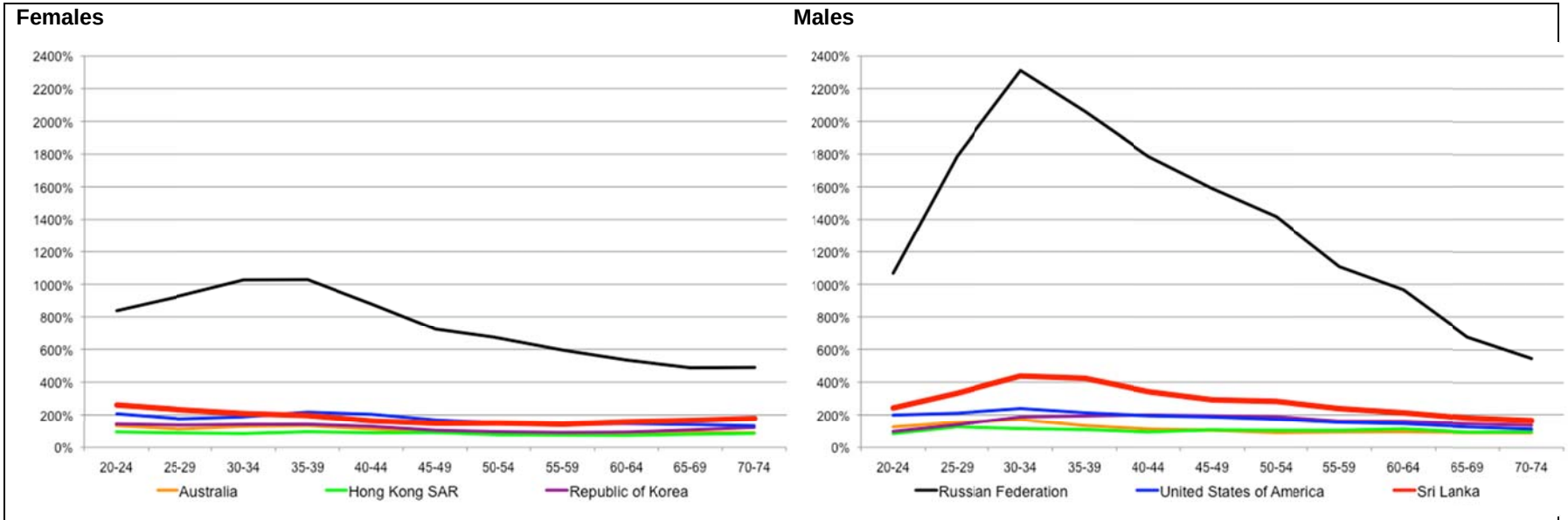


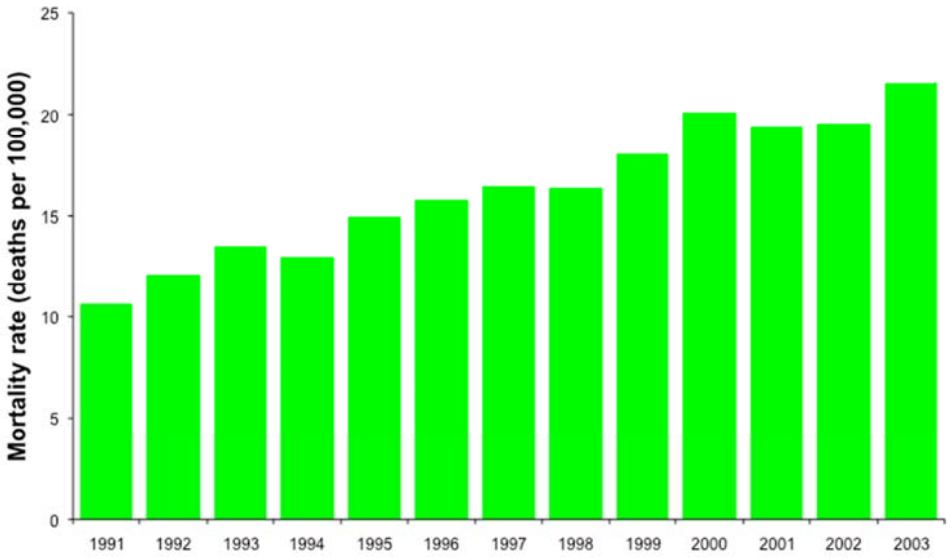
Figure 10: Age-specific mortality for all causes as a percentage of those in Sweden, Sri Lanka and selected other countries (circa 2001), by sex

49. In the following sections, we take a closer, selective look at specific NCDs. We focus on ischaemic heart disease, diabetes and asthma, as these are the conditions with a high impact, and with relatively coherent aetiologies. In so doing, we note that mental disease and injuries also make major contributions to the disease burden, but that these conditions are more complex in their causation, and have less reliable data on prevalence.

Asthma

50. A common impression of Sri Lankan clinicians is that asthma has been increasing. This would parallel increases that have occurred in many developed countries around the world, such as the UK and New Zealand. However, there are no reliable survey data to assess prevalence in the community in Sri Lanka, which leaves only the data on registered mortality.

51. The trends in the crude mortality rate from asthma from 1991 to 2003 point to an increasing burden from asthma, as illustrated by Figure 11, as do the statistics in Table 1, where asthma deaths are classified under bronchitis. Since 1991, mortality rates from asthma have doubled, with annual recorded deaths from asthma also doubling from under 2,000 a year to more than 4,000 in 2003, which is 4% of all deaths.[1] This can be contrasted with the ratio of 1% of all deaths attributed to the bronchitis category, which would have included asthma, during the 1940s-60s (UN Economic and Social Commission for Asia and the Pacific, 1976).



Source: IHP computations using data from Registrar General's Department. Standard mortality rates not calculated owing to the lack of reliable population data for the whole period.

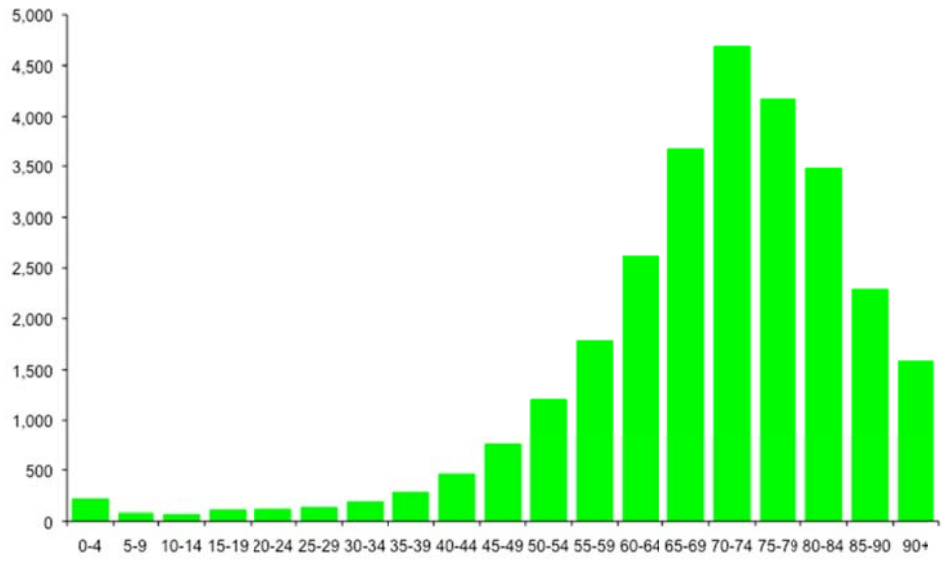
Figure 11: Annual mortality from asthma, Sri Lanka 1991-2003

[1] Trends in standardized mortality rates for asthma are not presented, owing to the lack of reliable data on the age composition of the population during the early 1990s.

52. However, recorded mortality from asthma is not a reliable measure of the asthma burden for two reasons. The first is the high potential for misdiagnosis of asthma deaths in the elderly, leading to an over-reporting of asthma mortality. The second is that the percentage of asthma cases that result in death is highly susceptible to treatment interventions, and so the mortality rate is a function of both disease incidence and overall treatment success.

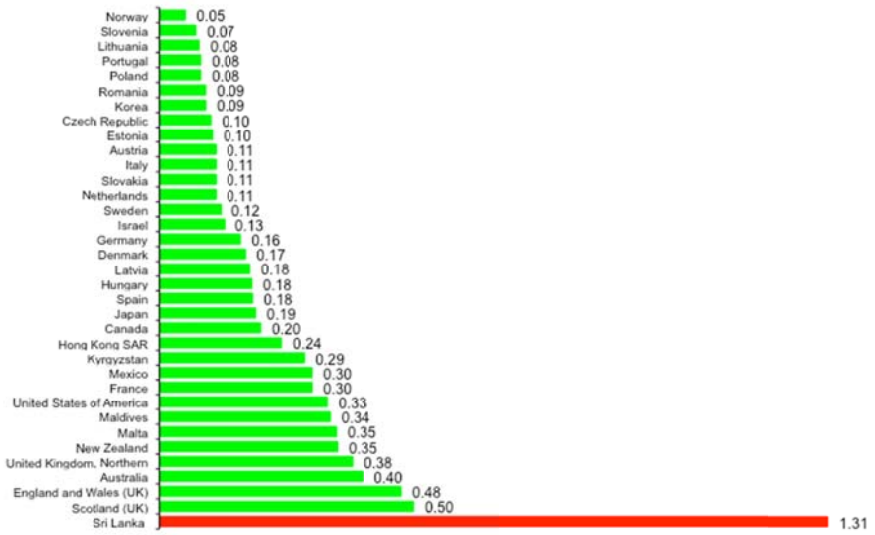
53. The first issue is pertinent, since the recorded mortality from asthma in Sri Lanka is concentrated amongst the elderly (Figure 12). The mortality rate from asthma in the 5-34 year age group is considered internationally a more reliable measure (Masoli et al., 2004). For Sri Lanka, this rate was 1.3 deaths per 100,000 per year during 2001-2003. This is significantly higher than all countries for which data are reported to the WHO Mortality Database or to the OECD, and 2-5 times the levels in Europe and other developed countries (Figure 13). Such a high relative level of asthma mortality in Sri Lanka has not been previously reported.

54. The second issue in interpreting asthma mortality is the varying impact of treatment. The high rates of mortality in Sri Lanka could be the result of an unexceptional rate of asthma prevalence combined with high case fatality rates. However, even if this were the situation, the very high mortality from asthma would still imply that the disease imposes a high disease burden, since death is the ultimate burden. Consequently, it is valid to interpret the available evidence as indicating that asthma imposes a disease burden that is exceptionally high in relative terms.



Source: IHP computations using data from Registrar General's Department.

Figure 12: Deaths from asthma by age group, Sri Lanka 1999-2003



Source: Sri Lanka estimate for 1999-2003 computed from Registrar General's Department data, estimates for OECD countries around 2005 from OECD (2007), and estimates for other countries estimated from WHO Mortality Database.

Figure 13: Asthma mortality in 5-39 year olds, Sri Lanka and selected other countries

Diabetes

55. Diabetes and dysglycaemia, which involves impaired glucose tolerance and is a precursor to full diabetes, have been increasing rapidly in prevalence in Sri Lanka in the past two decades. This is partly due to the ageing of the population, since diabetes prevalence increases with age, as well as due to increasing age-specific prevalence rates for diabetes. That trend is most likely explained by increases in obesity, changes in diet, and decreases in physical activity.

56. Table 2 presents the estimates of diabetes prevalence as reported in different surveys in Sri Lanka since the 1990s. They show the increasing prevalence of diabetes, from the earliest study that found a prevalence of 2.5% in a rural community in 1990, to the Sri Lanka Diabetes and Cardiovascular Survey (SLDCS), which found a prevalence of 10% in a national sample in 2005/2006. These levels indicate that Sri Lanka already has a prevalence of diabetes comparable to or more than in many developed countries, and a high prevalence compared to most other developing countries.

57. Taking into account the increasing ageing of the population, Katulanda *et al.* (2008a) project that the diabetes prevalence in Sri Lanka will increase to 14% by 2030. However, this does not take into account factors, such as changes in diet or physical activity, which may further increase prevalence rates.

Table 2: Changes in prevalence of diabetes mellitus as estimated by different surveys, Sri Lanka, 1993-2006

Period	Study population	Sample size	Ages (years)	Prevalence (%)
1990 [(1)]	Suburban community	975 men	35-59	5.8
1991 [(2)]	Rural community	200	≥18	2.5
1994 [(3)]	Suburban community	633	30-64	5.2
2000 [(4)]	Suburban community	1,303	30-64	6.6
2000 [(5)]	Rural community	200	19-80	8.5
2004 [(6)]	National	6,047	30-65	Males 14.9 Females 13.9
2005/2006 [(7)]	National	5,000	≥ 20	10.3

Sources: (1) Mendis and Ekanayake (1994); (2) Illangasekara *et al.* (1993); (3) Fernando *et al.* (1994); (4) Malavige *et al.* (2002); (5) Illangasekera *et al*. (2004); (6) Wijewardena (2006); (7) Katulanda *et al*. (2008b).

Ischaemic heart disease

58. The mortality data reveals a high burden from cardiovascular disease, which is mostly ischaemic heart disease (IHD). This is confirmed by other available data on hospital admissions. Acute admissions for IHD, in particular acute myocardial infarction, are a good crude indicator of underlying IHD trends, as at least half the IHD cases, even in developed countries, are identified only when acute events occur. In 2005, 82,000 admissions in government hospitals were IHD cases, equivalent to a rate of 410 admissions per 100,000 (this is without considering IHD admissions in the private sector, which may add a significant number, since IHD admission rates are higher in Colombo district). These rates are comparable to those in OECD countries of 330-1,200 per 100,000 (Moïse, 2003). Given that the Sri Lankan population is younger than OECD countries, this rate will be higher on an age-standardized basis than admission rates in most developed countries.

2.3 Prevalence of NCD risk factors

59. The previous section has shown that NCDs account for the predominant share of overall mortality in Sri Lanka, and that the mortality rates for the major NCDs are significantly higher in Sri Lanka than in developed countries. The question that must be asked is how much do these high mortality rates reflect a high prevalence of risk factors. This section summarizes what is known about some of the risk factors for the major NCDs in Sri Lanka.

Foetal under-nutrition and epigenetic determinants

60. Owing to the work of Barker and colleagues (Barker and Robinson, 1992; Barker and Clark, 1997), foetal under-nutrition is now recognized as a major long-term risk factor in the development of adult coronary heart disease, stroke, diabetes and hypertension. In addition to this, recent research has identified epigenetic mechanisms as potentially providing a pathway by which conditions of scarcity in the past can influence the pathogenesis of heart disease in

subsequent generations (NHLBI Working Group Epigenetic Contributions to Coronary Artery Disease, 2008).

61. Maternal under-nutrition was widespread in Sri Lanka in the past and continues today. Consequently, this legacy of high levels of foetal under-nutrition should be expected to act as a significant predisposing factor for adult cardiovascular disease and diabetes in Sri Lanka for many years to come, and must be considered as a key explanation for current high levels of cardiovascular disease. However, there has been no research on this in Sri Lanka, and this is an area that should be a future national research priority. Nevertheless, one implication is that given the future impact on NCDs, the country should ensure that the raising of nutritional levels of mothers be a continuing priority in the development agenda.

Smoking

62. Smoking prevalence and per capita consumption of tobacco are low compared to other countries. The percentages of the Sri Lankan population who smoke at all and who smoke on a daily basis, and the mean number of cigarettes consumed per capita are lower than most other developing and developed countries, and has been declining in the past two decades (Rahman and Ramaboot, 2003; Central Bank of Sri Lanka, 2005). So high levels of smoking do not appear to be a likely explanation for Sri Lanka's high burden of NCDs.

63. According to the unpublished findings of the Sri Lanka STEPS survey conducted in 2007, 22.8% of male and 0.3% of female adults are current smokers (Table 3). These rates are amongst the lowest in the Asia-Pacific region, and lower than in USA and almost all European countries. Smoking rates in children and youth are also lower than in other countries. According to the Global Youth Tobacco Survey 2007, 5.1% of youth (13-15 years) had ever smoked tobacco cigarettes, 39.5% of them had smoked cigarettes before age 10, and 8.6% were current users of other tobacco products (National Authority on Tobacco and Alcohol, 2008).

64. There is a marked gender disparity in smoking in Sri Lanka, which is particularly unusual, with smoking almost exclusively confined to men. The actual rate of smoking in men is thus higher than implied by the overall population average. This disparity would help explain part of the gender disparity in overall NCD mortality rates. However, even taking this into account, the rates of regular smoking in men (~23%) are still low by global standards, and are less than in most OECD countries, so smoking cannot be the main culprit for the relatively high NCD mortality in Sri Lanka compared with developed countries.

Obesity

65. Obesity is a major risk factor for cardiovascular disease and diabetes, and it also plays a role in a number of cancers. Overall obesity levels in Sri Lanka have been increasing in the past 20 years, and are comparable to many developed countries, although they are not currently higher.

66. Wijewardene et al. (2005) found that 20.3% of men and 36.5% of women aged 30-65 years were obese by US standards (BMI>=23), compared with 25.0% and 24.7% of men and women in the US, and 12.0% and 28.5% of men and women in Russia. However, WHO recommends the classification of obesity at smaller body mass weights in Asian populations than in European populations, so this comparison understates the extent of the problem. Nevertheless, data from the SLDCS 2005 reveal obesity rates of 7% in men and 13% in

women aged 18-74 years, when applying the stricter WHO Asian cut-offs, so confirming that obesity rates in Sri Lanka are still lower than in most developed nations.

67. In general, levels of obesity are higher in women than men, and higher in urban than rural areas. Arambepola *et al.* (2008). Mean BMI of the urban population in the district of Colombo was found to be 1 kg/m^2 higher than that of their rural counterparts, which suggests that urbanization in Sri Lanka will lead to increases in BMI.

Table 3: Prevalence of NCD risk factors, Sri Lanka STEPS survey 2007

Risk factor	Both Sexes	Males	Females
Tobacco use			
Currently smoke tobacco daily (%)	11.5	22.8	0.3
Smoke manufactured cigarettes (% of smokers)	85.8	85.7	94.4
Mean number of cigarettes smoked per day (smokers)	9.2	9.1	13.7
Alcohol Consumption			
Current drinkers (drank alcohol in the past 30 days, %)	13.5	26	1.2
Drank alcohol on 4 or more days in the last week (%)	16.7	17.4	1.5
Fruit and Vegetable Consumption (in a typical week)			
Mean number of days fruit consumed	3.7	3.6	3.7
Mean number of servings of fruits consumed per day	1.1	1.1	1.1
Mean number of days vegetables consumed	6.7	6.6	6.7
Mean number of servings of vegetables consumed per day	2.2	2.2	2.1
Ate less than 5 of combined servings of fruit & vegetables/day (%)	82.4	81.4	83.3
Physical Activity			
Low levels of activity, defined as <600 MET-minutes/week (%)	25	17.9	31.9
Physical measurements			
Percentage (%) who are obese (BMI ≥ 30 kg/m^2)	4.8	3.6	5.9

Source: NCD Unit, Ministry of Health

Lipid levels

68. Abnormal lipid levels, specifically high levels of triglycerides, and a low ratio of HDL-cholesterol to LDL-cholesterol are major risk factors for cardiovascular disease. Levels in Sri Lanka are higher than in India, and comparable to those in developed countries, and also in the Maldives. The World Bank-funded risk factor survey of 1998-2002 found that mean total cholesterol levels were 200-236 mg/dl in the Western Province (Sri Lanka Medical Association, 2004), compared with levels of 200-240 reported from developed countries. Similarly, LDL-cholesterol levels were found in the same survey to be 117-151 mg/dl. The more recent, and more nationally-representative 2005/2006 Sri Lanka Diabetes, Cardiovascular Study done by Katulanda *et al.* (2008a) has reported similar levels. Mean total cholesterol and LDL-cholesterol levels in the population were found to be 203 mg/dl and 133 mg/dl respectively, and levels are significantly higher in females than in males.

69. The high prevalence of abnormal lipid levels is not due to a high fat intake in the Sri Lankan diet, since at 25% of total energy intake this is relatively low. Instead the main

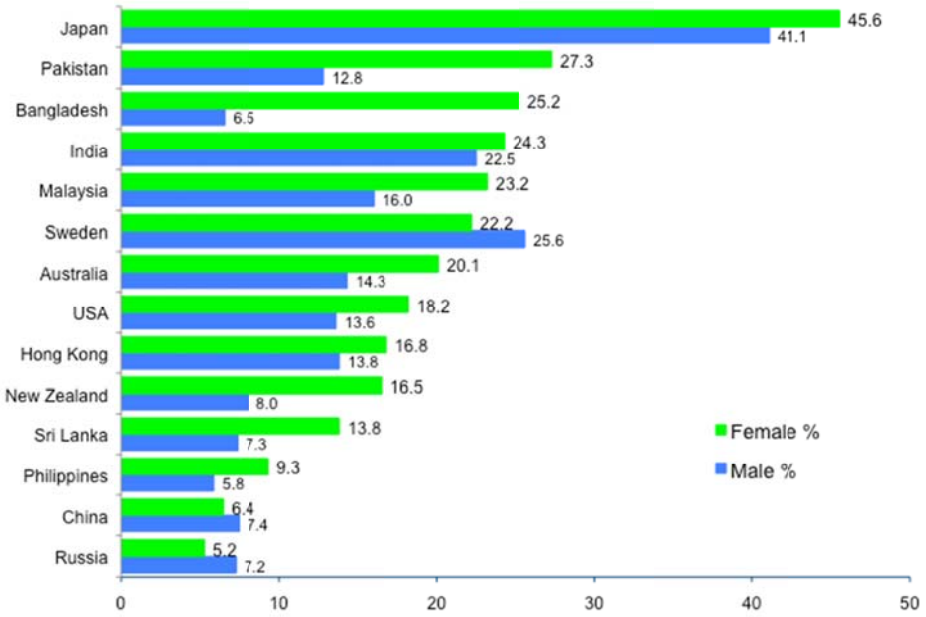
explanation is an exceptionally high ratio of saturated fats to polyunsaturated fats, which is 9:1 compared to a recommended ratio of <1:1 (Abeywardena, 2003). This problem will require significant efforts to change dietary patterns.

Hypertension

70. Hypertension is a major risk factor for cardiovascular disease, including stroke. The prevalence of hypertension in Sri Lanka is low by international standards. The World Bank-funded population survey of cardiovascular risk factors in Sri Lanka in 1998-2002 (Wijewardene et al., 2005) found that the age standardized prevalence rate for hypertension (defined as systolic blood pressure ≥140 mmHg and diastolic pressure ≥90 mmHg) was 19% in Sri Lanka, with little difference between men and women. The more recent national survey by Katulanda *et al.* in 2005 reported a national prevalence of hypertension in adults of 13% in men and 14% in women. These levels are lower than those reported for most developed countries (Wolf-Maier et al., 2003), such as the USA (28%) or in Europe (44%).

Physical inactivity

71. Physical inactivity is a risk factor for both cardiovascular disease and diabetes, and an increase in inactivity is a widespread global corollary of modernization (Guthold et al., 2008). Rapid urbanization, economic growth and technological changes in the developing world contribute to the likelihood of increased physical inactivity, and in Sri Lanka to the need to focus on developing measures to develop interventions to counter an increasing level of physical inactivity among men and women in Sri Lanka.



Source: Data for Bangladesh, Malaysia, Pakistan, Philippines, Russia, and Sri Lanka are from the World Health Survey, 2002-2003 (Guthold *et al.*, 2008), and data for the other countries are from Bauman, *et al.* (2009).

Figure 14: Comparison of physical inactivity in Sri Lanka by gender with selected other countries

72. Figure 14 presents a crude comparison of the physical inactivity levels in Sri Lanka by gender with selected other countries to provide an idea of how high levels are in Sri Lanka. The data are from surveys that have used the International Physical Activity Questionnaire (IPAQ) instrument to measure inactivity levels in national populations. The level of inactivity in men in Sri Lanka in 2002 was 7.3% and in women 13.8%. These levels of inactivity for each gender are low by international standards, and lower than in most developed countries, such as USA, Australia and Japan, as well as lower than in many developing countries. These data indicate that physical inactivity, which is almost certainly increasing in Sri Lanka, cannot be a culprit in explaining Sri Lanka's high mortality rates from NCDs and from cardiovascular disease.

Alcohol

73. Excessive consumption of alcohol is a risk factor for a range of NCDs, including liver disease, cancers and cardiovascular disease. Assessment of the prevalence of excessive consumption is difficult in most countries, including Sri Lanka, owing to difficulties in obtaining reliable responses in surveys, and the potential impact of illicit consumption. Sri Lanka is no different given a significant level of illicit alcohol production and consumption. Nevertheless, the mean per capita consumption of alcohol is considered a reasonable proxy indicator for heavy drinking in a population.

74. WHO statistics show that average alcohol consumption in Sri Lanka is lower than in most countries, with the exception of countries with predominantly Muslim populations. Annual per capita consumption of alcohol among adults aged 15 years or older was estimated to be 0.28 litres in 2003, compared with an average of 4.0 litres in lower-middle income countries, and 9.07 litres in high-income countries (World Health Organization, 2008).

75. The situation in Sri Lanka is characterized by a high prevalence of abstinence, and very low rates of consumption in women (World Health Organization, 2004). According to the WHO GENACIS Study (2002 survey) the rate of last year abstainers in Sri Lanka was 67.6% (total), 41.4% (males) and 92.9% (females). A separate 2002–2003 survey conducted in 11 districts in Sri Lanka found that 63% of the total subjects had never consumed alcohol. The WHO GENACIS Study also found that the rate of last year heavy and hazardous drinking among drinkers was 15.6% for men and 0.0% for women. Heavy and hazardous drinking was defined as average daily consumption of 40 g or more of alcohol for men and 20 g or more of alcohol for women (World Health Organization, 2004).

76. Although as in the case of smoking, alcohol consumption is largely confined to men, this still implies relative low levels of alcohol consumption in Sri Lanka. The main problem in Sri Lanka is that alcohol consumption and heavy drinking is concentrated in a small proportion of the male population, and these people tend to be poorer and less educated. There is also a significant concentration of heavy alcohol intake in the estate population, where alcoholism is a significant social problem. Nevertheless, despite this concentration of alcohol intakes, there is little evidence to show that there is an exceptionally high rate of heavy drinking in Sri Lanka.

2.4 Socioeconomic and geographical differentials in NCDs and NCD risk factors

Dimensions of inequality

77. Inequalities in health needs and health outcomes are an important issue for public health policy, especially in Sri Lanka where the concern for equity has been a major motivating factor in guiding policies. NCDs might give rise to significant inequalities, as a result of inequalities in the incidence of illness, inequalities in obtaining treatment for NCDs, and inequities caused by the costs of illness. The key dimensions along which inequalities might arise are in relation to income and socioeconomic status, and where people live (urban/rural).

78. In developed countries, NCDs disproportionately affect the poor. Disadvantages in access to health care, increased incidence of disease and risk factors associated with employment and living conditions, and poor health behaviours mean that the poor generally suffer a higher burden from NCDs than the rich. The situation in developing countries is much less understood, but the limited available evidence suggests that the relationship with income is reversed in developing countries, with the rich suffering more from NCDs than the poor (World Health Organization, 2002). This is particularly the case for IHD and diabetes in India, for which many studies exist. However, in the case of the Maldives, recent research indicates that the socioeconomic gradient for several NCDs is shifting from one where NCDs are more prevalent in richer and better educated persons to one where they will be concentrated in poorer and less educated persons (Anurana et al., 2009).

NCDs in the conflict-affected population

79. An important dimension of health inequalities in Sri Lanka is related to the impact of the conflicts in the north and south of Sri Lanka, as a result of the JVP and LTTE insurgencies. The past four decades of political violence have inevitably had a negative impact on health outcomes and equity in access to health services. Part of this was due to the direct impacts of conflict itself and the hardships and privations that it produced. Another part was from the impact of the conflict on health service provision. Private provision of medical services largely disappeared in most parts of the north and east, and there was significant degradation in the capacity of the public sector to deliver services owing to logistical difficulties and the problems of maintaining staff in a conflict zone. Finally, it must be noted that the conflict in the north of Sri Lanka eliminated the space for democratic politics as the LTTE eliminated all opposition to it in the areas it dominated, and this in turn prevented Sri Lankans living in these areas to demand accountability of the public sector.

80. Although there was a substantial negative impact of the conflict on the health of the population in the east and north, as well as on the adjacent border areas, there is little data on NCD prevalence in the affected areas. Unfortunately, the associated impact of the violence on health information systems means that it is essentially impossible to make any systematic assessment of the impact of the conflict on NCDs. However, numerous studies and surveys have identified that a high prevalence of mental health problems in the affected population is one of the most significant health consequences of both the JVP and LTTE insurgencies in Sri Lanka (Watkins, 2005; Nagai et al., 2007). Fortunately, the end of the armed conflicts in 2009 removes the primary cause of these sequelae, and should provide the basis to address these health disparities, including those related to NCDs.

Using mortality to assess differentials in NCD burdens

81. There are almost no systematic population surveys that collect information on disease prevalence in relation to socioeconomic status (SES) in Sri Lanka. The single exception has been the demographic and health surveys, which contain data mostly for child and maternal health indicators. These were first exploited by IHP researchers, who analyzed the 1993 and 2003 DHS surveys, and have reported generally pro-rich gradients in most indicators, except for family planning uptake (Rannan-Eliya and Somanathan, 2006; Saleem-Ismail, Rannan-Eliya, and Perera, 2007; Rannan-Eliya and Sikurajapathy, 2008). Similar patterns have been reported from the SLDHS 2006/2007.

82. However, the DHS surveys do not cover adult mortality or NCDs, so cannot provide much evidence on social disparities in NCDs. To the examine this, other data sources and methods are required. So the following sections present a profile of inequalities in the NCD burden along income and geographical dimensions, exploiting primarily mortality data.

83. Sri Lanka's mortality registration system achieves almost universal coverage, but the death registration system does not record information on the socioeconomic status of the deceased, so it is not possible to directly infer SES inequalities in mortality from these data. To overcome this limitation, this study uses variations in mortality by small areas as a proxy for variations in mortality by socioeconomic status. This method, which is adapted from that used in Australia (AIHW: Moon L & Waters A-M, 2006), exploits the fact that death certificates in Sri Lanka record both the place of death as well as the place of usual residence of the deceased, and that this information is available in the national mortality database at the level of Registrar General's divisions (RGDs). This is the first time this method has been used in Sri Lanka, since the data on usual place of residence have until now not been made publicly available. In fact, most researchers have assumed incorrectly that the mortality data contained information only on the place of death, and have not been aware of that additional data exist on the place of usual residence of the deceased.

84. All registered deaths (numbering 553,192) during 1999-2003 were pooled in the analysis, and the place of death mapped from RGDs to the corresponding divisional secretariat divisions (DSDs). It is noted that the Registrar General's data actually code the place of usual residence at a lower level than RGDs, but these data are not reliable, and so were not used.

85. The cause of these deaths is coded using ICD-10, and this information plus data from the Population Census 2001 on the age-sex composition of the populations resident in each DSD in 2001 were used to estimate the age-sex standardized mortality rates for major disease categories for each DSD. In doing this, deaths that were coded with an invalid cause of death were redistributed on a pro-rata basis across the valid causes of death in their respective DSD and age and sex category. Such deaths account for 26% of all registered deaths. To relate mortality to SES, an index of average SES level was generated for each DSD applying principle component analysis to rank them using Census 2001 data on the DSD-level averages for household amenities and other characteristics. The DSDs were then grouped into quintiles of equal population. This index of relative DSD SES levels is preliminary, as the use of area averages is associated with some biases, which can only be overcome by use of individual household level data. Follow-up analysis is being undertaken by IHP to address this issue, by exploiting a 5% sample of the 2001 population census. In this report, we report the preliminary results of this analysis, which have been mapped to show the geographical variation in mortality rates, in a similar manner to analyses in the USA (Pickle et al., 1996), EU (Eurostat, 2009) and UK (Gregory, 2009).

86. Figure 15 shows the geographical variations in socioeconomic status and in standardized mortality rates for all causes by DSDs for the period 1999-2003. Statistics for DSDs in the east and north are not reported, owing to the unavailability of Census 2001 population data for these areas. Figure 16 then shows the relationship between all cause mortality and quintiles of socioeconomic status.

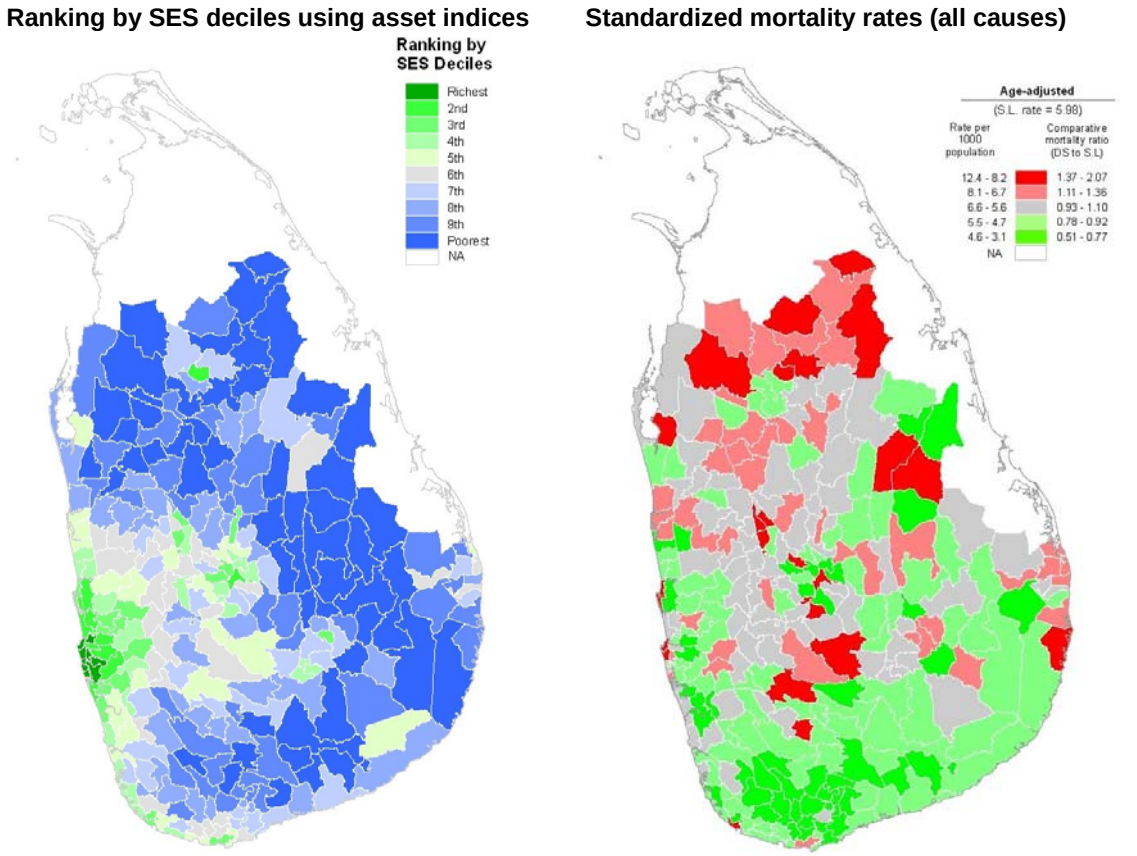


Figure 15: Socioeconomic ranking and mortality rates for both sexes combined by DSDs, Sri Lanka 1999-2003

87. All cause mortality in Sri Lanka tends to be highest in urban and estate areas of the country. This is consistent with the pattern in Sri Lanka since the 1960s, when mortality rates in rural areas were first noted to be below those in urban areas. However, increased mortality rates are seen in the north-central and eastern areas, which border the conflict areas.

88. When all cause mortality rates are examined in relation to SES (Figure 16), it can be seen that all cause mortality increases in both sexes with socioeconomic position, although the gradient is steeper with male mortality. An increase in mortality with SES is seen across all major disease groups, including infectious diseases, maternal, neonatal and child health conditions, injuries, and NCDs.

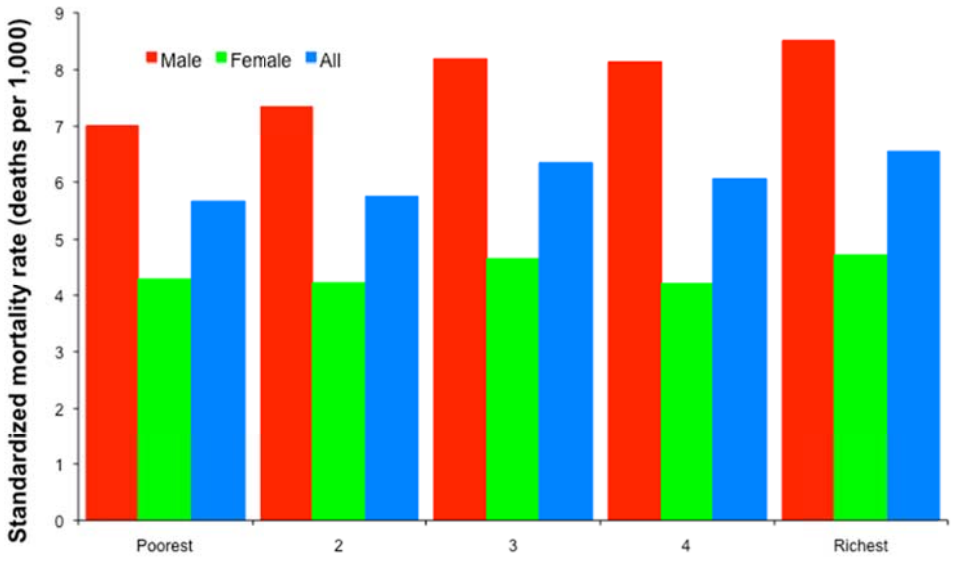


Figure 16: All cause mortality by quintiles of socioeconomic status

89. It should be emphasized that this finding of higher mortality rates in richer areas, although unusual in an international perspective, is not new. It is consistent with the demographic record in Sri Lanka, where official life-table estimates have consistently reported the highest life expectancies and lowest overall mortality rates as occurring in some of the poorest and most rural districts of the country since at least the 1970s, and where mortality rates in rural areas have long been lower than in urban areas (Meegama, 1986). Further explanation of this unusual pattern is important in order to better understand the determinants of mortality change in Sri Lanka, but awaits more detailed research that will decompose mortality change in past decades by age, sex, cause of death and area of residence.

90. The subsequent section discusses the variations in NCD mortality. In general, the results suggest that for many NCDs, the current disease burden tends to be highest in the more urbanized and richer areas, with some high rates also seen in areas with a significant estate population. This is probably due to changes in diet and other risk factors with income growth and urbanization, which are yet to be countered by changes in mitigating healthy behaviours.

Socioeconomic inequalities in major NCDs

91. Figure 17 shows the variations in mortality by SES quintiles for hypertension, IHD, diabetes and malignant neoplasms. These exhibit three different patterns. Mortality from hypertension is lower in higher quintiles. In contrast, mortality from IHD and diabetes increase significantly with SES, whilst mortality from malignant neoplasm increases only modestly.

Hypertension

92. The finding of a negative SES gradient in mortality due to hypertension is consistent with the patterns seen in developed countries, where the socioeconomic gradients for hypertension-related mortality tend to be weak or negative. Lower levels of psychosocial stress in higher income groups might explain the pattern of hypertension mortality, and this would be consistent with findings from other countries (Pickering, 1999; Steptoe and Willemsen, 2004). However, as discussed later in this report, the prevalence of hypertension appears to increase with SES. Although noting that caution must be applied in comparing the different data sources involved, this contrast between underlying morbidity and observed mortality would be consistent with a scenario where the prevalence of hypertension increases with SES, but where better access to diagnosis and treatment in higher SES groups results in a lower net mortality.

Ischaemic heart disease and diabetes

93. The positive gradients in IHD and diabetes mortality with SES is the opposite of that reported from developed countries, where gradients are either generally negative in the case of IHD, or absent or negative in the case of diabetes (Chaturvedi, 2004). The reasons for this different pattern in Sri Lanka are probably higher levels of risk factors in higher income groups in Sri Lanka, principally diet and physical inactivity. Evidence for these higher risk factors in richer Sri Lankans is presented later in this report.

Malignant neoplasms

94. The SES gradient in malignant neoplasm mortality is positive, but not as great as for IHD and diabetes. A positive SES gradient in risk factors linked to behaviours may not be as dominant a factor with these diseases, and other factors such as exposure to environmental risk factors and access to treatment may also play a role. This report does not discuss these patterns further, since cancers are in reality many different diseases, and explaining these patterns would have required extensive new research beyond the capacity of this study.

Asthma

95. Asthma shows an increase in mortality with SES position in the poorest quintiles, but then significant decreases with SES position in the top two SES quintiles (Figure 18). Given the very high rates of asthma mortality found in Sri Lanka and the known sensitive of asthma mortality to treatment, it is likely that access to and use of effective treatment plays a significant role in determining the SES gradients in mortality from asthma in Sri Lanka. The higher levels of mortality in the poorest quintiles thus may reflect worse access to care, whilst only those in the richest quintiles are able to access care and prevent mortality. This possibility is confirmed by the geographical pattern of asthma mortality rates, which are highest in the estate areas of the central hill country and Eastern province. These high rates may be due to a mix of poor access to treatment, as well as climatic factors (Figure 19).

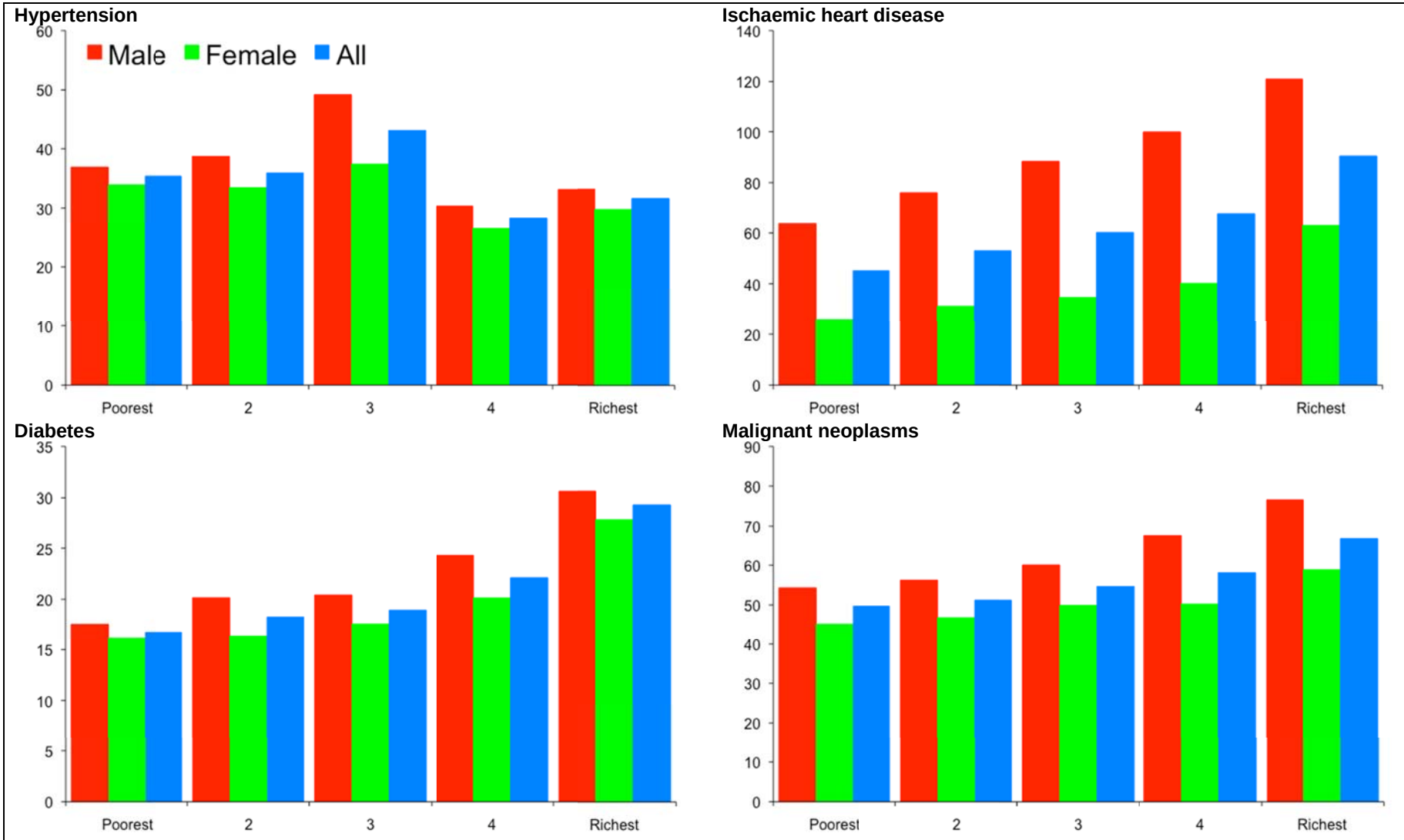


Figure 17: Mortality from hypertension, IHD, diabetes and malignant neoplasms by SES quintiles, Sri Lanka 1999-2003

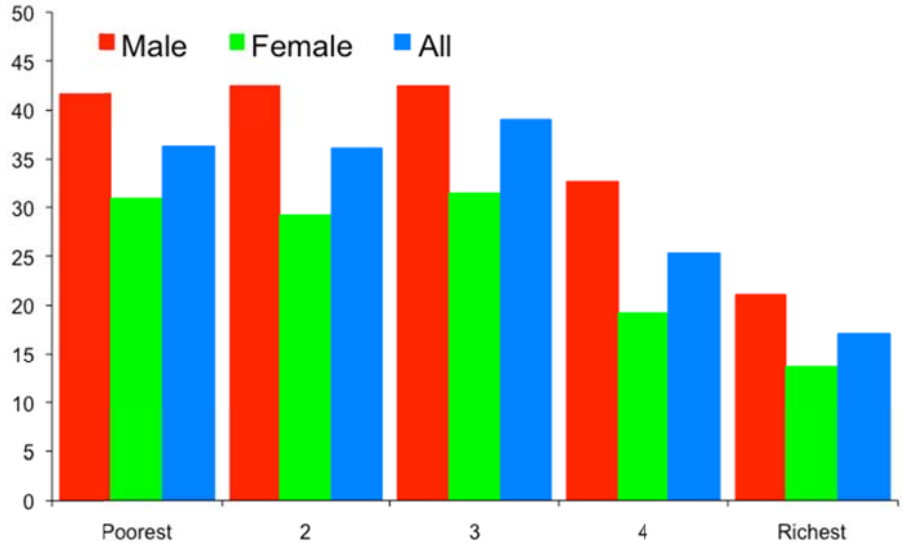


Figure 18: Asthma mortality for all ages by SES quintiles, Sri Lanka 1999-2003

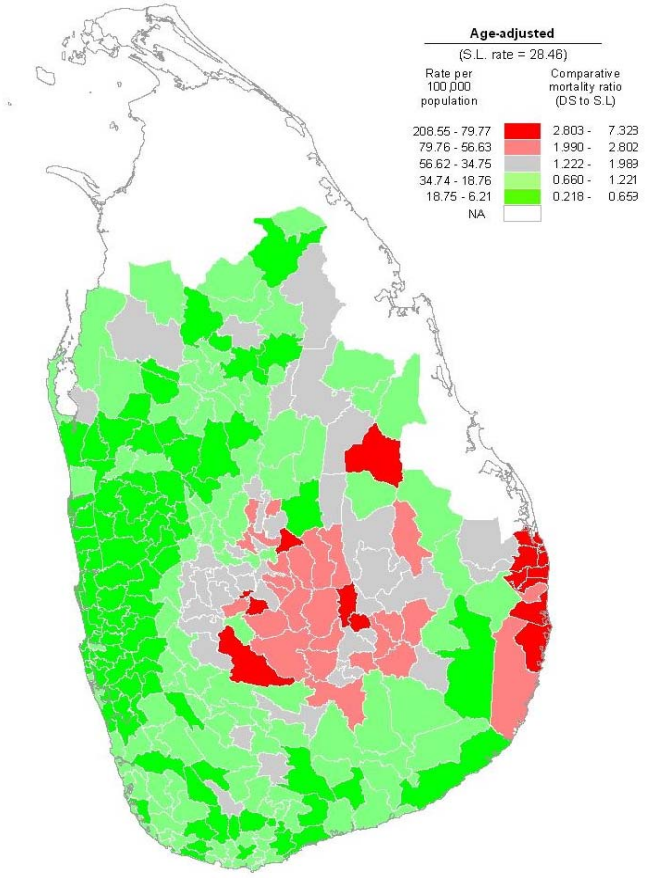
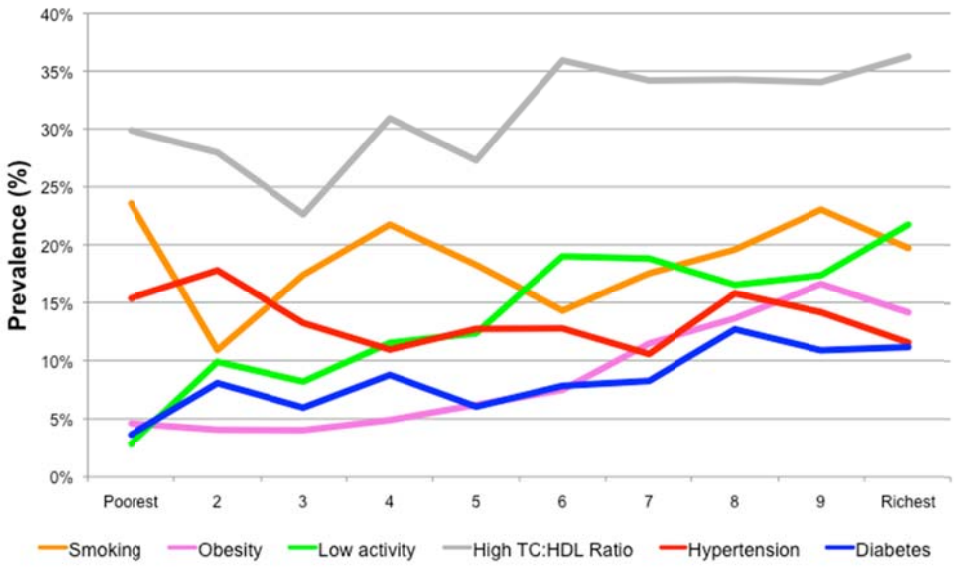


Figure 19: Asthma mortality for all ages by DSDs, Sri Lanka 1999-2003

Evidence on IHD and diabetes inequalities from the SLDCS 2005

96. In addition to the analyses of mortality data, there is one substantial new source of information on SES differentials in NCD risks and burden. This is the Sri Lanka Diabetes and Cardiovascular Survey 2005 (SLDCS), which collected data on NCD risk factors and prevalence of diabetes and heart disease from a nationally-representative sample of 5,000 adults (Katulanda *et al.*, 2008a). Although the survey did not collect detailed and reliable data on the socioeconomic status or income of its respondents, an index to proxy for respondents' socioeconomic status was developed by IHP and Colombo University researchers, and then used to stratify NCD risks and burden by SES deciles.[2]

97. The distribution of key NCD risk factors by SES decile in the SLDCS survey is shown in Figure 20. These show that all risk factors, with the exception of smoking increase with SES. The concentration indices are positive and statistically significant in all cases with p values ≤ 0.001 (except for a high total cholesterol:HDL ratio, $p \leq 0.038$). Smoking decreases with income, although the concentration index is not quite statistically significant ($p \leq 0.23$). These results are consistent with the spatial analysis of IHD and diabetes mortality rates, which found increasing mortality rates with increasing SES.



Source: Analysis of SLDCS 2005 data by Isurujith Liyanage and Ravi P. Rannan-Eliya
Note: Statistics are national estimates for both sexes combined

Figure 20: Distribution of IHD and diabetes risk factors by SES quintile, SLDCS 2005

98. The total cholesterol:HDL-C and other dyslipidaemia ratios in Sri Lanka exhibit a pro-rich gradient, in contrast to the lack of a consistent pattern in developed countries, where the available data are quite mixed (Riddell and North, 2003). On the other hand, the pro-rich

[2] Detailed descriptions of the methodology used in this parallel study will be reported in a forthcoming publication by IHP and University of Colombo researchers.

gradients in obesity, hypertension and diabetes are comparable to those generally reported in developing countries, but the opposite of those seen in developed countries (World Health Organization, 2002; Riddell and North, 2003).

99. Interestingly, in the Maldives, recent analysis by Anurana *et al.* (2009) indicates that the profiles for obesity, hypertension and diabetes are either mixed or run in the opposite direction to that in Sri Lanka.[3] There, the gradient for diabetes in both sexes and for obesity in males was negative with increasing SES, although neither statistically significant, whilst the gradient for hypertension was flat. On the other hand, the gradient for physical inactivity was increasing with increasing SES, which is similar to that in Sri Lanka. However, this gradient was due to a strong relationship with education, and income was not a significant explanatory factor. A similar analysis of the correlates of some of these risk factors in Sri Lanka is warranted, and is currently being undertaken by a joint team of IHP and University of Colombo researchers.

100. These results suggest that the patterns of inequalities in cardiovascular risk factors in Sri Lanka fall in between the patterns reported in India and other developing countries and those observed in developed countries, with perhaps the country transitioning between the two patterns. This would be consistent with the patterns observed in the Maldives, whose higher living standards and level of modernization, probably place it further ahead in the transition.

2.5 Self-reporting of chronic disease

101. The World Bank Sri Lanka Aging Survey (SLAS) in 2006 collected information on self-reported health status and self-reporting of chronic disease in the older adult population (World Bank, 2008). Since most chronic disease is likely to be the outcome of NCDs, these provide another perspective on the relative burdens from NCDs. The levels of self-reported illness by SES quintiles are shown in (Table 4).

Table 4: Distribution of Health Status by Socioeconomic Quintiles, SLAS 2006

	Expenditure Quintile					
Age Sex Standardized Indicators	**1**	**2**	**3**	**4**	**5**	**Concentration Index**
ADL index	0.8386	0.8369	0.8315	0.8357	0.8483	0.0018
Poor Health	0.3904	0.3307	0.3275	0.2846	0.2160	-0.1012
Chronic Disease	0.6157	0.6242	0.6078	0.7205	0.6972	0.0326
Acute Disease	0.4850	0.4924	0.5009	0.4554	0.4346	-0.0235

102. The concentration index for age-sex standardized self assessed poor health is -0.10, which indicates prevalence of the perception of having poor health is higher in poorer quintiles, but chronic disease was associated with a positive concentration index indicating greater prevalence in higher quintiles. These results are consistent with the findings reported earlier about the patterns in mortality.

[3] The Maldives analysis was of the data from the WHO STEPS 2005 survey conducted in Malé.

Chapter 3: Patterns and trends in utilization of curative care for NCDs

3.1 Organisation of health system

Overall structure

103. Sri Lanka has an extensive healthcare system. Public services are financed and provided in an integrated fashion by the central Ministry of Health and nine Provincial Council Departments of Health, and span the full range from preventive and basic primary care activities to complex hospital-provided tertiary care. The largest part of private provision is ambulatory, with most outpatient services provided by government medical officers working in their off-duty hours. A small, but growing, private hospital sector supplements this, providing inpatient and tertiary services, most of which is concentrated in the Colombo metropolitan area. The public sector dominates inpatient provision, but the private sector has emerged as the provider of half of all outpatient care in the past two decades (Table 5).

Table 5: Sources of treatment used by sick persons

Source of treatment	1978/79	1981/82	1986/87	1996/97	2003/04
Western (government)	42.6%	45.6%	44.1%	50.7%	43.5%
Ayurvedic (government)	1.9%	2.2%	1.9%	2.0%	1.2%
Western (private)	34.3%	34.2%	37.2%	38.1%	45.1%
Ayurvedic (private)	16.1%	12.1%	12.9%	7.6%	5.0%
Others	5.1%	6.0%	3.8%	1.7%	1.6%

Source: Computed by IHP from reports and data of Central Bank Consumer Finance Surveys.

Note: The percentages are for those who reported falling ill during a 14 day reference period, and used any source of treatment, including both inpatient and outpatient treatment. Western (private) sources include pharmacies.

104. The healthcare system is financed almost equally by public and private financing, with total expenditures being 4.2% of GDP in 2006 (Institute for Health Policy, 2009). There has been no substantial change in the relative shares of public and private financing since the early 1990s. Public financing, which is from general revenue taxation, almost exclusively finances government provision. Private financing, which is mostly household out-of-pocket spending, almost exclusively pays for privately provided medical services.

Health services delivery

105. The overall level of health expenditures at 4.2% of GDP is low in comparison with other middle-income countries or with those with comparable demographic indicators (Hsiao and Associates, 2001; World Health Organization, 2007; Institute for Health Policy, 2009). However, despite this, there is an extensive and tiered network of facilities operated by the public sector, and high rates of patient throughput in both public and private sectors.

106. The key elements of the government delivery system were put in place as early as the 1950s. Subsequent changes have been incremental, with devolution in the 1990s being the

only recent major change. This devolution led to transfer of operational responsibility for most health facilities and delivery of primary healthcare to the provincial health departments, with the line ministry retaining control of teaching and specialized institutions.

107. The network of government curative care institutions ranges from teaching hospitals with ultra-specialized services to small central dispensaries, which provide only outpatient services. This network covers all areas of the island, and delivers a high volume of basic services in quantitative terms. The health ministry grades facilities according to three major levels:

1. **Primary level:** Central Dispensaries, Maternity Homes, Rural Hospitals, Peripheral Units and small District Hospitals are designated as primary healthcare institutions.
2. **Secondary level:** District Hospitals with specialist services and Base Hospitals function as secondary care institutions.
3. **Tertiary level:** Teaching and Special Hospitals and Provincial Hospitals form the tertiary care institutions.

108. Although there is a formal referral system in the public sector with patients expected to use primary level services as the first point of contact, this is not enforced. So patients seek care in the medical institution of their choice. The main reason why official regulations that seek to regulate access to higher level are not enforced is that the political system, in response to public pressure, has prioritized equity in access over other technocratic and quality concerns. This has implicitly recognized that restrictions in access would in practice result in differential rights of access to higher-level care, which is in practice more accessible to better-off Sri Lankans (Rannan-Eliya and de Mel, 1997). This phenomenon of prioritizing equity in access over quality and technical concerns is similar to what has happened in Japan (Campbell and Ikegami, 1998), and like in Japan is a key reason for the good equity performance of the Sri Lankan system.

109. Consequently, with growing patient expectations, awareness and demand for physician care, there is an increasing tendency for patients to seek care from higher-quality facilities, a trend that is most easily seen in the case of childbirth. In response to this, the public sector has demonstrated considerable flexibility and dynamism, by incrementally expanding higher-level facilities over time, and by gradually upgrading facilities to provide better services.

110. Most public sector curative care and primary care services are provided by hospitals. Outpatient care in hospitals is provided by both general and specialist outpatient departments (OPDs). General OPDs are staffed by junior medical officers, who only have basic medical training, and other health staff, and patients are seen on a first-come-first-served basis during their official opening hours, which are typically 8.00 am to 12 noon and 2.00 pm to 4.00 pm. OPDs are busy and crowded in large hospitals, and patients typically see the doctor for less than five minutes each. There is no system to maintain patient records in most. Specialists run specialist OPDs, and patients must first be referred and registered before they can access these services.

111. Despite the substantial provision of hospital services, there is no publicly funded or organized general practitioner service, as in European countries. So with exception of pregnant mothers, patients cannot register with a primary care physician to obtain regular and continuous care of their health problems. The lack of such a system is historically because the Sri Lankan public sector was never expanded beyond its hospital core to put in place such arrangements. The principle reason has been lack of financing.

112. Public sector preventive and public health services are primarily provided through Medical Office of Health units (MOHs), the main focus of which is to provide maternal and child health (MCH) and family planning services. Their organizational model was developed in the 1920s, and they provide maternal, infant and family planning services through teams consisting of medical officers, community midwives and others. This part of the delivery system is vertical in nature, since it is tightly coordinated and supervised by central ministry directorates, and in practice operates on highly standardized procedures.

113. The private sector provides mostly general outpatient services, but the supply of inpatient and specialist services is increasing. Most private outpatient care is by 5,000-9,000 government medical officers who engage in private practice in their off-duty hours. These government medical officers working privately staff most of the private sector's inpatient and outpatient services. About a thousand full-time private independent practitioners, who provide mostly general practitioner services, supplement them. They are mostly located in urban areas, so most private provision in other provinces and in rural areas is by public sector physicians (Hsiao and Associates, 2001; Rannan-Eliya, Jayawardhane, and Karunaratne, 2003).

114. Private hospital services have shown significant growth in recent years. They remain concentrated in the Colombo district and a few provincial urban centres. Many of the newest private hospitals are large facilities offering high technology services, which are not available or only available in limited volumes in the public sector.

3.2 General patterns of utilization of curative care services

Levels of curative care utilization

115. Sri Lanka's extensive healthcare system facilitates a high level of healthcare utilization by the population. Overall levels of utilization of curative care services at 4-5 physician visits per capita and 23 hospital admissions per 100 capita per annum are high for a lower-income developing country, and in volume terms are comparable to OECD nations (Table 6).

Table 6: Annual rates of medical care utilization, Sri Lanka and OECD nations

Indicator	Sri Lanka (2006)	OECD range
Outpatient visits per capita	4-5	3-14
Inpatient admissions per 100 capita	22-24	6-28
Acute care bed-days per 100 capita	90-100	40-180
Bed-occupancy rate	74%	65-91%

Source: IHP estimates from MOHN and IHP data, OECD Health Data 2008.

116. Provision of curative care is by both public and private sectors, and the each sector's relative contribution has not changed substantially in the past three decades (Table 5). The public sector dominates inpatient provision, accounting for more than 90% of all inpatient admissions in the country as a whole, and more than 95% of all admissions in the regions outside Colombo. However, outpatient provision is almost equally split between public and private provision, with people in all income levels making significant use of both public and private services, although use of private services is greater in urban than rural areas.

117. It is important to emphasize that the high rates of healthcare use in comparison to other developing countries do not mean that Sri Lankans make excessive use of healthcare services, since being sicker on average and dying earlier than people in OECD nations, Sri Lankans actually have greater need and should be making more use of healthcare services than people in OECD nations. In the past, external commentators on the Sri Lankan healthcare system have sometimes argued that excessive use of medical care is the main problem in Sri Lanka, but this type of argument has always lacked actual evidence or been based on comparisons of the rates of unnecessary care between Sri Lanka and other countries, which is anyway very difficult to do.

118. Nevertheless, in comparative terms, the rate of inpatient care utilization in Sri Lanka is relatively higher than outpatient utilization. Outpatient utilization rates are at the lower end of those seen in OECD nations, whilst inpatient utilization rates are at the higher end. This relatively high rate of use of inpatient care is well known. As was pointed out by the earlier World Bank's assessment of Sri Lanka's health sector, the main explanation for this is the high pressures that the public sector has to operate under (Hsiao and Associates, 2001). Given the lack of adequate primary care services in the community, patients go to hospital outpatient departments to consult for most minor illnesses. There the pressure of patients (physicians may see over 100 patients a day) and the lack of adequate diagnostic facilities result in a high frequency of uncertain diagnoses, and risk-averse physicians rationally respond to the diagnostic uncertainties by admitting many patients for observation. This commendable behaviour will be hard to eliminate until adequate primary care provision is made available to handle routine illnesses outside the hospital sector. At the same time, it must be noted that the main reason why this has not happened is that the alternative of extensive primary care provision would cost the government more than the current hospital-dominated public system. The predominant emphasis on hospital care and inpatient treatment have in fact been the key to how Sri Lankan has achieved high levels of healthcare provision despite limited resources.

Utilization by type of institution

119. The curative care institutions of MOHN and the provincial departments of health account for almost all public sector curative care provision, with only a very limited volume of other services being provided by a few dispensaries run by municipal councils, and two small hospitals for the army and police.

120. The bulk of both inpatient and outpatient curative care is provided by tertiary and secondary level facilities, with tertiary institutions accounting for over one third of all patient admissions and a greater proportion of bed-days. However, in outpatient care, the primary and secondary level institutions account for most of the provision, although primary level institutions themselves only account for a quarter of all visits in the public sector (Table 7). This reflects the general trend, for at least the past half-century, for public sector patients to increasingly opt to access and use higher-level facilities, even for routine, minor care.

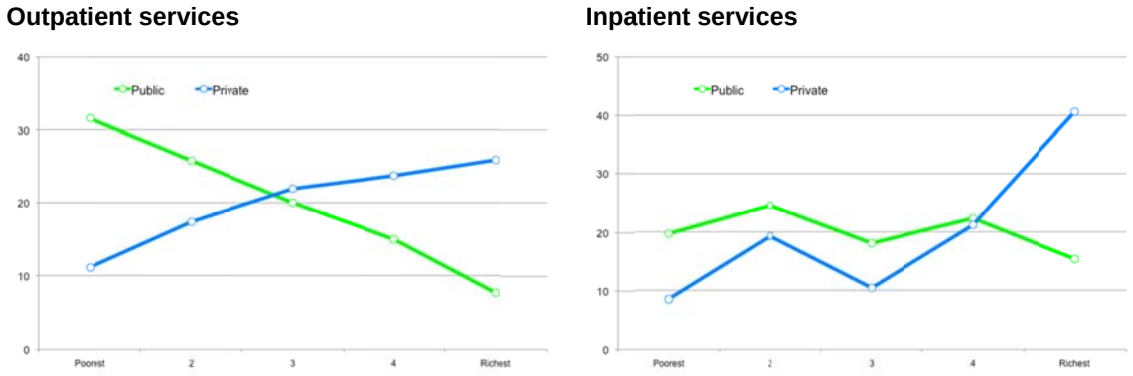
Table 7: Distribution of public sector institutions and patient utilization by level of facilities, 2003

	Number	Beds (%)	Admissions (%)	Outpatient visits (%)
Teaching hospitals	18	25.8	28.7	11.2
Provincial hospitals	6	7.8	10.6	4.2
Base hospitals	38	17.3	23.0	14.9
District hospitals	159	24.1	21.6	26.3
Peripheral units	98	7.8	6.7	10.9
Rural hospitals	183	7.7	6.5	13.1
Others	505	9.6	2.9	19.4
Total number		59,262	4.0 million	43.8 million

Source: Medical Statistician, Ministry of Health.

Utilization by income level

121. The overall volume of use of curative services is essentially equal across income levels, although if the need for medical care were greater amongst the poor, the use of care would not be equitable. However, unlike in other countries, the evidence on this is mixed in Sri Lanka, with some health indicators, such as infant and child mortality being higher amongst the poor, but overall mortality rates possibly higher amongst the better-off (Figure 21).



Source: IHP estimates from CB CFS 2004/2004.

Figure 21: Share of healthcare utilization of outpatient and inpatient services in public and private sectors, by household quintile (%), Sri Lanka 2004

122. Despite this, patterns of use of public and private services do differ, with public services used more by the poor than by the rich, and private services used more by rich patients. These gradients are most pronounced for outpatient care, whilst for inpatient care all income groups, except the very richest, make almost equal use of public hospitals (Figure 21). It is worth noting that this pattern of use of public and private services by income level is unusual, and elsewhere in Asia only seen in Malaysia, Hong Kong SAR and some Pacific islands.

Utilization by cause of illness

123. Although comprehensive data on the illnesses of patients seeking care at curative care facilities are not collected, the profiles of morbidity in government inpatients and private outpatients provide a reasonable representation. Table 8: Leading causes of patient morbidity in Sri Lanka, inpatients and outpatients profiles the leading diagnoses and problems seen in each sector, using data from 2003 (government inpatients) and 2000 (outpatients at private general practitioners). As can be seen injuries, respiratory illnesses, viral diseases, and admissions for investigation or with unclear diagnoses are the leading reasons for admission. On the outpatient side, minor illnesses and complaints such as viral fever, asthma, and respiratory tract infections are the leading patient problems.

Table 8: Leading causes of patient morbidity in Sri Lanka, inpatients and outpatients

Inpatient morbidity by cause	%	Outpatient morbidity by problem	%
Traumatic injuries	16.1	Viral fever	15.6
Diseases of respiratory system	9.7	Asthma	6.3
Symptoms and signs not elsewhere classified	8.7	Upper respiratory tract infection	5.2
Viral diseases	6.4	Hypertension	4.8
Disease of gastrointestinal tract	5.9	Respiratory infection	4.2
Direct and indirect obstetric causes	5.4	Gastritis	3.2
Diseases of the urinary system	4.0	Gastroenteritis	2.8
Intestinal infectious diseases	3.7	Lower respiratory tract infection	2.2
Diseases of musculoskeletal system and connective tissue	3.3	Urinary tract infection	2.0
Diseases of skin and subcutaneous tissue	3.9	Muscle pains	2.0

Source: Inpatient morbidity statistics for 2007 kindly provided by Medical Statistician, Ministry of Health. Outpatient morbidity statistics from Rannan-Eliya et al. (2003).

Note: The statistics in each column are not strictly comparable, since MOH classifies inpatient morbidity according to its own statistical classification, which is based on ICD-10, whilst the survey from which the outpatient morbidity data are obtained classified morbidity using the WHO-recommended ICPC-2 (International Classification of Primary Care, version 2) classification.

124. Figure 22 provides a more comprehensive profile of inpatient admissions at government hospitals in 2005. NCDs account for 36% of all admissions, and almost half of these are injuries. The other major NCD conditions are cardiovascular disease, diabetes and asthma.

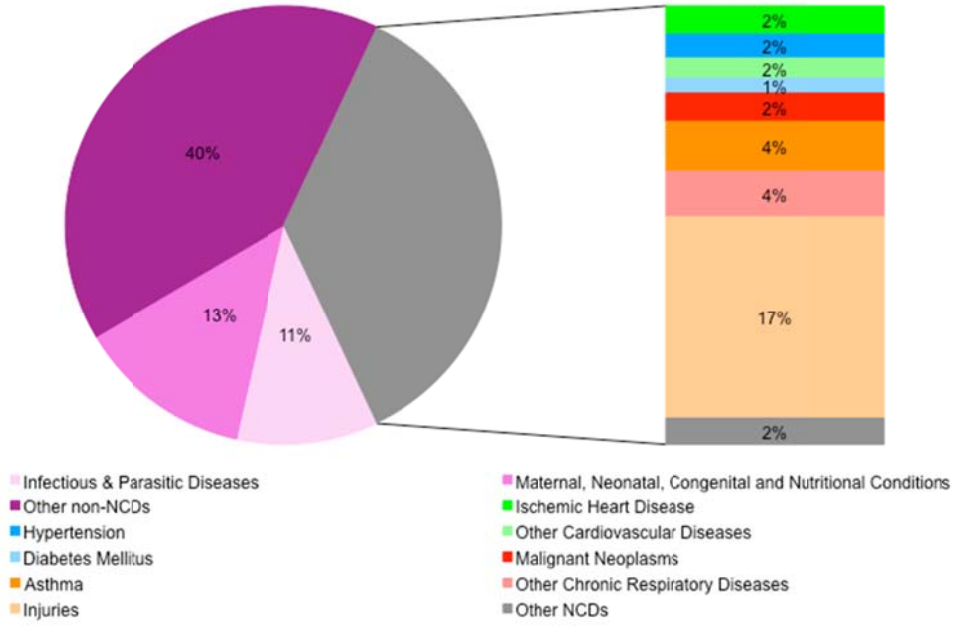


Figure 22: Distribution of inpatient admissions at MOHN hospitals by categories of disease (%), 2005

3.3 Patterns of curative care services by patients with NCDs

Data availability

125. Systematic data on the use of curative care services by patients with NCDs are limited, and largely restricted to public services. The private sector, which accounts for half of all outpatient provision, reports no data to the health information system. Available estimates of the volume of patient turnover in the private sector are based largely on inferences made from occasional surveys of households and private hospitals. There has been only one national survey in 2000 of patient morbidity in the private outpatient sector, and even this was restricted to patients seeing full-time private general practitioners (Rannan-Eliya, Jayawardhane, and Karunaratne, 2003). Consequently, the following analysis focuses on the patterns of curative care use for NCDs by government inpatients.

126. Within the public sector, every inpatient discharge is counted and a record kept of their diagnosis and age and sex. Inpatient diagnoses are recorded using ICD-10, or a shorter list of over 200 larger groupings of ICD-10 categories. In higher-level institutions, trained medical records officers are responsible for the coding. These data are then aggregated by these larger groupings, and by broad age-categories and sex, and reported, together with data on bed-occupancy and inpatient mortality, in the monthly inpatient morbidity return submitted to MOHN. These returns are aggregated as they are compiled, so at the national level only aggregate numbers of annual patient discharges are available to the health information system, with separate breakdowns by broad disease groups and by broad age

categories and sex. Owing to the level of aggregation, at the national level it is not possible to analyze inpatient discharges by bed-days or to make any further cross-tabulations by disease or age. In the case of outpatient visits to government health institutions, only the number of visits is reported nationally, and no routine data are collected on the reasons why patients visited.

127. To address this gap, the Institute for Health Policy, in collaboration with the Ministry of Health, conducted a sample survey of 10,000 patient discharges in government hospitals in 2005, extracting data on the diagnosis, age, sex, treatments given and outcome on discharge (Perera et al., 2009). These data represent the only nationally representative database of patient level records available for analysis of inpatient discharges by types of disease. The data from this Public Hospital Inpatient Discharge Survey (PHIDS) 2005 have been used to supplement the national data to develop the estimates and projections reported in this chapter.

Contribution of NCDs to curative care use

128. One third of all hospital admissions in the public sector are due to the major NCDs. Their importance at each level is shown in Table 9. As can be seen, injuries account for half of all these admissions at all levels of the system, although a bigger share of admissions at primary and secondary institutions than tertiary ones. Of the rest, asthma is the leading cause of admission at all levels, but it is much more important at primary level (8% of admissions) than in higher-level institutions (2-3%). The next major cause NCD admissions is heart disease (hypertensive and ischaemic heart disease). Malignant neoplasms account for almost no admissions at primary level, but the share increases at higher levels.

Table 9: Percentage of patient discharges accounted by selected NCD and other conditions at different levels of healthcare institutions, Sri Lanka 2005

Primary diagnosis	Tertiary	Secondary	Primary	All levels
Asthma	1.8	3.0	7.7	4.2
Other chronic respiratory disease	2.1	3.2	5.8	3.7
Diabetes mellitus	1.1	1.4	1.2	1.2
Ischaemic heart disease	1.8	2.4	1.8	2.0
Hypertension	0.9	1.5	3.5	1.9
Other cardiovascular disease	2.2	2.2	1.4	2.0
Malignant neoplasms	6.5	0.5	0.2	2.3
Other NCDs	3.3	1.6	1.5	2.1
Injuries	11.1	18.5	19.7	16.6
Maternal/neonatal/congenital/nutritional	13.4	16.3	7.8	12.6
Infectious & parasitic disease	6.7	8.3	16.6	10.5
Others	49.2	41.1	32.8	40.9
Total	100.0	100.0	100.0	100.0

Source: Authors' estimates from PHIDS 2005 (Perera *et al.*, 2009)

Note: NCD causes ranked in order of decreasing size.

129. Table 10 provides additional information on the inpatient demand from NCDs. It classifies the overall composition of inpatient discharges, bed-days and costs in the public

sector in 2005. Injuries account for the largest share of overall patient discharges and also hospital costs. However, as can be seen the average length of stay (ALOS) for injuries is relatively short, indicating that most such admissions are for minor injuries. Although some NCDs, such as diabetes account for only a small proportion of actual discharges, they account for a greater proportion of bed-days, and overall inpatient costs. Diabetes, malignant neoplasms and other cardiovascular diseases in particular tend to be more costly than the average admission. In general, the more expensive NCD diseases are more likely to be handled in higher-level hospitals (see Table 10).

Table 10: Patient discharges, bed-days and inpatient costs by major NCD categories in the public sector, Sri Lanka 2005

Cause	Discharges (%)	ALOS (days)	Bed-days (%)	Costs (%)
Injuries	16.6	3.4	13.4	14.7
Malignant neoplasms	2.3	10.8	5.8	7.2
Other cardiovascular diseases	4.0	4.4	4.1	5.8
Chronic respiratory diseases	7.9	4.0	7.4	5.2
Diabetes mellitus	1.2	6.3	1.8	1.5
Hypertension	1.9	3.8	1.8	1.0
Other NCDs	2.1	10.4	5.3	3.7
Infectious & parasitic diseases	10.5	3.6	8.9	7.4
Maternal, neonatal, congenital and nutritional	13.0	5.2	15.8	17.7
Other	40.5	3.7	35.7	35.8

Source: Authors' estimates from data collected in PHIDS 2005, and cost estimates from IHP Sri Lanka disease-specific accounts project.

130. The pattern of NCD admissions by income level of patients cannot be estimated, as no appropriate data sources exist. However, the relative burden of NCDs by income level can be assessed to some extent by the analysis of NCD mortality by socio-economic status of small areas reported elsewhere in this report.

International comparison of NCD inpatient demand

131. The rates of hospital admission for selected major NCDs are compared with the statistics for OECD countries in Table 11. As this shows, overall rates of inpatient demand for many NCDs are already comparable to the average in OECD economies, despite Sri Lanka's relatively younger population, although those for myocardial infarction are comparably low. This reinforces the view that the demand for curative care posed by NCDs in Sri Lanka is already comparable to that in developed countries.

132. The most notable difference in Table 11is that admission rates for asthma are ten times higher than the OECD average, and three times higher than the highest rate reported by any OECD country. Asthma is inherently a treatable disease through appropriate medical care, so hospitalization for asthma is essentially a consequence of insufficient medical treatment in the community. For this reason, asthma admission rates are used in many OECD countries as a health system quality indicator. For example, asthma admission rates are a High Level Performance Indicator in the UK National Health Service, and both paediatric and adult admission rates are part of the US National Healthcare Quality Report (OECD,

2007). This exceptionally high rate of admissions for asthma points to serious deficiencies in quality of care for asthma in Sri Lanka.

Table 11: Rates of admission for selected NCDs (discharges per 100,000 population), Sri Lanka and OECD countries 2005

Cause of admission	Sri Lanka	OECD mean	OECD range
Acute myocardial infarction	70	183	15 – 390
Diabetes Mellitus	177	197	66 – 498
Schizophrenia	87	93	4 – 370
Asthma	893	97	27 – 301
Bronchitis/COPD	138	200	20 – 414
Cataracts	196	208	2 – 902

Source: Sri Lanka estimates are authors' computations using data from the PHIDS 2005 (Perera *et al.*, 2009), and are for public sector only. OECD estimates are from OECD Health Data 2008.

3.4 Future trends in healthcare utilization and costs due to NCDs

Projecting future inpatient demand

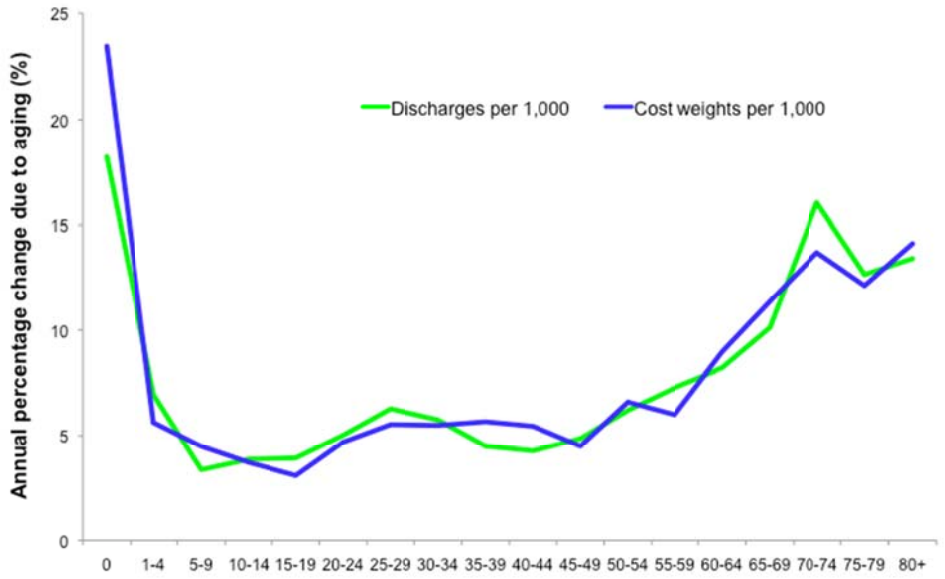
133. Building on a model originally conceived with funding from the US National Institute on Aging, Rannan-Eliya (2008) has previously developed projections of future healthcare costs in Sri Lanka. This study found that population ageing would only be one of many factors to influence growth in future healthcare costs. It concluded that changes in healthcare seeking behaviour, in public sector productivity, and in private sector price inflation would be equally important determinants, and that sustained productivity growth and continued public sector dominance of financing would be able to minimize the impact of ageing. These projections, however, did not explore further the trends in demand for curative care, or look specifically at trends in specific diseases.

134. It is not possible to meaningfully project future trends in utilization of NCDs in Sri Lanka at the current time, as there is a lack of data on past trends in prevalence, as well as minimal data on the relationships between risk factors and disease prevalence in most cases. Such projections if they are to be robust enough to be useful for planning, would need extensive data, as well as analytical resources beyond the scope of this study. Nevertheless, in order to explore some of the aspects of future trends, a projection model was developed to project the impact of population ageing on future inpatient admission rates of NCDs. This was based on the comparable analysis for the USA – *The Effect Of Population Aging On Future Hospital Demand*, by Strunk *et al.* (2006).

135. Data from the Public Hospital Inpatient Discharge Survey (PHIDS) 2005 (Perera *et al.*, 2009) were used to generate for 2005, estimates of admission rates per capita for each age and sex group in the population for major disease categories. The PHIDS data are coded for cause of admission using ICD-10, and the ICD-10 codes were used to group discharges into disease categories. The PHIDS data were then linked to estimates of inpatient expenditure by disease produced in the IHP Sri Lanka Disease Accounts Study. Having linked them in this way, the mean government cost in 2005 of admissions in each disease category, by age and

sex, was computed, and a relative cost weight assigned to each class of admissions. This allows consideration of the differences in costs of treating patients in different disease categories, and in different age and sex groups.

136. Figure 23 presents the computed relative rates of admissions and the relative rates of inpatient costs in cost weights by age in 2005. As can be seen, the two lines generally coincide, and in Sri Lanka there is insufficient evidence to conclude that the relative unit costs of admissions by older patients is more than the average.



Source: Authors' calculations from data of the PHIDS 2005 and the IHP Sri Lanka Health Accounts Study

Figure 23: Discharges and charge weights per 1,000 population of each age, distributed by age, 2005

137. This pattern contrasts with that in the USA, where Strunk *et al.* report that the relative unit costs of admissions in the over 60 years age group is higher than for other ages. The lack of an observed difference in Sri Lanka may be partly due to fewer and less precise data available in Sri Lanka, but it also indicates that such differences in cost by age are still small in Sri Lanka compared with the USA. This is not necessarily surprising, since healthcare provision in Sri Lanka is not as capital or technology intensive as in USA, and so cost variations by age in Sri Lanka largely relate to differences in lengths of stay that are small.

138. Using the IHP population projections for Sri Lanka (De Silva, 2007), the rate of admissions for reach disease category was then projected forward over the period 2005 to 2050, by taking account of the projected changes in the age and sex structure of the population. This allows assessment of how future population ageing might affect the pattern of inpatient care use, both for NCDs and other diseases. The modelling assumes that age-sex specific rates of inpatient admission for each disease category will not change. In reality, this is unlikely to be the case, but to project future trends in the age-sex specific rates of admission would require the modelling of future disease prevalence, which is not feasible for

Sri Lanka at present, or historical trend data on age-sex specific rates of admission which are not available.

139. Having projected the future rate of hospital admissions by disease, consideration was given to what impact this would have on the cost of hospital admissions. To do this, the relative cost weight of admissions in each disease category was taken into account, so that if the rate of admission for more expensive diseases increased more, this would be reflected in the results. In doing this, the unit costs of admissions were kept at the level of 2005, which assumes that there is no increase in the real unit cost of inpatient services.

Projected trends in inpatient admissions and costs

140. The net impact of population ageing on overall rates of inpatient admission per capita, and on overall costs per capita are given in Figure 24. The projection results indicate that both will increase at approximately 0.4% each year between 2005 and 2030, before showing a modest decline in the rate of increase.

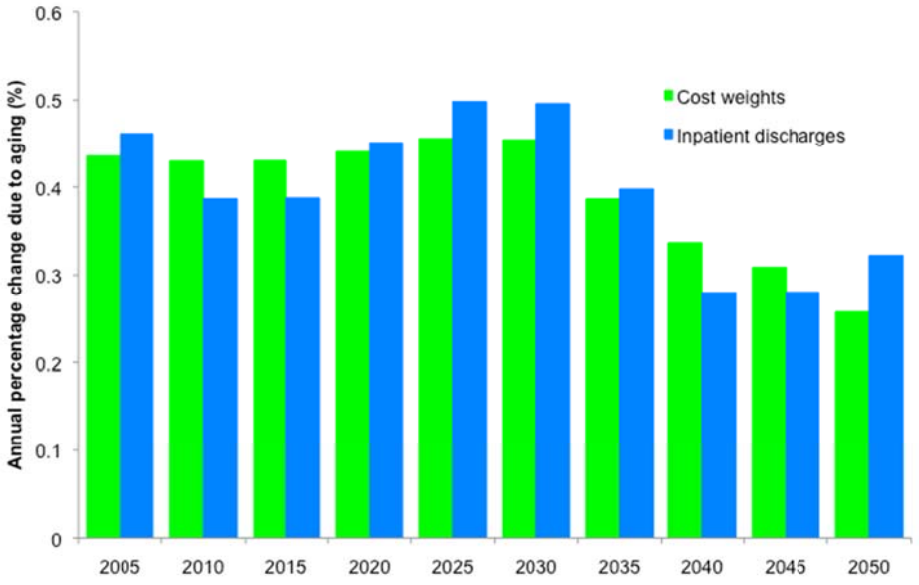


Figure 24: Effect of ageing on per capita hospital admission rates and costs, Sri Lanka 2005-2050

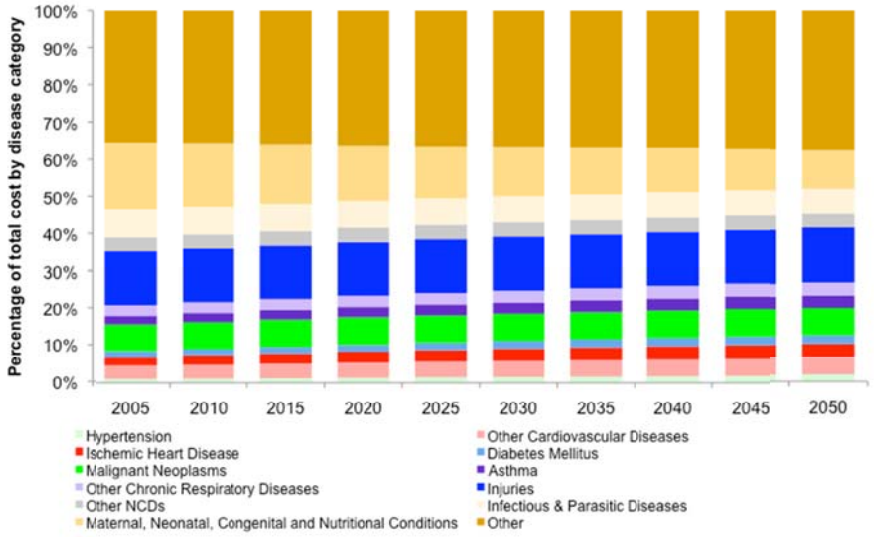
141. Consistent with the patterns noted in Figure 23, the results also imply that there will be little difference between the increase in costs and in admissions. This is different from the US projections, which imply that costs will increase faster than overall admissions, owing to admissions by older people being more expensive than average. However, given the small sizes of the sample data derived from the PHIDS 2005, and the impreciseness in currently available cost estimates for Sri Lanka, it can not be definitively concluded that such a difference in future rates will not arise in Sri Lanka as well.

142. Having projected total hospital admissions, the model was then used to examine how admissions and admission costs will change for different categories of medical conditions.

The projected rates of change in per capita admission costs are shown in Table 12, which also ranks the conditions in descending order of rates of change. What the table indicates is that per capita hospital costs will increase by 6% in real terms from 2005 to 2020. This is mostly due to the impact of the increases in admission rates owing to population ageing, with minimal impact from the changing composition of medical conditions in an older population.

143. The medical conditions which will see the largest increases in per capita costs will be hypertension, ischemic heart disease and diabetes, which will see increases respectively of 40%, 37% and 30% in national per capita spending. In general, NCDs and chronic conditions will see the largest increases in costs, and these will more than enough to outweigh the cost savings likely to be seen from maternal and neonatal causes, and infectious disease.

144. What these projections confirm is that the increased age of the population will lead to increased rates of admission for NCDs, and these trends will increase pressure on costs faster than the cost savings likely to be achieved from lower rates of admission for maternal and neonatal conditions, and infectious diseases. The largest increases in overall costs will be due to hypertension, ischemic heart disease and diabetes. Consequently, the overall share of admission costs accounted for by the major NCDS will increase from 39% in 2005 to 42% in 2020, and further to 45% in 2050 (Figure 25).



Note: These results are from an ongoing IHP analysis of future hospital inpatient costs in Sri Lanka. Details of the methods and data sources will be provided in a forthcoming IHP publication.

Figure 25: Projected distribution of future inpatient costs by major condition, 2005-2050

Table 12: Effect of population ageing on growth in per capita hospital admissions and costs, by major causes of admission, 2005-2020

Medical condition*	Relative cost weights per 1,000 population	Effect of population only on	
		Average annual percent change per person (%)	Total growth per person (%)
All conditions	212.8	0.4	6.3
Hypertension	2.2	2.5	40.2
Ischemic heart disease	4.5	2.3	37.0
Diabetes mellitus	3.3	1.8	29.5
Other cardiovascular diseases	7.7	1.5	23.7
Malignant neoplasms	15.2	1.3	21.4
Asthma	5.1	1.3	20.5
Other chronic respiratory diseases	5.9	0.7	11.2
Other	76.2	0.5	8.6
Other NCDs	7.9	0.5	7.4
Injuries	31.3	0.0	0.1
Infectious & parasitic diseases	15.8	-0.1	-1.8
Maternal, neonatal, congenital and nutritional conditions	37.7	-0.6	-10.3

Source: Authors' computations.

Chapter 4: Issues in the ability of the health system to treat and manage NCDs

4.1 Organization of curative care services for NCDs

Structure of service delivery system

145. Sri Lanka's current healthcare delivery system is not geared to provide curative care services for NCDs in an organized and coherent manner. Curative care for NCDs has evolved by default as a passive expansion of the activities of the existing service delivery infrastructure, which was originally designed to meet the needs of a country where maternal and child health and infectious diseases were the priority problems. The effective management of NCDs and many other conditions requires a modernization and re-engineering of healthcare delivery to meet the issues that have now become predominant. This has not yet happened. As with the rest of the delivery system, there is also no coordination between the public and private sectors in the provision of NCD care. Although a national NCD policy has been finalized in 2009, it is not currently linked to a budgeted and detailed work plan for restructuring delivery of curative care for NCDs.

Organization of public sector NCD care service delivery

146. The current national approach to delivery of healthcare services makes no targeted provision for NCDs within the public sector, beyond some modest efforts at individual institutions. NCD patients can seek outpatient or inpatient care at any level of the government delivery system, and if they are new patients, they will be seen mostly by junior doctors staffing the general OPD clinics. At the national level, there is no system in place to encourage people to seek and to obtain regular screening for NCDs, with the exception of women, for whom some provision is made through well-woman clinics. A few districts have recently piloted schemes to undertake mass screening for NCDs, but these are small scale, and their future is uncertain.

147. If patients have been diagnosed with an NCD, such as hypertension, diabetes, asthma, or ischaemic heart disease, this usually happens when they present to an OPD clinic with overt symptoms, or if they are admitted as an inpatient for treatment of complications. If they are previously undiagnosed patients, there are no systematic procedures in place in most institutions to ensure that standard diagnostic and treatment procedures are followed, so diagnosis depends on the clinical awareness and training of the physicians involved. Although national treatment guidelines and protocols have been developed for all major NCDs as part of the current World Bank financed Health Sector Development Project, this effort has a number of deficiencies. First, there does not appear to be any sustained and systematic effort to ensure continuous training of all frontline clinical staff in these materials, and follow-up training of new staff, and monitoring of the implementation of training has been poor. Second, the treatment protocols were distributed on CD-ROM, but many peripheral institutions lack the computer facilities to make use of such products, whilst limited resources have been invested in providing access to paper-based guidelines. Third, the initiative was undertaken more as a project, and was not embedded in an overall national process to continuously review and update the guidelines, as is the case in countries such as UK or USA which follow this type of approach.

148. Once diagnosed, patients are referred to a specialist for continuing care and management, and in many higher-level institutions these patients will be permanently registered in specialist clinics, where they can continue to obtain care on a regular basis. At these clinics, patients may be given regular appointments for routine follow-up and management, as well as supplies of medication. This specialist-led treatment model, where patients are managed in specialist clinics, is currently the predominant one for managing NCDs in the public sector. Complications and advanced stage conditions related to NCDs are also handled in this way, or by admission at government hospitals.

149. The type of specialist clinics offered varies between districts and institution, and depends on the local availability of relevant specialists, as well as the internal decisions made by hospital directors, and deputy provincial directors of health at the district level. These clinics generally are only available where there are medical specialists, and so they are restricted to institutions at the level of base hospitals and above. Two other factors reinforce the restriction of these clinics to higher-level institutions. First, the laboratory facilities or diagnostic equipment that are typically needed to manage NCDs, such as measurement of A1C (glycated haemoglobin) or blood lipids, are only available at higher-level institutions or not available at all.[4] Even low-tech diagnostic equipment, such as peak-flow meters[5] are not available at district hospitals or level-level institutions. Second, many of the medicines that are needed for routine management of NCDs are not available at lower-level institutions and often not even at higher-level institutions, for reasons discussed further below. When medications or tests are not available in facilities, patients are often asked to self-purchase the medications from private pharmacies or obtain the tests from private laboratories, or may not be given any advice at all.

150. Outside these specialist clinics, the delivery system is not able to provide organized, continuing care of NCD patients. In general OPD clinics, there is no system to ensure follow-up management of NCD patients, supported by the necessary access to permanent medical records. MOH units might be somewhat better placed in providing follow-up care, but they typically lack access to the necessary medications and laboratory facilities, as well as the necessary training in NCD case management. In addition, MOH units are primarily orientated towards screening and MCH activities, and it is not evident that they are naturally suited to providing NCD care on a continuing basis.

151. Patients appreciate these limitations in the system, and so most diagnosed patients show a strong preference to continue to obtain care from the specialist clinics. This leads to systematic bypassing of the primary level institutions for NCD care, with patients in rural areas often travelling long distances and spending considerable time to access the specialist clinics. The need to travel long distances to access specialist clinics, and the common need to spend significant amounts to obtain necessary medications and tests for NCD care is frequently reported as the number one complaint and cause of dissatisfaction amongst public sector patients. Such findings were made in the studies conducted for the JICA Health Master Plan project in the early 2000s (JICA Study Team, 2003), and again in the patient surveys commissioned by the HSDP for the Annual Health Forum 2006.

---

[4] A1C tests are the preferred method for monitoring blood glucose control in diagnosed diabetic patients, and screening for blood lipids is a critical test for diagnosing patients with high risk of cardiovascular disease, and in managing their care. A1C tests are not currently available, even at the Sri Lanka National Hospital in Colombo, which is the apex referral institution in the country.

[5] Peak-flow meters are an essential part of routine management of asthma, and in developed countries are often made available to patients for their own home use owing to their low cost.

152. However, not all patients are fortunate enough to be identified early and to be assigned to a well-provisioned, specialist clinic that they can afford to routinely visit. Many patients are not so assigned, and so fail to obtain adequate continuity of care, and many patients also find that the cost of self-purchasing medications is so excessive that they choose to go without regular medication. Consequently, for many patients, NCDs are not properly managed, and subsequent progression to disease complications and eventually hospital admission or death is not prevented.

153. If NCD patients need specialized interventions, the public sector often makes some provision, but availability is typically very limited. So for example, complex procedures such as coronary bypass graft surgery (CABG) are available for free from government teaching hospitals, but the overall volume of supply is such that most patients needing such services will not obtain the treatment in adequate time. Currently, approximately 1,000 CABGs are undertaken in government hospitals each year, which translates into a rate of less than 20 per 100,000 persons aged 40 years or more, which can be compared with rates of 40-600 in OECD economies

154. Similarly, chemotherapy or radiotherapy treatments for cancers are provided by a few government institutions, such as the National Cancer Institute, but again only with a limited capacity. The limited geographical distribution of these services also means that patients in most parts of Sri Lanka are not in a position to avail themselves of these services, without incurring substantial personal costs.

Organization of private sector NCD care service delivery

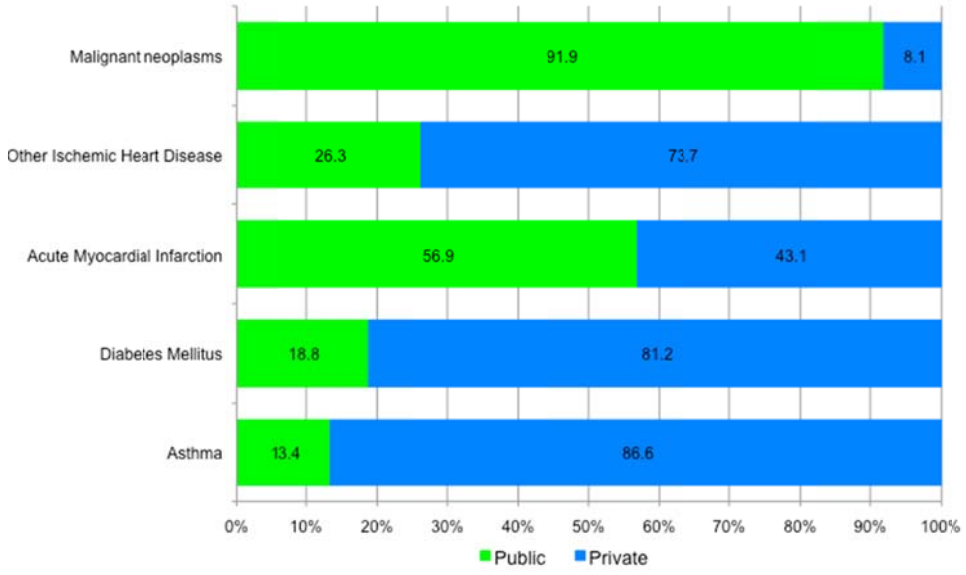
155. The private sector only provides care to those who are in a position to pay. NCD patients obtaining care in the private sector need to directly pay for the cost of consultations, any laboratory tests needed, as well as all medications. Since NCDs are typically excluded from coverage as pre-existing conditions, private health insurance generally does not pay for NCD care (JICA Study Team, 2003). Nevertheless, use of private outpatient care is common by both high and middle-income Sri Lankans, as outpatient consultation is affordable for many (Figure 21). To the extent that NCD patients can identify a doctor that they can see on a routine basis, access to continuity of care is feasible. This is most likely in the case of the minority of private sector physicians, who are full-time private family or general practitioners, or who are government specialists with established private sector practices. However, such practitioners are only found in urban areas, with almost no full-time private general practitioners operating in rural areas.

156. There is limited evidence on the quality of care given to private sector patients, but past studies indicate that the quality of treatment for common NCDs given by private general practitioners may be high. For example, analysis of data from the Sri Lanka Private Clinic Survey 2000, indicates that the pattern and appropriateness of drugs prescribed, the type and number of interventions, and the overall level of referrals for patients with asthma and hypertension seen by private general practitioners in Sri Lanka are comparable with the patterns reported for Australian primary care physicians (Rannan-Eliya, Jayawardhane, and Karunaratne, 2003). This is almost certainly related to the high levels of formal training in family practice of these private general practitioners, and a high degree of professionalism that most gained following training in the public sector. However, such levels of quality may not be representative of the care received by most private sector patients, since these general practitioners see less than 15% of all private patients. Junior government doctors working in their off-duty hours, with no formal training in family medicine, see most private sector patients.

157. In recent years, there has been a significant increase in supply of high-technology NCD treatments by private sector hospitals. These range from CABGs and angioplasty procedures for heart disease, to specialized radiotherapy services. For some services, private sector provision may now be greater than that in the public sector, for example, coronary angioplasty. However, access to such services is limited to the richest Sri Lankans, and they remain out of reach of the average person. To that extent, private sector provision of these services is making no material impact on the overall NCD burden in the country.

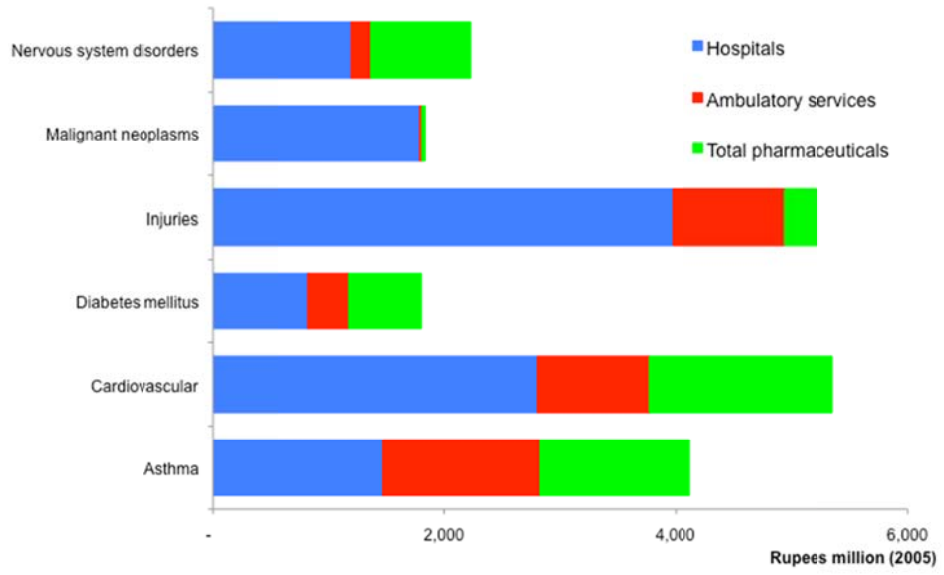
Financing of NCD expenditures

158. Owing to the deficiencies in the system, financing of routine treatment for NCDs tends to be mostly private. Private sector patients pay for almost all their treatment costs, whilst public sector patients frequently must pay for the costs of prescribed medicines and needed laboratory tests. However, for emergency inpatient care of NCDs and for serious NCD illnesses, such as malignant neoplasms, most patients have to rely on the public sector. Figure 26 illustrates the relative contributions of public and private financing to spending on several major NCDs, using the work of IHP to produce disease-specific accounts for Sri Lanka. As can be seen, treatment of malignant neoplasms and acute myocardial infarctions is mostly or predominantly publicly financed, whilst expenditures on chronic NCDs, such as diabetes, asthma and heart disease are predominantly privately financed.



Source: Computed from estimates of IHP Disease Accounts Project.

Figure 26: Expenditure on major NCDs, by public and private sources (%), Sri Lanka 2005



Source: Computed from estimates of IHP Disease Accounts Project.

Figure 27: Expenditure on major NCDs, by major spending areas (%), Sri Lanka 2005

159. Figure 27 shows how spending on selected NCDs is distributed by area of spending. For those NCDs where private financing is predominant, most spending is for medicines and for ambulatory care services. It is because patients must mostly finance these costs themselves that these conditions are predominantly privately financed. These point to a significant under-financing by the public sector of medicines and ambulatory care for NCDs. As this is an important issue, although not the only one, the next section examines in greater detail some of the problems related to the supply of NCD medicines.

4.2 Supply of medicines for NCDs

Availability of essential medicines for NCDs in public sector

160. Substantial under-provision of the essential medicines required for routine management of chronic NCDs is the prevalent feature of Sri Lanka's public sector. Both international (WHO and global best practice guidelines for developing countries), as well as Sri Lanka national clinical guidelines, recommend the use in primary care of relatively cheap, essential medicines for secondary prevention and treatment of complications of the major, chronic NCDs (IHD, diabetes, asthma). In Sri Lanka, there is an overall limited supply of these medicines at all levels, and a definite absence of supply at the primary care level.

161. Evidence for this lack of availability is long-standing. In a WHO study, Mendis *et al.* (2005) assessed the extent to which registered IHD patients being treated at health facilities receive adequate secondary prevention in ten developing countries, including Sri Lanka. In Sri Lanka, the study looked at diagnosed IHD patients registered in a secondary level institution. They found that patients in most developing countries are inadequately treated, but surprisingly, that levels of treatment were lowest in Sri Lanka. For example, only 8.7% of

IHD patients in Sri Lanka were receiving beta-blockers, compared with 34-72% in the other countries studied. Similar disparities were reported for the use of aspirin, ACE inhibitors and statins. Despite Sri Lanka's vaunted good access to health services, IHD patients receive worse treatment than in many developing countries, including those with weaker health systems.

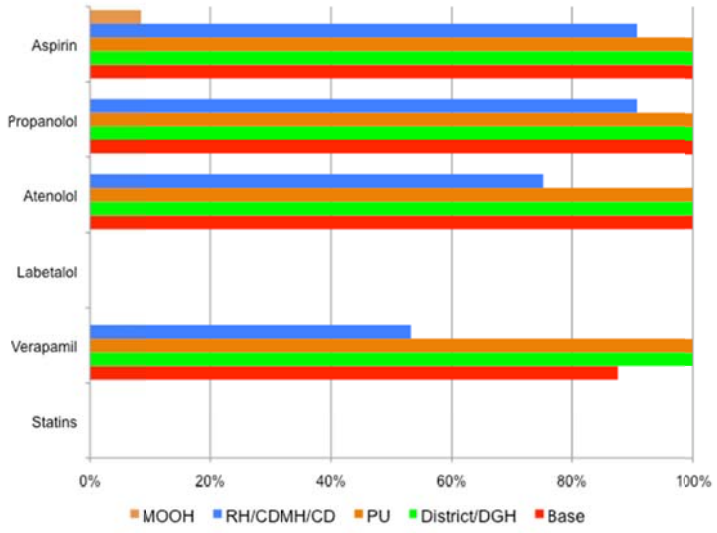
162. Whilst the WHO study focused on secondary healthcare facilities in Sri Lanka, the lack of medicines is even greater at the primary care levels which is where the global consensus indicates the bulk of NCD care should be given. The following charts show the availability of selected NCD medicines in the MOHN health facilities in three districts surveyed in the IHP/MOH Public Facility Survey 2005. Availability is defined here as the supply to a facility during the 12 month period of any quantities of the relevant medicines. This is a rather generous definition of availability, since a facility that receives only sufficient stocks of a medicine to last one month is still defined as having availability.

163. Figure 28 presents the availability of the four medicines identified by WHO as essential treatment for patients diagnosed with IHD: aspirin, beta-blockers, ACE inhibitors or calcium-blockers, and statins. As can be seen, most of these medicines were not available at the lowest health facilities, which MOHN regards as the entry point of its primary care system At MOH level, only 8% of facilities were provided aspirin, and none were provided stocks of the other three medicines. Central dispensaries to rural hospitals fared a little better, but even at their level, no facilities were provided statins, and less than half received stocks of calcium-blockers, such as verapamil, whilst supplies of beta-blockers were not universal. Only peripheral units and above had supplies of all three medicines, excepting statins, which were not made available to any facilities surveyed in the three districts.

164. Figure 29 illustrates the availability of other medicines for asthma, diabetes and heart disease. Again only peripheral units and above were assured of supplies of medicines for asthma (salbutamol) and diabetes (tolbutamide, metformin), whilst other essential medicines such as spironolactone and streptokinase (essential treatment for acute myocardial infarction) were only available in limited supply at the level of base hospitals and above.

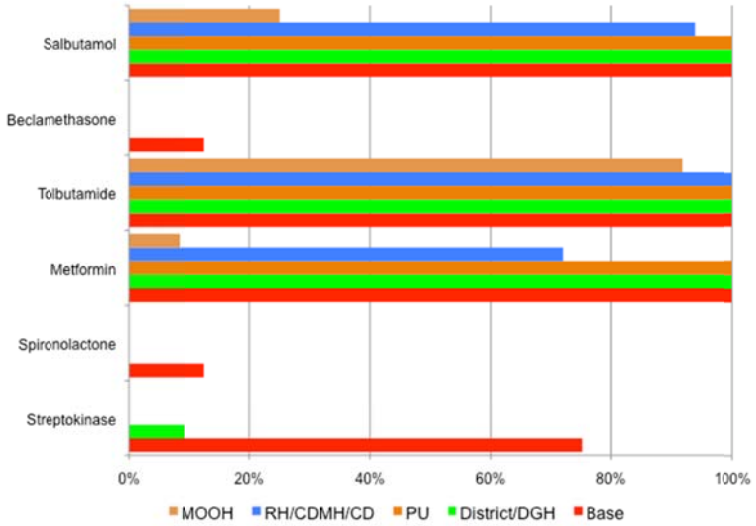
165. This pattern of limited or no supply of essential NCD medicines at primary care level is in fact consistent with the current approach to patient care, where most diagnosed NCD patients receive treatment only at secondary or tertiary level, and where the organized management of NCD patients is based on treatment by specialist clinics. This approach is reinforced by internal controls of the health ministry, which has in the past restricted by circular the list of medicines that the lowest level facilities are entitled to receive. These rules prevented the lowest level facilities stocking the essential medicines required at primary care level for the minimum treatment of heart disease, diabetes and asthma. More recently, these rules have been relaxed, but overall supply of these medicines remains poor.

166. Such a pattern of distribution evidently will be a significant barrier to shifting management of NCDs to the primary care level in future, if such a change in strategy was adopted. Unfortunately, it will not be sufficiently to simply relax the internal distribution of these medicines within the public sector so as to allow primary care facilities to stock these medicines. This is because the main reason for the limited supply at all levels is that the overall quantity of NCD medications purchased by MOHN is grossly inadequate for the actual patient demand.



Note: Estimates for the districts of Colombo, Badulla and Matale

Figure 28: Any availability during year of essential medicines for IHD at different facility levels, IHP/MOH Public Facility Survey 2005



Note: Estimates for the districts of Colombo, Badulla and Matale

Figure 29: Any availability during year of essential medicines for asthma, diabetes and heart disease at different facility levels, IHP/MOH Public Facility Survey 2005

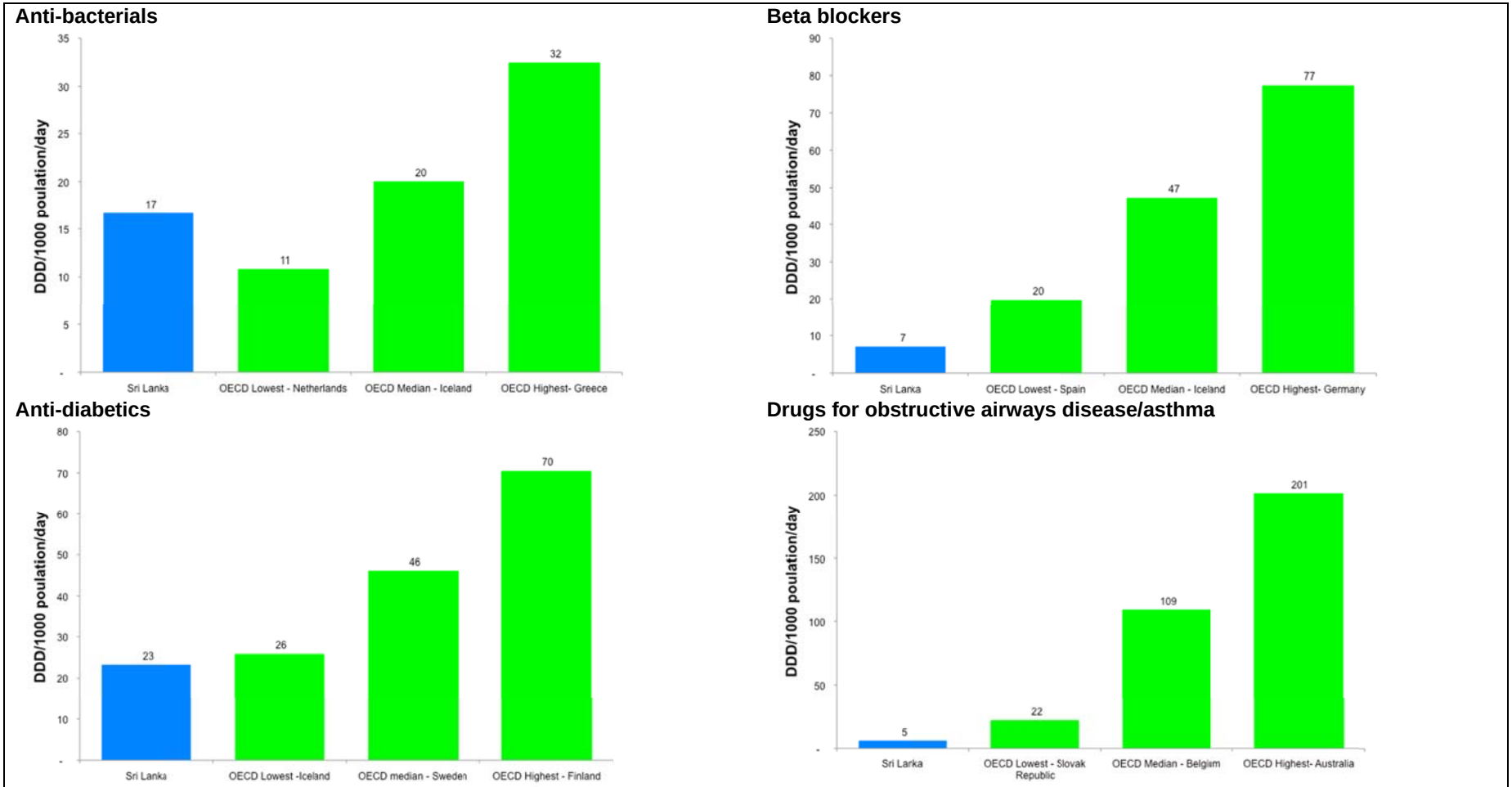
Use of NCD medicines in international comparison

167. Overall rates of use of NCD medicines in Sri Lanka are very low in comparison with developed countries with comparable standardized mortality rates for these diseases. Comparison of medicines utilization with OECD countries is appropriate, because Sri Lanka has comparable levels of NCD mortality, as already noted. Figure 30 contrasts levels of use of anti-bacterial drugs and selected NCD medications in Sri Lanka, measured in terms of defined daily dosages (DDDs) per 1,000 capita per year, with the range of use seen in OECD countries. The charts present the rates of use in the lowest, median and highest using OECD countries. It is noted that no other example of this type of comparison of national drug utilization between a developing country and developed countries could be found in the published literature, so this analysis for Sri Lanka maybe the first of its kind.

168. The data show that whilst the rates of use of medicines for infectious disease are similar in Sri Lanka and OECD countries, the rates of use of NCD medicines are systematically lower in Sri Lanka, and substantially lower in the case of many NCD medicines, such as beta-blockers or medications for asthma. Nevertheless, rates of use in Sri Lanka may still be more optimal than this suggests, if overall rates of use in OECD countries are too high. However, analyses of the prescribing of these medicines in OECD countries generally find that almost all these NCD medicines are under-prescribed and under-consumed in relation to clinical guidelines (Dickson and Jacobzone, 2003), indicating that the gap with actual need is greater in Sri Lanka than these data have suggested.

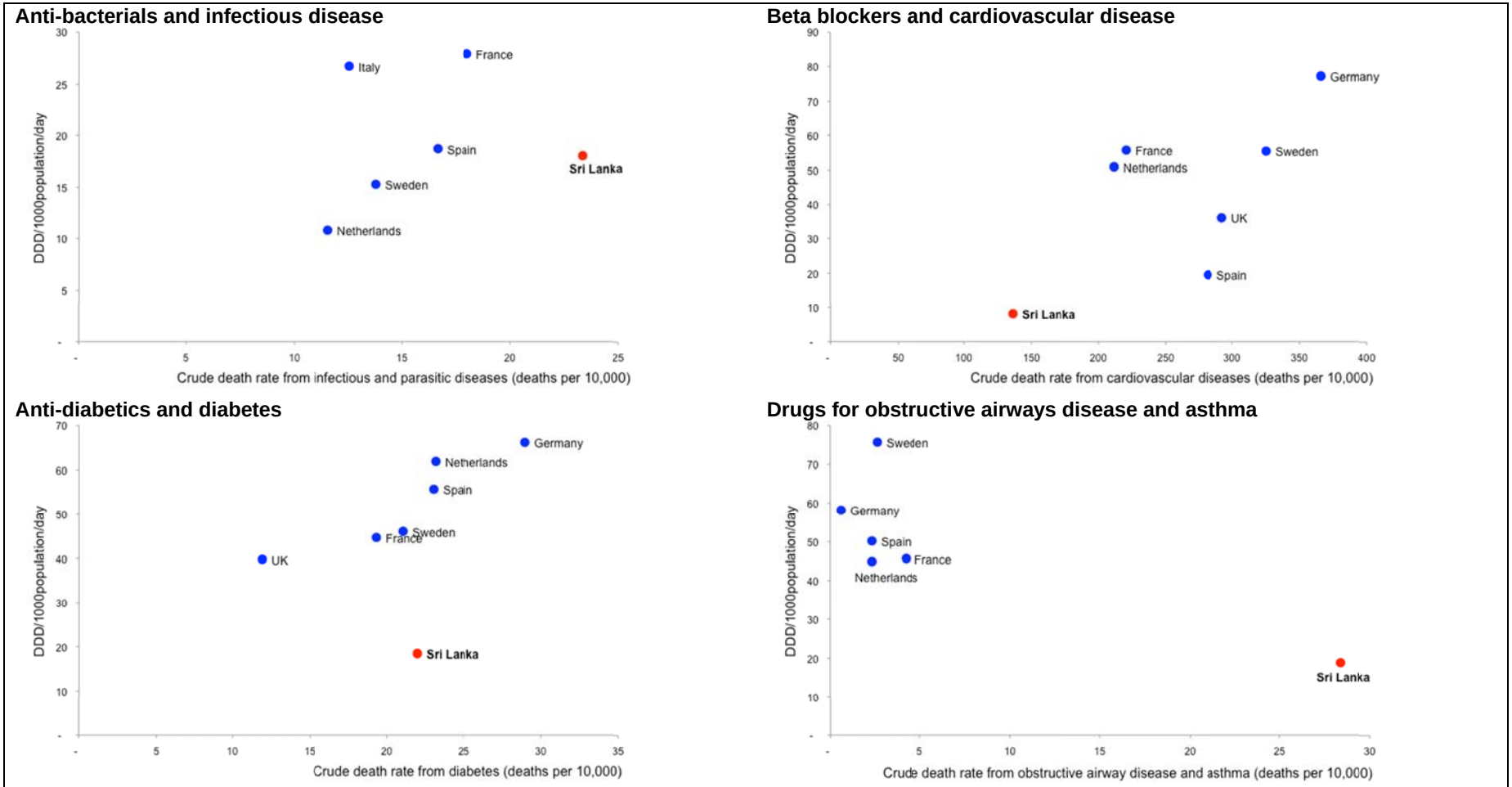
169. Of course, it could be argued that the side-by-side comparisons made in Figure 30 may be misleading, since the aggregate NCD burden in Sri Lanka will be lower given its younger population, despite having comparable standardized mortality rates. To address this, Figure 31 extends the comparison by charting the levels of use of these medicines against the crude death rates for relevant diseases, which are a measure of the total burden of disease. In OECD economies, there is a clear linear relationship between the underlying disease burden and the use of relevant medicines, as can be seen. However, in all the cases, consumption of relevant medicines in Sri Lanka is less than the expected level, with the differences least for anti-infective drugs and beta-blockers, and most for asthma. This result implies not only that overall medicine utilization is less in Sri Lanka, but also that the disparity is most substantial for NCD treatments. However, the small disparity for beta-blockers would be consistent with research in OECD countries that has found that cross-country variations were least for the cheapest and oldest heart disease medicines, such as beta-blockers (Dickson and Jacobzone, 2003).

170. The primary explanation for the low overall levels of use of NCD medicines in Sri Lanka is the low volumes of essential NCD medicines purchased by the public sector. In OECD economies, the bulk of NCD medicines are purchased through public financing, and considerable evidence exists to indicate that if not for this public financing, overall levels of use of NCD medicines in OECD economies would be substantially less (Dickson and Jacobzone, 2003). The next section discusses the current pattern of NCD medicines purchasing in Sri Lanka.



Source: OECD countries for 2006 from OECD Health Data 2008, and Sri Lanka for 2008 computed from data provided by MOHN and IMS-Health (Sri Lanka)

Figure 30: Consumption of selected NCD medicines in DDD units, Sri Lanka compared with range of levels in OECD countries



Source: For medicine consumption as in previous figure; crude death rates for OECD countries for 2003 from WHO Mortality Database, and Sri Lanka from RG data.

Figure 31: Consumption levels of medicines and mortality rates for relevant NCDs, Sri Lanka and selected OECD countries

Financing of NCD medicines

171. Appropriate use of medication for diseases such as asthma, IHD and diabetes can substantially cut mortality rates, and reduce levels of disability and illness. Sri Lanka has reduced its overall mortality rates to levels close to those in developed economies, but has done less well in reducing mortality rates from NCDs that are amenable to treatment. A major concern of any NCD policy in Sri Lanka must thus be to ensure that the population has access to and makes use of adequate quantities of cost-effective NCD medicines.

172. The current implicit policy in Sri Lanka is that patients should bear the significant part of the cost of NCD medicines. Although government services are free at the point of delivery, there has never been sufficient supply of medicines in government facilities to provide all attending patients. This gap between actual patient need and available financial resources has in practice been minimized and managed largely through three mechanisms.

173. The first is that the Sri Lankan public sector operates one of the most cost-efficient medicines procurement mechanisms in the world, making extensive use of global tendering, and generic and bulk purchasing. Consequently, the average price paid by the public sector for most medicines is substantially less than in other countries, and the volume of medicines purchased with the government budget is greater than it would have otherwise been. The second mechanism involves an implicit recognition that the health ministry cannot afford to stock all needed medicines all of the time, and an official policy of transparency that requires institutions to inform public sector patients when medicines are not available, so that they know when they need to self-purchase needed medicines. The third mechanism is the prioritization by the health ministry of what medicines it buys with its budget. In recent years, three-quarters of the stocks of medicines requested by government medical institutions have been provided for in the budgetary allocations.[6] The initial requests for medicines supply are generated each year by institutions, and then collated and transmitted upwards to formulate an overall estimate of national needs. The MOHN Medical Supplies Division then decides what medicines to purchase, taking into account the actual budget allocations. This rationing process involves internal deliberation, and there is no explicit or public policy on how medicine purchases should be prioritized. In practice, purchases of medicines for treatment of acute and life-threatening illnesses are prioritized, whilst purchases of medicines for chronic NCDs are given lower priority. This favours medicines for conditions such as injuries and acute NCD events, including acute myocardial infarction, but results in under-purchasing of medicines for long-term treatment of NCDs. In recent years, there has been an increasing demand from institutions for NCD medications, particularly for heart disease, but these have only gradually been reflected in increased purchases.

174. Figure 32 presents a profile of the pattern of financing and supply of selected NCD medicines in Sri Lanka in 2008. This is based on analysis of the purchases of MOHN Medical Supplies Division, which is responsible for more than 95% of all public sector purchases, and data provided by IMS-Health (Sri Lanka) on the volume and cost at wholesale price of medicines supplied through pharmacies, which account for 85% of total private sector distribution. The volumes of medicines distributed in public and private sectors are compared after converting all quantities into defined daily dose units (DDDs), as defined by WHO (WHO Collaborating Centre for Drug Statistics Methodology, 2008). To provide a comparison with non-NCD medicines, statistics for anti-bacterial drugs are provided as an indicator group.

[6] Personal communication from Director, Medical Supplies, MOHN, November 2009.

175. For most medicine classes, public sector expenditures are only a fraction of those in the private sector (top-left panel). For example, for beta-blockers, calcium channel blockers, anti-diabetic agents, private spending is more than four times public sector spending. However, in terms of volume of supply (top-right panel), the public sector accounts for half or more of actual consumption, with the exception of statins. Extensive use of bulk purchasing and competitive tendering ensures that MOHN purchases most medicines at a fraction, usually less than half, of the price paid by the private sector.

176. The bottom-left panel of Figure 30 shows the ratio of public to private prices for selected medicines. For most NCD classes, the public sector purchases at prices ranging from half to one tenth of wholesale prices in the private sector. Its ability to purchase at far lower prices than the private sector means that for many NCD medicines, if the public sector was to expand its purchasing, it could reach OECD levels of supply whilst still spending less than current combined public and private spending. OECD levels can be considered a reasonable indication of what is appropriate for Sri Lanka, given comparable levels of NCDs.

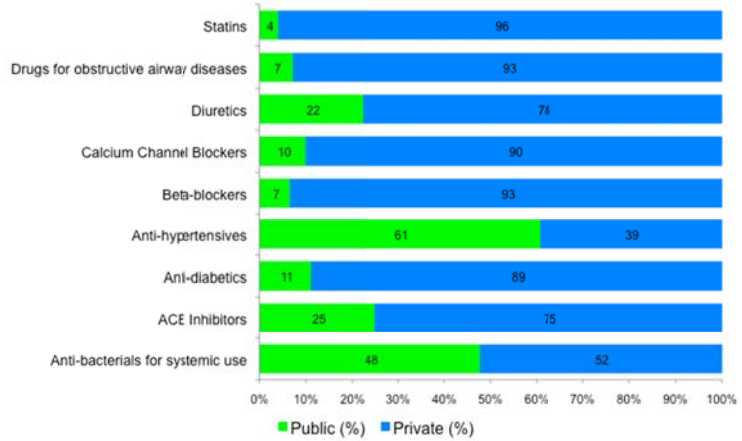
177. The bottom-right panel of Figure 32 illustrates this point. It shows the additional cost to the government of increasing public provision of NCD medicines to raise the overall volume of public sector supply to 80% of the median level in OECD economies. This assumes that the public sector can purchase the additional medicines at the same average price as current stocks, which is a reasonable assumption given that increased MOHN purchasing can only enhance its ability to negotiate prices. The increases implied are either significantly less than or comparable to current private expenditures for most medicine classes: Rs. 86 versus Rs. 113 million for beta-blockers; Rs. 91 versus Rs. 79 million for diuretics; Rs. 173 versus Rs. 619 million for anti-diabetics; and Rs. 83 versus Rs. million 514 for drugs to treat obstructive airways disease and asthma. The only drug class for which the increased public cost would be substantially greater than current private spending would be statins, where the increase required of Rs. 2 billion is four times current private spending.

178. This implies that to raise supply levels of these essential NCD medicines, excluding statins, *i.e.,* anti-diabetics, anti-hypertensives, beta-blockers, calcium channel blockers, diuretics and drugs for obstructive airways disease/asthma, to OECD levels would come to less than Rs. 700 million, or US$ 7 million per annum. In 2008, this would have represented less than 1% of total public sector health expenditures of more than Rs 72 billion. To put this into perspective, the cost compares well with other important public expenditure priorities in 2008, such as the average cost of building two kilometres of the Southern Express Highway which was Rs. 1,200 million (Anonymous, 2009), or the average public subsidy required by Sri Lanka's second airline, Mihin Air, for three months (Rs. 740 million).[7]

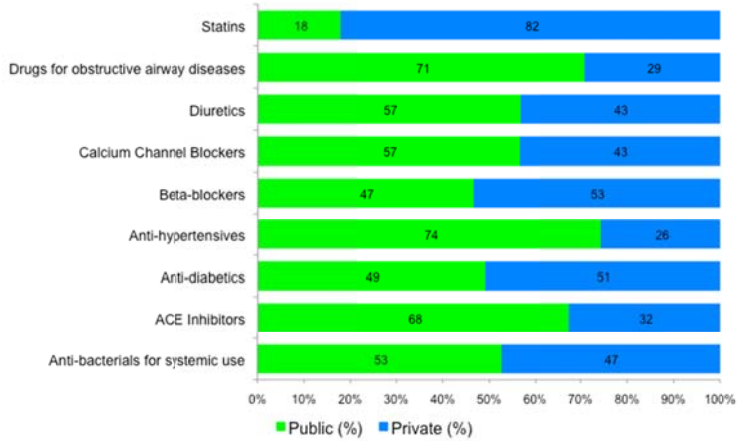
179. This assumes that public financing is needed to raise overall consumption levels of these medicines to more desirable levels, instead of the alternative of expanding the sale of these medicines at low prices through government-owned pharmacies. However, this is a logical inference given the experience of OECD countries. There, the evidence shows that the levels of public financing or reimbursement by public insurance schemes have major impacts on the overall level of use of essential heart disease drugs (Dickson and Jacobzone, 2003). To argue that much poorer Sri Lankans would buy adequate quantities of these medicines, even when subject to price controls, when rich Europeans don't in similar circumstances would of course require a suspension of economic theory.

[7] Computed from information provided to Parliament by the Hon. Minister of Ports and Civil Aviation, 23 September 2008, as reported in Lankadeepa of 24 September 2008 (Samarajiva, 2008).

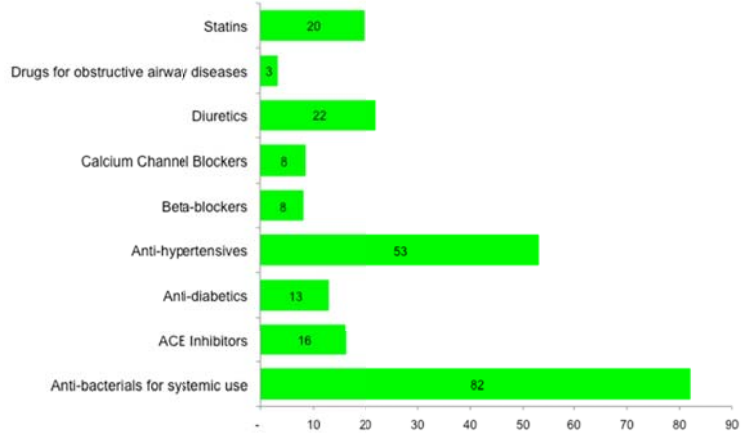
Percentage of expenditures on selected medicines by source (%)



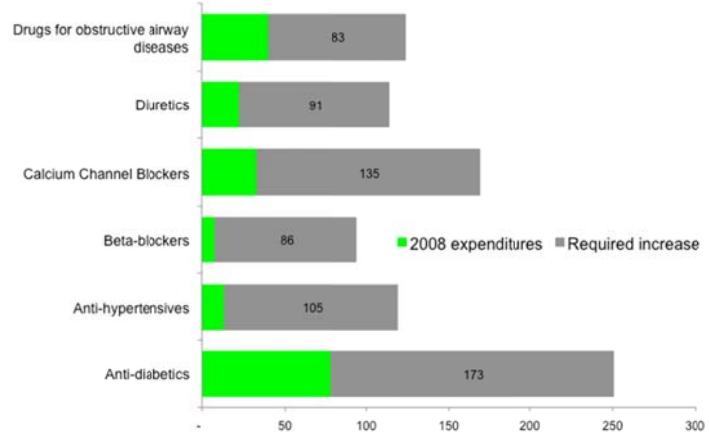
Percentage of volumes of selected medicines financed by source (%)



Ratio of public to private sector unit prices for selected medicines (%)



Cost to increase MOHN supply to 80% of OECD median level (Rs million)



Source: Sri Lanka for 2008 from MOHN and IMS-Health (Sri Lanka), and OECD countries for 2006 from OECD Health Data 2008.

Figure 32: Analysis of financing and supply of NCD medicines by public and private sectors and funding gap, Sri Lanka 2008

4.3 Implications

180. Sri Lanka is suffering from an increasing burden from NCDs. The evidence from the available mortality and morbidity data are consistent with rising morbidity from NCDs, and where the data exist with high levels of morbidity in comparison with other countries. At the same time, mortality rates for most NCDs are already substantially higher than in developed countries. Since the 1970s, a gap has opened up in adult health between Sri Lanka and developed countries, with life expectancy for adult males in particular stagnating. This relative deterioration in performance is due to a failure to reduce mortality from NCDs, at the rates seen in developed countries in the past three decades. The evidence indicates that this is due to a systematic failure since the 1970s to apply the benefits of emerging medical knowledge to treating NCDs, which are amenable to treatment. We have shown how the current healthcare system lacks the capacity to provide effective and integrated care for NCDs, and we have found evidence of substantial under-use of effective medicines that can reduce NCD mortality and morbidity.

181. These failures and deficiencies have extensive negative implications for Sri Lanka's health and social systems, and its economy. The failure to effectively manage treatable conditions is resulting in an excess burden from avoidable healthcare use, with asthma being the most notable case. Sri Lankans are dying earlier and enduring greater rates of sickness than they need to. With population ageing, impacts of these negative health trends will only get worse, placing increasing pressures on the country's healthcare system, and the government's health budget. Furthermore, it should not be forgotten, households are already bearing a sizable burden, with public sector patients frequently been forced to pay for medications and specialist care for NCDs, and these problems being the leading cause of dissatisfaction with the government health system.

182. Looking beyond the healthcare system, we speculate that the under-treatment of IHD may in future substantially increase the need for long-term care (LTC) amongst the most elderly Sri Lankans. Recent medical research is suggesting that sub-clinical IHD may be the primary cause of physical frailty in the elderly (Newman et al., 2006), and the future demand for LTC will be closely linked to future increases in frailty and the numbers of the physically-dependent elderly. As governments in developed countries have found in the past decade, once the need for LTC becomes substantial, it is not possible to depend solely on households and the private sector to finance the provision of LTC. In the long run, the costs of providing LTC will end up being shared with public financing, and these costs will be substantial, being of the order of 2% or more of GDP (Huber et al., 2009).

183. A growing NCD burden will also have broader economic costs. The World Bank Sri Lanka Aging Survey 2006 found that chronic illness was the leading cause for older working-age adults to retire from work (World Bank, 2008). Managing the fiscal costs of financing retirement income is undoubtedly the primary long-term macroeconomic challenge for Sri Lanka's rapidly ageing population. As developed countries have come to accept in the past few years, the key policy for managing this challenge must be to encourage people to work longer and retire later: developed nations are increasingly raising retirement ages to as high as 67 to 70 years. However, in Sri Lanka, such a policy is unlikely to be socially acceptable when so many workers in their forties and fifties are either becoming chronically sick from NCDs, or are dying prematurely. Ensuring that workers live longer and healthy lives will be central to managing the challenges of pensions and retirement income financing.

184. What the healthcare system should do in response to these issues is the critical question. Expanding access to and supply of effective medical treatment for NCDs must be part of this, in addition to ensuring that prevention options are fully implemented. In the past, expanding the provision of secondary prevention and treatment for NCDs has not been a priority, and the most important reason for this has been the belief that such a response is too expensive and is also unlikely to be effective. The next section looks at this issue, and examines how effective treatment interventions might be and what they might cost.

Chapter 5: Potential options and issues in improving the curative care response to NCDs

5.1 The need for focus on IHD, diabetes and asthma

185. This study has shown that the available evidence indicates that Sri Lanka faces a high and increasing burden from NCDs. It has identified a failure to reduce adult mortality from NCDs, in particular cardiovascular disease, as being the major reason why Sri Lanka has lagged recent mortality improvements in developed countries. Further, the evidence indicates that this failure is most marked in adult men. As Sri Lanka has succeeded in managing the health problems arising from infectious disease and maternal and child health conditions, the importance of NCDs in the overall disease burden would have inevitably increased. However, modernization and increasing living standards are also leading to an increase in the risk factors behind the major NCDs, such as IHD and diabetes, which is resulting in an increase in the absolute burden from NCDs.

186. For the past few decades, the conventional wisdom in the public health community, in Sri Lanka and elsewhere in the developing world, has been that preventive strategies for NCDs are more effective than treatment of those at high risk of developing complications, and that a NCD response involving predominantly health promotion and primary prevention will be adequate However, the revolution in medical therapies for NCDs, in particular for IHD, in the past three decades has changed the situation.

187. In developed countries, treatment, including treatment as part of secondary prevention, has been responsible for half or more of the decline in cardiovascular mortality since the 1970s . This decline in cardiovascular mortality is especially important because cardiovascular disease accounts for the largest share and more than half of overall NCD mortality, and an even greater share of the observed reductions in NCD mortality. It may also explain more than half of all the improvements in older adult disability that have occurred in several countries (Anonymous).

188. Asthma is another disease where substantial improvements in treatment have resulted in declining mortality and ill health in the past two decades in developed countries. The reductions in asthma mortality have occurred despite an increasing prevalence of the disease in many of these countries. So effective has treatment been in preventing the severe complications of asthma, that hospital admissions and mortality from asthma are now regarded in developed countries as indicators of failure in the healthcare system. Many developed countries and the OECD itself now use asthma admission and mortality rates as indicators of health system performance (World Bank, 2008). Although asthma only accounts for a small share of overall mortality in these countries, it accounts for a much larger share of averted mortality in these countries.

189. This study has focused most of its attention on IHD, diabetes and asthma, because they represent the areas where the global experience now indicates that the most can be done to improve adult health. Other diseases do still account for a large share of the overall NCD burden and mortality in Sri Lanka (~50%), but the global evidence does not support the view that equivalent gains in adult health can currently be achieved by focusing on these other diseases, such as cancers and mental health (with the exception of smoking-induced cancers). Further, although injuries in Sri Lanka account for a large share of the overall demand for healthcare services and of mortality, the aetiology of injuries has to a large extent been

beyond the control of the health sector. To the extent that government policy could reduce the burden from conflict related injuries and violence, it correctly prioritized the defeat of political violence, which claimed the lives of a quarter of a million Sri Lankans since 1971, making it the third largest cause of NCD deaths after IHD and cancers. Nevertheless, as peace is consolidated in Sri Lanka in coming years, the health sector should and will need to pay more attention to reducing the impact on health of other preventable injuries, such as road traffic accidents.

190. The next section explores and illustrates the potential benefits of expanding treatment for the most important NCD, ischaemic heart disease. This focus on one disease is deliberate for several reasons. First, as already noted, IHD accounts for the predominant share of the recent reductions in NCD mortality in developed countries, which Sri Lanka conspicuously has failed to match. Second, the evidence base for treatment of IHD is the most developed of all the NCDs, and uniquely allows for quantitative exploration of the impact of expanding treatment. Such quantitative exploration is useful because it sheds light on the potential importance of improving curative care for NCDs.

5.2 The potential impact of secondary prevention and treatment for cardiovascular disease

191. There are four types of intervention available to prevent and reduce cardiovascular disease morbidity and mortality. These are (i) smoking cessation; (ii) other preventive health and health promotion activities; (iii) treatment-based secondary prevention; and (iv) hospital treatment of advanced disease, including surgical interventions. Of these, smoking cessation is the single most effective intervention, and success in reducing smoking has been the most important reason for the decline in IHD in developed countries.

192. There is no controversy about the importance of reducing smoking, and Sri Lanka has done more in this area than most other countries. Through the use of tobacco taxation and other restrictions on the sale, advertising and consumption of tobacco, Sri Lanka has already reduced smoking to relatively low levels. More should and needs to be done to reduce these further and to eventually make smoking history, regardless of what other strategies are employed. Similarly, other health promotion strategies are an important and necessary part of the response to NCDs. However, the objective of this study is to assess issues and options related to the curative care response to NCDs. Consequently, we focus on the treatment options for NCDs, but in doing so some comparison with health promotion interventions is valid and necessary. This is because the relative merits of treatment strategies as a response to NCDs has changed dramatically in recent years, and especially for IHD.

193. Today, we have a much more sophisticated understanding of which people are at most risk of developing NCDs, than we did thirty years ago. In addition, the number and effectiveness of medicines used for treating NCDs or in the secondary prevention of NCDs has substantially improved. This is most apparent for cardiovascular disease, where several classes of medicines are now recommended standard treatment for patients or those at high risk of developing disease. Such an essential package consists of four medicines: aspirin, beta-blockers, other anti-hypertensives such as ACE inhibitors or calcium channel blockers, and statins for reducing LDL-cholesterol. Extensive use of these medicines in primary and secondary prevention explain more than half of all the IHD mortality reductions in developed countries in recent years (OECD, 2007), and should be considered a necessary strategy today in responding to NCDs, in addition other preventive measures. In this section, we explore what impact expanding access to these medicines will have in Sri Lanka.

A model of the impact of expanding use of medications for cardiovascular disease

194. Modelling the impact of different interventions on future disease is most feasible for cardiovascular disease, comprising coronary heart disease and stroke. This is because the research and global state of knowledge is most developed for this NCD. Taking advantage of this, we follow the approach of Manuel *et al.* (2007), and use the data of the Sri Lanka Diabetes and Cardiovascular Survey (SLDCS) to model the impact of different treatment interventions.

195. The SLDCS was a nationally representative survey of 5,000 adults conducted in 2005, which collected information on diabetes and cardiovascular disease risk factors, including laboratory measurements of blood lipids and fasting glucose, and ECGs, and information on the medications that respondents were taking for diabetes and heart disease (Manuel et al., 2006). These data are sufficient to predict future cardiovascular disease risk and mortality in the surveyed individuals using the widely used Framingham risk prediction equations (Katulanda *et al.*, 2008a).

196. Applying the Framingham risk prediction equations, we first estimated for the Sri Lankan population, aged 18-74 years, the future risk of coronary heart disease (CHD), CHD death, stroke and stroke death. For this analysis, we focus on CHD death.

197. We then computed the future risk of coronary heart disease (CHD) death at 10 years for each respondent, under different intervention scenarios. In doing this, we assumed that the whole population was screened according to the New Zealand cardiovascular disease prevention guidelines (Anderson et al., 1991), which are comparable to the national guidelines used in most OECD countries. The intervention scenarios considered were:

(i) *Baseline scenario* – where no intervention was made, but individuals continue to take any medications they currently do.

(ii) *Population health strategy to reduce cholesterol by 2%* – lowering total cholesterol uniformly in the population by 2%, which is the mean reduction in cholesterol observed over 10 years in the 21 country MONICA study (New Zealand Guidelines Group, 2003; Kuulasmaa et al., 2000).

(iii) *Population health strategy to reduce cholesterol by 9%* – lowering total cholesterol uniformly in the population by 9%, which is the mean reduction in cholesterol observed in the top decile of country performances over 10 years in the 21 country MONICA study.

(iv) *Single risk factor strategy* – screening the whole population, and treating everyone with total cholesterol concentration >8 mmol/l with a standard dose of statins, which is similar to an older strategy of treating single risk factors.

(v) *Treatment of high individual risks with an antihypertensive* – screening the whole population, and treating everyone with a high risk (>15% at 10 years) of cardiovascular disease, or anyone with blood pressure more than 170/100 mm Hg.

(vi) *Treatment of high individual risks with a statin* – screening the whole population, and treating everyone with a high risk (>15% at 10 years) of cardiovascular disease, or anyone with total cholesterol >8 mmol/l.

(vii) *Treatment of high individual risks with two medications* – screening the whole population, and treating everyone with a high risk (>15% at 10 years) of cardiovascular disease with a combination of one anti-hypertensive and one statin.

198. We did not explicitly model the impact of aspirin, since the estimates of its impact on coronary heart disease death are not so clear, although it does have other cardiovascular disease benefits.

199. In the baseline scenario, out of the 13.3 million Sri Lankans aged 18-74 years in 2005, we estimate that there would be 164,000 CHD deaths after 10 years. In all the treatment scenarios, the model predicts a reduced number of deaths at ten years. This is summarized in Figure 33. It shows that the 2% population cholesterol reduction strategy and the single risk factor treatment strategy will save the least numbers of lives – avoiding less than 6,000 deaths over 10 years. Treatment with one or two medicines saves substantially far more lives, ranging from 16,000 deaths avoided with the use of one anti-hypertensive, to 38,000 lives with the use of both an anti-hypertensive and one statin. A population strategy that achieves a 9% reduction in population cholesterol would do almost as well as the use of just one statin, but it should be noted that this level of cholesterol reduction would be far better than what most countries achieved in the MONICA study.

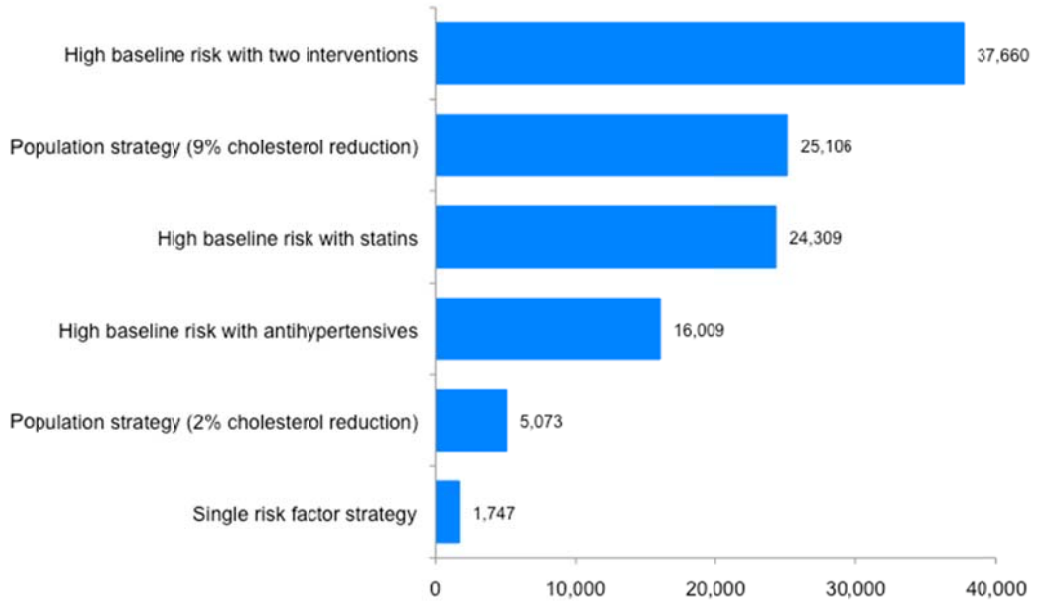


Figure 33: Deaths avoided at 10 years under different intervention strategies for CHD, Sri Lankans aged 18-74 years

200. A reduction of 38,000 deaths (23%) over 10 years in CHD mortality with the use of just two medications is substantial, and in combination with other measures is of the order of magnitude necessary to reduce Sri Lankan CHD mortality rates to the levels seen in OECD economies. It provides added evidence that increasing treatment of NCDs would allow Sri Lanka to close the gap with developed countries in adult mortality rates.

201. These results show that expanding access to secondary prevention would have a major impact on cardiovascular disease in Sri Lanka, and should be a necessary component of any overall NCD strategy, supplementing other preventive health measures. Furthermore,

it should be noted that the primary prevention strategy that has had the most impact in developed countries is reduction in smoking, but since smoking rates in Sri Lanka are already low, it is unlikely that this will provide as much potential for mortality reduction as it did in the developed countries.

202. The SLDCS also allows us to look at the distributional impact of the different strategies. Figure 34 shows the number of avoided deaths by quintiles of socio-economic status in three strategies. These results indicate that secondary prevention strategies using medications will benefit the poorest quintile more than a population strategy that achieves a uniform 9% reduction in cholesterol. This comparison almost certainly understates the pro-poor advantage of treatment measures, since any population strategy will rely substantially on behaviour change through health education, and global experience indicates that such measures will change behaviour in the richest and most educated households the most.

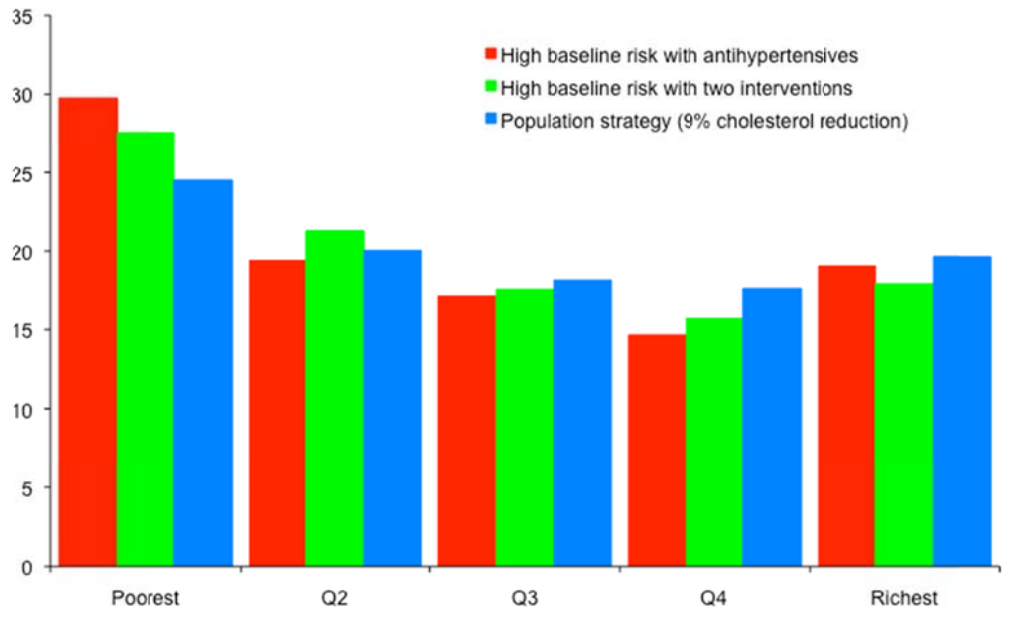


Figure 34: Distribution of avoided deaths at 10 years by SES quintile under different intervention strategies for CHD, Sri Lankans aged 18-74 years

How much would the expanded access to NCD medicines cost?

203. Expanding access to essential medicines for secondary prevention of cardiovascular disease will save substantial numbers of lives. The next question is then how much this would cost. It is not feasible to estimate the cost of the delivery system, since almost certainly the current system will need to be revamped. However, we can estimate the cost of the additional medicines. In all the treatment strategies modelled above, the percentage of the population aged 18-74 years who would need to be prescribed new medicines ranges from 9 to 11%, which is about 1.3 million people.

204. In 2008, the price of purchasing a single standard dose of an antihypertensive ranged from Rs 0.18 to 1.1, depending on the medicine class, and the price of one dose of a statin was just Rs 1.02. At these costs, it would cost just Rs 1.5 per day to purchase one antihypertensive and one statin for each individual who needed this. This would come to less than Rs 700 million a year, which is less than 2% of government health expenditures. These cost estimates indicate that the cost of purchasing these medications will not be the principle barrier to expanding access. In practice, however, the costs are likely to be less, since it is unrealistic to expect that even with the best primary care system that all those who need medication will be identified or treated.

5.3 Experience of developed countries in responding to rising burden of chronic disease

205. Population ageing and the increased prevalence of NCDs present new challenges to all health systems. Two features of the increase in NCDs are at the heart of this challenge. First, most NCDs are the result of accumulated exposure to risk factors over a lifetime, and modern medical knowledge can only control them, but not cure them. The second is that increased incidence of chronic NCDs with age means that the share of the population living with these conditions will not only increase, but also the numbers of people living with multiple chronic NCDs. Consequently, in contrast to many infectious diseases, a very large proportion of the population may eventually be living with chronic NCDs at any given time. That this is already the case in Sri Lanka can be gauged from the finding in the previous section that 9-11% of current adult population would be considered as eligible for treatment with medications under New Zealand screening guidelines.

206. Most health systems, including Sri Lanka's, were developed to treat and manage acute illnesses with definitive end-points, and so are organized around an episodic, acute care model. This approach is not suitable for managing the problems of NCD patients, who require prolonged and coordinated management by healthcare professionals, who are equipped not only with essential medicines, but also appropriate screening and monitoring equipment and aids.

207. As a consequence, the health systems in developed countries have responded to the emergence of NCDs by evolving new organizational arrangements. In doing this, most of these countries have benefited from being able to build on an organized system of primary care where treatment is led by primary-care physicians, who are expected to provide care on an a routine and sustained basis to patients within the community. Even with this, most developed countries have still had to experiment with new models of care to cope with the challenges of managing chronic NCD patients. Consequently, there is no universal model that countries are using to manage chronic NCDs, and experience indicates that the models that each country has developed reflects the characteristics of each health system, in terms of their governance mechanisms and the relationships between, and responsibilities of, different stakeholders in the regulation, funding and delivery of health care. Nevertheless, recent reviews have identified some common patterns in the approaches adopted by developed countries for managing chronic NCDs (Tunstall-Pedoe et al., 2000; Nolte, Knai, and McKee, 2009), and these have important lessons for Sri Lanka. Some of these lessons are briefly summarised.

208. The most coordinated response has been in developed countries, where multi-professional teams of physicians, nurses and other health professionals were already responsible for delivering primary care including most routine curative care, and where

patients are registered with a specific primary care facility. In these countries, healthcare personnel at the primary level play the dominant role in managing NCDs and other chronic diseases. However, in all these cases, healthcare provision at the primary care level is closely coordinated and integrated with the delivery of hospital and secondary care services.

209. In these countries, there has been a progressive increase in the role of nurses in managing many chronic diseases. This commonly takes the form of nurse-led clinics, discharge planning and/or case management. This has been the case in Sweden and England and, more recently, the Netherlands. However, the extent of nurse-led care varies, being extensive in Sweden, but less important in England. In Sweden for example, nurse-led clinics are now common at primary health care centres and in hospital polyclinics, managing diabetes and hypertension, with some also managing allergy/asthma/chronic obstructive pulmonary disease (COPD), psychiatric disorders and heart failure. Given differences in professional roles within Europe, it is evident that caution is required in applying this model elsewhere even in Europe. In England, whilst nursing staff make an increasing contribution, general practitioners (GPs) have been entrusted with the lead role, but working with larger primary care teams employing both nurses and other healthcare professionals. Through the use of a national performance framework (Quality and Outcomes Framework, QOF), which pays GPs according to quality of care and health outcomes, primary care physicians are being incentivised to expand and improve the quality of care provided to NCD patients. However, the feasibility of this has been dependent on the high degree of computerization in primary care in the UK, and the existence of a tradition of independent, but highly administered GPs, who are financed from public funds.

210. In other developed countries, such as Canada, Germany or France, there is usually more of a history of separation between primary care and hospital sectors, and usually patients have had free choice of both family practitioners and office-based specialists. Physicians are more likely to work as individual practitioners, and national responses have focused on introducing structured disease management programmes to improve the care given for selected diseases. In these countries, there has been more concern about the lack of coordination and continuity of care, both in the outpatient and inpatient settings. Governments have often attempted to address this by encouraging or developing coordination mechanisms between providers, including provider networks, but many of these initiatives have been criticised for lacking an integrative vision. In all these countries, the tradition of primary care delivered by single-handed doctors, often with limited support staff, has mode more difficult the development and implementation of new roles and competencies.

211. Another common finding in developed countries is that payment systems often hinder the delegation of tasks from doctors to other health professionals. A lack of appropriate incentives has also been identified as creating barriers to greater involvement by GPs in integrated approaches to care in Denmark and the Netherlands. In France, the payment of providers on a fee-for-service basis does not encourage improved coordination between physicians and nurses.

212. As Busse and Mays (2008) note, those health systems with a tradition of patient choice of any provider, little or no enrolment with particular providers and/or of paying for services episodically using fee-for-service payments as the predominant method of reimbursement seem to face the greatest challenges in adapting their payment arrangements to provide effective chronic care. Such systems tend to discourage continuity of care or a population perspective. In contrast, systems with strong primary health care are more likely to give greater attention to the management of people with chronic conditions and to obtain better results.

5.4 Challenges in developing a response in Sri Lanka

213. This study can only begin to explore the many issues involved in improving the curative care response to NCDs in Sri Lanka. However, some key issues emerge from what is known about the Sri Lankan situation, and global experience.

214. Expansion of the curative treatment of NCDs must be an integral and central component of any health system successful response to NCDs. The curative care response to NCDs should prioritize the expansion of treatment with cheap and cost-effective medications for primary and secondary prevention of NCDs, in particular IHD. The cost of medicines for expansion of treatment for NCDs is unlikely to the major barrier to expanding coverage with treatment. At small marginal cost, most of the essential medicines can be purchased by the public sector. The expansion of treatment for NCDs, however, requires the development of primary care delivery system that can ensure coordinated and continuous care for a large percentage of the population. The current system is only able to do this using specialist clinics based in higher-level hospitals. Expansion is unlikely to be feasible with a specialist-led care model, and will require substantial expansion of the primary care system, with specialists shifting their role to providing back-up for more difficult cases, as well as supporting initial assessment of new patients. The reality is that even if all NCD essential medicines were made freely available, the current primary care system lacks the capacity to screen large numbers of people, or to assess them adequately with the required tests, or to provide long-term follow-up of their treatment with appropriate calibration of treatment schedules, and coordination with treatment of other chronic conditions.

215. It is beyond the scope of this study to provide recommendations of how primary care should be restructured in Sri Lanka. Nevertheless, the emergence of NCDs as a major healthcare problem does require a fundamental reorientation of the way in which primary care is delivered in Sri Lanka. Sri Lanka has done well historically because it imitated the strong public hospital component of healthcare systems in countries such as the UK and Sweden. However, unlike the UK in the 1940s, it did not move to bring private primary providers into the framework of public financing, and so has persisted with a system in which most primary care is delivered by public services which are either more focused on providing maternal and child health services or on providing acute care through hospital clinics, and by private physicians who work completely independently of the public sector on a single-handed fee-for-service basis. To this extent, Sri Lanka's experience is not that dissimilar to that of Malaysia and Hong Kong SAR, which have faced similar problems. However, this system is not well placed to deliver primary care for NCDs and chronic disease, and it will need to evolve suitably.

References

Abeywardena, M. Y. 2003. Dietary fats, carbohydrates and vascular disease: Sri Lankan perspectives. *Atherosclerosis* 171 (2):157-61.

Adeyi, Olusoji, Owen Smith, and Sylvia Robles. 2007. *Public Policy and the Challenge of Chronic Noncommunicable Diseases*. Washington, D.C.: World Bank.

AIHW: Moon L & Waters A-M. 2006. Socioeconomic inequalities in cardiovascular disease in Australia: current picture and trends since the 1990s. Canberra, Australia: AIHW.

Anand, Sudhir, and Kara Hanson. 2005. Disability-adjusted Life Years: A Critical Review. In *Public Health, Ethics, and Equity*, edited by S. Anand, F. Peter and A. Sen. Oxford, UK: Oxford University Press.

Anderson, K. M., P. W. Wilson, P. M. Odell, and W. B. Kannel. 1991. An updated coronary risk profile. A statement for health professionals. *Circulation* 83 (1):356-62.

Anonymous.

———. 2009. *Southern Highway Project Sri Lanka, Sri Lanka*. roadtraffic-technology.com 2009 [Accessed on 12 December 2009 2009]. Available from http://www.roadtraffic-technology.com/projects/southern-highway/.

Anurana, Chamara, Shanaz Saleem, Anna Glynn-Robinson, and Ravi P Rannan-Eliya. 2009. Social disparities in health in the Maldives: An assessment and implications. Report prepared for Ministry of Health and Family, Maldives with the funding support of WHO. Colombo: Institute for Health Policy.

Arambepola, Carukshi, Steven Allender, Ruvan Ekanayake, and Dulitha Fernando. 2008. Urban living and obesity: is it independant of its population and lifestyle characteristics? *Tropical Medicine and International Health* Volume 13 (No 4):PP 448-457.

Barker, D J P, and Roger J Robinson, eds. 1992. *Fetal and Infant Origins of Adult Disease*. London, UK: British Medical Journal.

Barker, David J. P., and Phillipa M. Clark. 1997. Fetal undernutrition and disease in later life. *Reviews of Reproduction* 2:105-112.

Bauman, A., F. Bull, T. Chey, C. L. Craig, B. E. Ainsworth, J. F. Sallis, H. R. Bowles, M. Hagstromer, M. Sjostrom, and M. Pratt. 2009. The International Prevalence Study on Physical Activity: results from 20 countries. *Int J Behav Nutr Phys Act* 6 (1):21.

Bell, Felicitie C., and Michael L. Miller. 2005. *Life Tables for the United States Social Security Area 1900-2100*, *Actuarial Study No. 120*: Social Security Administration, Office of the Chief Actuary.

Caldwell, J.C. 1986. Routes to Low Mortality in Poor Countries. *Population and Development Review* 12 (2):171-220.

Campbell, John Creighton, and Naoki Ikegami. 1998. *The Art of Balance in Health Policy: Maintaining Japan's Low-Cost, Egalitarian System*. Cambridge, UK: Cambridge University Press.

Central Bank of Sri Lanka. 2005. *The Consumer Finances and Socio Economic Survey Report 2003/04*. 2 vols. Vol. Part 1. Colombo, Sri Lanka: Central Bank of Sri Lanka.

Chaturvedi, N. 2004. Commentary: Socioeconomic status and diabetes outcomes; what might we expect and why don't we find it? *Int. J. Epidemiol.* 33 (4):871-873.

Cutler, David M., and Ellen Meara. 2001. Changes in the age distribution of mortality over the 20th century. Cambridge, MA, USA:

De Silva, W. Indralal. 2007. *A Population Projection of Sri Lanka for the New Millenium, 2001-2101: Trends and Implications*. Colombo, Sri Lanka: Institute for Health Policy.

Department of Census and Statistics. 1970. Life Tables Ceylon 1962-1967. Colombo: Department of Census and Statistics.

———. 1987. Vital statistics, 1967-1980, Sri Lanka.

Dickson, Michael, and Stéphane Jacobzone. 2003. *Pharmaceutical Use and Expenditure for Cardiovascular Disease and Stroke: A Study of 12 OECD Countries*, *OECD Health Working Papers Number 1*. Paris, France: Organisation for Economic Co-operation and Development.

Eurostat. 2009. *Health statistics – Atlas on mortality in the European Union* Luxembourg: Office for Official Publications of the European Communities,.

Fernando, DJ, Siribaddana S, and de Silva D. 1994. Impaired glucose tolerance and diabetes mellitus in a suburban Sri Lnakan community. *Postgraduate Medical Journal* 70 (347-9).

Ford, Earl S., Umed A. Ajani, Janet B. Croft, Julia A. Critchley, Darwin R. Labarthe, Thomas E. Kottke, Wayne M.D., H. Giles, and Simon Capewell. 2007. Explaining the Decrease in U.S. Deaths from Coronary Disease, 1980–2000. *New England Journal of Medicine* 356 (23):2388-98.

Gottret, Pablo, George J Schieber, and Hugh R Waters, eds. 2008. *Good practices in health financing : lessons from reforms in low and middle-income countries*. Washington, D.C., USA: World Bank.

Govindaraj, Ramesh, and Ravi P. Rannan-Eliya. 1994. *Democracy, Communism and Health Status – A cross-national analysis*, *Data for Decision Making Publication*. Boston: Harvard School of Public Health.

Gregory, Ian N. 2009. Comparisons between geographies of mortality and deprivation from the 1900s and 2001: spatial analysis of census and mortality statistics. *British Medical Journal* 339 (102):b3454.

Gunasekera, H.R. 2008. *Life Tables for Sri Lanka and Districts 2000-2002*. Colombo: Department of Census and Statistics.

Guthold, R., T. Ono, K. L. Strong, S. Chatterji, and A. Morabia. 2008. Worldwide variability in physical inactivity a 51-country survey. *Am J Prev Med* 34 (6):486-94.

Hsiao, William C., and Associates. 2001. A Preliminary Assessment of Sri Lanka's Health Sector and Steps Forward. Cambridge, MA, USA:

Huber, Manfred, Ricardo Rodrigues, Frédérique Hoffmann, Bernd Marin, and Katrin Gasior. 2009. Facts and Figures on Long-Term Care. *Unpublished draft report prepared for the European Centre.* Vienna: European Centre for Social Welfare Policy and Research.

Illangasekara, U, Nugegoda DB, and Perera LS. 1993. Prevalence of diabetes mellitus and impaired glucose tolerance in a rural Sri Lankan Community. *Ceylon Medical Journal* 38:123-6.

Illangasekara, U, Rambodagalla S, and Tennakoon S. 2004. Temporal trends in the prevalence of diabetes mellitus in a rural community in Sri Lanka. *Journal of Royal Society of Health* 124 (92-4).

Institute for Health Policy. 2009. *National Health Expenditures: Sri Lanka Health Accounts 1990-2006*, *IHP Health Expenditure Series Number 1*. Colombo: Institute for Health Policy.

Jayasinghe, S., N. Mendis, and R. Lie. 2002. Use of disability adjusted life years in health planning: a plea for caution. *Ceylon Med J* 47 (2):61-3.

JICA Study Team. 2003. Health Master Plan: Supporting Document II - Surveys and Study Datasets. Unpublished report. Colombo, Sri Lanka:

Katulanda, P, GR Constantine, J G Mahesh, R Sheriff, RDA Seneviratne, S Wijeratne, M Wijesuriya, MI McCarthy, AI Adler, and DR Mathews. 2008a. Prevalence and projection of diabetes and pre-diabetes in adults in Sri Lanka - Sri Lanka Diabetes, Cardiovascular Study (SLDCS). *DIABETIC Medicine* 25:1062-69.

———. 2008b. Prevelance and projection of diabetes and pre-diabetes in adults in Sri Lanka - Sri Lanka Diabetes, Cardiovascular Study (SLDCS). *DIABETIC Medicine* 25:1062-69.

Katulanda, P, MHR Sheriff, and DR Mathews. 2006. The diabetes epidemic in Sri Lanka - a growing problem. *Ceylon Medical Journal* Volume 51 (No 1).

Kuulasmaa, K., H. Tunstall-Pedoe, A. Dobson, S. Fortmann, S. Sans, H. Tolonen, A. Evans, M. Ferrario, and J. Tuomilehto. 2000. Estimation of contribution of changes in classic risk factors to trends in coronary-event rates across the WHO MONICA Project populations. *Lancet* 355 (9205):675-87.

Langford, Christopher, and Pamela Storey. 1993. Sex Differentials in Mortality Early in the Twentieth Century: Sri Lanka and India Compared. *Population and Development Review* 19 (2):263-282.

Lopez, Alan. 2008. Personal communication with Ravi P. Rannan-Eliya. Colombo, Sri Lanka, October 2008.

Malavige, GN, de Alwin NM, Weerasooriya N, Fernando DJ, and Siribaddana SH. 2002. Increasing diabetes and vascular risk factors in a sub-urban Sri Lankan population. *Diabetes Reearch Clinical Practice* 57 (143-5).

Manuel, Douglas G, Jenny Lim, Peter Tanuseputro, Geoffrey M Anderson, David A Alter, Andreas Laupacis, and Cameron A Mustard. 2006. Revisiting Rose: strategies for reducing coronary heart disease. *British Medical Journal* 332:659-662.

Masoli, Matthew, Denise Fabian, Shaun Holt, and Richard Beasley. 2004. Global burden of asthma: Global Initiative for Asthma. http://www.ginasthma.com/ReportItem.asp?l1=2&l2=2&intId=94 (accessed 18 September 2009).

Meegama, A. 1986. The Mortality Transition in Sri Lanka. In *Determinants of Mortality Change and Differentials in Developing Countries: The Five-Country Case*

Study Project. Population Studies, No. 94; ST/ESA/SER.A/94, Pub. Order No. E.85.XIII.4. New York, USA: United Nations.

Mendis, S, and Ekanayake EM. 1994. Prevalence of coronary heart disease and cardiovascular risk factors in middle aged males in a defined population in central Sri Lanka. *International Journal of Cardiology* 46 (135-42).

Mendis, Shanthi, Dele Abegunde, Salim Yusuf, Shah Ebrahim, Gerry Shaper, Hassen Ghannem, and Bakuti Shengelia. 2005. WHO study on Prevention of REcurrences of Myocardial Infarction and StrokE (WHO-PREMISE). *Bulletin of the World Health Organization* 83 (11):820-828.

Moïse, Pierre. 2003. The Heart of the Health Care System: Summary of the Ischaemic Heart Disease Part of the OECD Ageing-Related Diseases Study. Part I, Chapter 2. In *A Disease-based Comparison of Health Systems: What is Best and at What Cost?* Paris, France: OECD.

Nagai, M, S Abraham, M Okamoto, E Kita, and A Aoyama. 2007. Reconstruction of health service systems in the post-conflict Northern Province in Sri Lanka. *Health Policy* 83 (1):84-93.

National Authority on Tobacco and Alcohol. *Nata Bloomberg Project*, 12 May 2009 2008 [Accessed. Available from http://www.nata.gov.lk/index.php?option=com_content&view=article&id=49&Itemid=2.

New Zealand Guidelines Group. 2003. Assessment and management of cardiovascular risk. Wellington: NZGG. www.nzgg.org.nz/guidelines/0035/CVD_Risk_Full.pdfwww.nzgg.org.nz (accessed 15 September 2009).

Newman, Anne B., Eleanor M. Simonsick, Barbara L. Naydeck, Robert M. Boudreau, Stephen B. Kritchevsky, Michael C. Nevitt, Marco Pahor, Suzanne Satterfield, Jennifer S. Brach, Stephanie A. Studenski, and Tamara B. Harris. 2006. Association of Long-Distance Corridor Walk Performance With Mortality, Cardiovascular Disease, Mobility Limitation, and Disability. *JAMA* 295 (17):2018-2026.

NHLBI Working Group Epigenetic Contributions to Coronary Artery Disease. 2009. *Executive Summary*. National Heart Lung and Blood Institute 2008 [Accessed on 27 September 2009]. Available from http://www.nhlbi.nih.gov/meetings/workshops/epigenetic-cad.htm.

Nolte, Ellen, Cécile Knai, and Martin McKee, eds. 2009. *Managing chronic conditions: Experience in eight countries*. Copenhagen, Denmark: European Observatory on Health Systems and Policies.

Nolte, Ellen, and Martin McKee. 2008. *Caring for people with chronic conditions: a health system perspective*. Maidenhead, UK: Open University Press.

OECD. 2007. *Health at Glance 2007: OECD Indicators*. Paris, France: OECD.

Perera, Chamikara, Ravi P. Rannan-Eliya, Sunil Senanayake, Shanti Dalpatadu, Hirushaka de Silva, and Ruki Wijesinghe. 2009. *Public Hospital Inpatient Discharge Survey 2005*, *IHP Health Statistics Reports, No. 1*. Colombo: Institute for Health Policy.

Pickering, Thomas. 1999. Cardiovascular Pathways: Socioeconomic Status and Stress Effects on Hypertension and Cardiovascular Function. *Annals of the New York Academy of*

Sciences 896 (Socioeconomic status and health in industrial nations: social, psychological, and biological pathways):262-277.

Pickle, LW, M Mungiole, GK Jones, and AA. White. 1996. *Atlas of United States mortality*. Hyattsville, MD: National Center for Health Statistics.

Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2009. World Population Prospects: The 2008 Revision. http://esa.un.org/unpp (accessed Friday, September 25, 2009; 12:56:14 PM.).

Rahman, Khalilur, and Sawat Ramaboot. 2003. Regional Summary for the South-East Asia Region. 3 pages. Delhi, India:

Rannan-Eliya, Ravi P. 2008. *Population Ageing and Health Expenditure: Sri Lanka 2001-2101*, *Research Studies Series, Number 2*. Colombo: Institute for Health Policy.

Rannan-Eliya, Ravi P., and Nishan de Mel. 1997. *Resource Mobilization for the Health Sector in Sri Lanka*, *Data for Decision Making Publication*. Boston, MA, USA: Harvard School of Public Health.

Rannan-Eliya, Ravi P., Prashanthi Jayawardhane, and Leela Karunaratne. 2003. Private primary care practitioners in Sri Lanka. In *Health Policy Research in Asia: Guiding Reforms and Building Capacity*, edited by A. S. Yazbeck and D. H. Peters. Washington, DC, USA: World Bank.

Rannan-Eliya, Ravi P., and Lankani Sikurajapathy. 2008. Sri Lanka: "Good Practice" in Expanding Health Care Coverage. In *Good Practices in Health Financing Lessons from Reforms in Low- and Middle-Income Countries*. Washington, D.C., USA: World Bank.

Riddell, Tania Te Akau, and Diana North. 2003. Socioeconomic and Ethnic Inequalities in Cardiovascular Disease. Auckland: The National Heart Foundation of New Zealand,.

Samarajiva, Rohan. 2009. *Sri Lanka throwing good money after bad?* Lanka Business Online 2008 [Accessed on 10 December 2009 2009]. Available from http://www.lbo.lk/fullstory.php?nid=1526851480.

Sarkar, N.K. 1951. A Note on Abridged Life Tables for Ceylon, 1900-1947. *Population Studies* 4 (4):439-443.

Schopper, D., J. Pereira, A. Torres, N. Cuende, M. Alonso, A. Baylin, C. Ammon, and A. Rougemont. 2000. Estimating the burden of disease in one Swiss canton: what do disability adjusted life years (DALY) tell us? *Int J Epidemiol* 29 (5):871-7.

Sri Lanka Medical Association. 2004. *Guidelines on Management of Lipid Disorders in Sri Lanka*. Colombo, Sri Lanka: Sri Lanka Medical Association.

Steptoe, Andrew, and Gonneke Willemsen. 2004. The influence of low job control on ambulatory blood pressure and perceived stress over the working day in men and women from the Whitehall II cohort. *Journal of Hypertension* 22 (5):915-920.

Strunk, Bradley C., Paul B. Ginsburg, and Michelle I. Banker. 2006. The Effect Of Population Aging On Future Hospital Demand. *Health Affairs* 26:w141–w149.

Suhrcke, Marc, Lorenzo Rocco, Martin McKee, Stefano Mazzuco, Dieter Urban, and Alfred Steinherr. 2007. *Economic Consequences of Noncommunicable Diseases and Injuries in the Russian Federation*. Trowbridge, Wilts, UK: The Cromwell Press for European Observatory on Health Systems and Policies.

Tunstall-Pedoe, H., D. Vanuzzo, M. Hobbs, M. Mahonen, Z. Cepaitis, K. Kuulasmaa, and U. Keil. 2000. Estimation of contribution of changes in coronary care to improving survival, event rates, and coronary heart disease mortality across the WHO MONICA Project populations. *Lancet* 355 (9205):688-700.

UN Economic and Social Commission for Asia and the Pacific. 1976. *Population of Sri Lanka*, *Country Monograph Series No. 4*. Bangkok: UN ESCAP.

United Nations. 1982. *Levels and Trends of Mortality since 1950 - A joint study by the United Nations and the World Health Organization*, *United Nations publication, Sales No. E.81.XIII.3*. New York: United Nations.

United Nations Economic and Social Commission for Asia and the Pacific. 1976. *Population of Sri Lanka*, *Country Monograph Series No. 4*. Bangkok: UN ESCAP.

Watkins, Jonathan D. 2005. The State, Conflict and the Individual: The Effect of the Janatha Vimukthi Peramuna (JVP) Insurrections in Sri Lankan on the Mental Welfare of a Population. *Medicine, Conflict and Survival* 21 (3):216 - 229.

WHO Collaborating Centre for Drug Statistics Methodology. 2008. *ATC classification index with DDDs - EXCEL format*. Oslo: Norwegian Institute of Public Health.

Wijewardene, K, M.R. Mohideen, S. Mendis, D.S. Fernando, T. Kulathilaka, D. Weerasekara, and P. Uluwitta. 2005. Prevalence of hypertension, diabetes and obesity: baseline findings of a population based survey in four provinces in Sri Lanka. *Ceylon Medical Journal* 50 (2):62-70.

Wijewardene, K., and M. Spohr. 2000. An attempt to measure burden of disease using disability adjusted life years for Sri Lanka. *Ceylon Med J* 45 (3):110-5.

Wolf-Maier, K, RS Cooper, JR Banegas, S Giampaoli, HW Hense, M Joffres, M Kastarinen, N Poulter, P Primatesta, F Rodriguez-Artalejo, B Stegmayr, M Thamm, J Tuomilehto, D Vanuzzo, and F Vescio. 2003. Hypertension prevalence and blood pressure levels in 6 European countries, Canada, and the United States. *Journal of the American Medical Association* 289 (18):2363-69.

World Bank. 2008. Sri Lanka: Addressing the Needs of an Aging Population. Washington, DC:

World Health Organization. 2002. *World Health Report 2002: Reducing risks, promoting healthy life*. Geneva, Switzerland: World Health Organization.

———. 2004. *WHO Global Status Report on Alcohol 2004*. Geneva, Switzerland: World Health Organization.

———. 2007. *World Health Statistics 2007*. Geneva, Switzerland: World Health Organization.

———. 2008. *World Health Statistics 2008*. Geneva, Switzerland: World Health Organization.