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Addressing the Challenge of Non-communicable Diseases in Brazil

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ACRONYMS AND ABBREVIATIONS

AH	Arterial Hypertension
AIDS	Acquired Immune Deficiency Syndrome
BOD	Burden of Disease
BP	Blood Pressure
CDC	Centers for Disease Control and Prevention
CELADE	Centro Latinoamericano y Caribeño de Demografía
CENEPI	Centro Nacional da Epidemiologia
COPD	Chronic Obstructive Pulmonary Disease
CVD	Cardiovascular Disease
DALY	Disability-Adjusted Life Years
DM	Diabetes Mellitus
EME	Established Market Economies
FHP	Family Health Program
FSE	Former Socialist Economies
GBDS	Global Burden of Disease Study
GDP	Gross Domestic Product
GP	General Practitioner
HALE	Healthy Life Expectancy
IARC	International Agency for Research on Cancer
IHD	Ischemic Heart Disease
IMR	Infant Mortality Rate
INCA	Instituto Nacional do Câncer
LAC	Latin America and Caribbean
LEB	Life Expectancy at Birth
MOH	Ministry of Health
NCD	Non-Communicable Disease
NHPP	National Health Promotion Policy
PAHO	Pan-American Health Organization
RF	Risk Factor
RFS	Risk Factor and NCD Survey
SUS	Sistema Único de Saúde (Unified Health System)
TFR	Total Fertility Rate
UK	United Kingdom
US	United States
WHO	World Health Organization
WHR	World Health Report
YLD	Years Lost Due to Disability
YLL	Years of Life Lost

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ADDRESSING THE CHALLENGE OF NON-COMMUNICABLE DISEASES IN BRAZIL

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1. EXECUTIVE SUMMARY

1.1 Non-communicable diseases (NCDs) account for a large and growing share of Brazil's burden of disease. Currently, about 66% of the disease burden in Brazil is due to non-communicable diseases, compared to 24% from communicable diseases and 10% from injuries. Brazil's shift towards non-communicable diseases is a consequence of urbanization, improvements in health care, changing lifestyles, and globalization. Most of this disease burden is not an inevitable result of a modern, aging society, but preventable—often at low cost. The purpose of this report is to provide an overview of the changing non-communicable disease burden in Brazil and its root causes, to examine costs and effectiveness of alternative policy interventions to address this growing burden, and the costs disease and potential returns from expanding NCD prevention and control activities, and to consider policy implication of expanding activities to effectively address the shifting burden.

1.2 The report is intended to inform decision makers at the federal, state, and municipal level in health, finance, and infrastructure, transport, city planning, and other areas. This is because an effective non-communicable disease strategy must go well beyond the health sector. It will require broad educational and community interventions, as well as changes in economic policies, changes in the food supply, and changes in transportation policy and urban design.

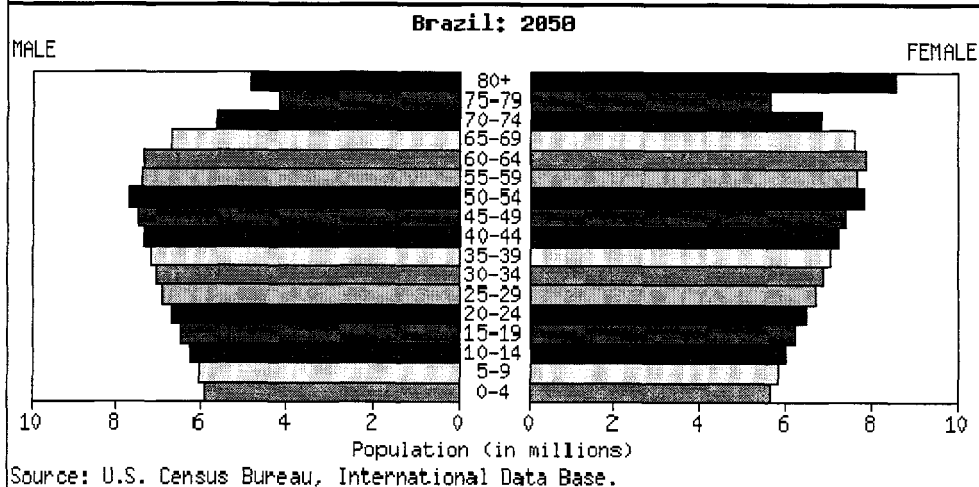
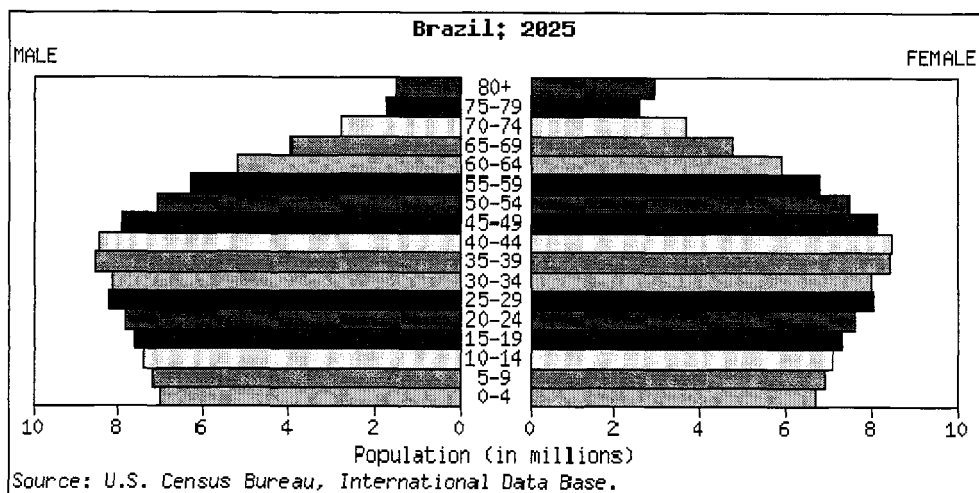
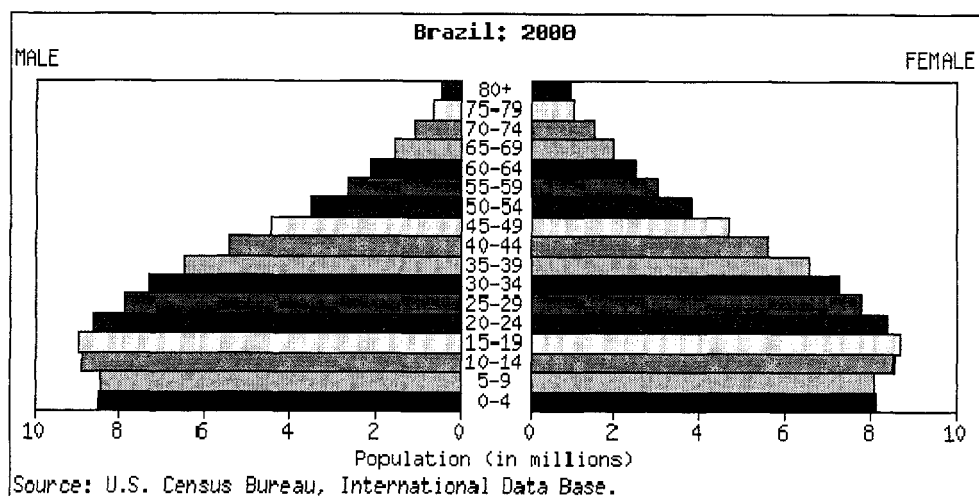
1.3 As Brazil's population continues to age, non-communicable diseases, on current trends, could overwhelm the health system and cause considerable needless suffering and lost productivity. The cost of treating NCDs already accounts for nearly half the cost of all hospital admissions. Demand will only increase as the health transition continues to evolve. Brazil has programs to prevent non-communicable diseases that are internationally-recognized success stories—such as tobacco control and *Agita São Paulo* – and it can build on these successes. Brazil can also draw on evidence of successful interventions in other countries for its own strategy, and there are many such examples.

Changes in Age Structure and Disease Burden in Brazil

1.4 Due to declining fertility and mortality rates, Brazil is undergoing a very rapid demographic transition. This is evidenced in the dramatic changes that have already occurred and are projected to occur in the age structure of the population (see Figure 1). In 2000, an estimated 15% of the population was aged 50 and over. This is projected to increase to 29% by 2005 and 42% by 2050. The increase in absolute numbers is even more dramatic. In 2000, about 27 million Brazilians were 50 and over. By 2025, this is projected to increase to 63 million, and to 96 million by 2050. The median age of the Brazilian population was 26 in 2000. It is projected to rise to 36 by 2025, and 44 by 2050.

1.5 During the next decades, the aging of the population will also produce a new and probably one-time situation: an optimum demographic ratio between dependent population – children and the elderly – and working age population. This situation, called

Figure 1. The rapid aging of Brazil's population: 2000 to 2050



the “demographic bonus”,¹ should succeed in triggering regional development provided social and economic conditions can absorb the large amount of labor. *The health status of this population will have a major impact on Brazil’s economic and social development.*

1.6 While there is still an unfinished health agenda in Brazil with preventable disability-adjusted life years (DALYs) related to communicable, maternal and perinatal disease and malnutrition, the burden due to non-communicable diseases and injuries is much greater, and will only increase, given the projected changes in the age structure of the population. The burden of non-communicable diseases is large for both years of life lost (YLL) and years lost to disability (YLD), as well as the combined measure, DALYs (Table 1). Cardiovascular disease is far and away the most important cause of years of life lost, with cancer another significant contributor. Neuro-psychiatric disorders predominate the years lost to disability with chronic respiratory disease and diabetes also important.

Table 1. Years of Life Lost (YLL), Years Lost Due to Disability (YLD), and Disability-adjusted Life Years (DALY) Rates* and Percent, Brazil, 1998						
	YLL		YLD		DALY	
Causes	Rate	%	Rate	%	Rate	%
ALL	111	100	120	100	232	100
Communicable, maternal, perinatal, nutritional	31	28	24	20	54	24
Infectious, parasitic	11	10	10	9	21	9
Respiratory infections	6	5	2	2	8	4
Maternal	<1	0	5	4	6	2
Perinatal	12	11	3	2	15	6
Nutritional	1	1	3	3	5	2
Non-communicable	64	58	90	75	154	66
Cancer	13	12	1	1	15	6
Diabetes	3	3	9	7	12	5
Neuro-psychiatric	2	2	41	34	43	19
Cardiovascular	28	25	3	3	31	13
Chronic respiratory	5	5	14	11	19	8
Other**	13	10			34	15
Injuries	17	15	7	6	24	10
Unintentional injuries	9	8	6	5	15	6
Intentional injuries	9	8	<1	<1	9	4

* per 1000 inhabitants
 ** Includes benign neoplasias, endocrine, sensory, digestive, genito-urinary, skin, musculoskeletal, oral, and congenital disorders.
 Source: Brazil Burden of Disease Study.

1.7 Much of the NCD burden is avoidable. The rate of DALYs due to NCDs is actually higher in Brazil compared with the more developed countries in the Americas, the United States and Canada. This suggests that there are effective interventions

available that have lowered the burden in more developed countries. It is important to consider whether some of these interventions could be applied in Brazil.

1.8 For most of the major NCD diseases, including coronary heart disease, stroke, diabetes, and many cancers—the primary cause is not underlying genetic factors, but environmental and behavioral risk factors. WHO supported a global study that estimated the proportion of deaths and DALYs that could be attributed to different risk factors by region. The study grouped the Americas into three country groupings with similar mortality profiles. For the grouping that includes Brazil, seven modifiable risk factors account for an estimated 53% of all deaths, and 30% of all DALYs. Of course the proportion would be much higher if it referred specifically to non-communicable disease deaths and DALYs. These seven risk factors include blood pressure, overweight, alcohol use, tobacco use, high cholesterol, low fruit/vegetable intake, and physical inactivity. The Americas country group with lowest mortality (made up of Canada, Cuba, and the United States) had an even higher share of deaths and DALYs attributed to these seven risk factors. It is useful to examine trends in this lowest-mortality country grouping given that Brazil's disease burden is increasingly similar to this group.

1.9 On current trends, the following can be predicted for Brazil:

- increases in the prevalence of poor diet, overweight, and physical inactivity (in part because of the aging of the population, but also because of lifestyle and diet changes) will give rise to increases in high blood pressure, high cholesterol, and diabetes in Brazil, which will in turn cause more heart disease, strokes, kidney disease, cancer, and other NCDs.
- the current, relatively small share of mortality and burden of disease from smoking will increase as the lag time for its related illnesses catches up with the population (heart disease, strokes, chronic lung disease, and cancer).

1.10 Although a comprehensive national study assessing the attributable burden of disease from risk factors has not been done for Brazil, there are two recent household surveys that provide important information on several key risk factors. They are the Risk Factor and NCD Survey (RFS) carried out between 2002 and 2003 in 16 Brazilian capital cities,² and the World Health Survey, Brazil, carried out in 2003.³ The RFS survey showed **smoking rates** among adults 25 or older in capital cities at about 20%, while for young adults, the prevalence was 15%. (The adolescent group is a key target of anti-smoking interventions as it has been shown that those who do not start smoking in adolescence are much less likely to start smoking in adulthood.) The World Health Survey showed prevalence of about 18%. Earlier surveys are not standardized, making comparison difficult, but it does appear that prevalence has fallen since the 1980s. Nevertheless, this will still cause considerable preventable harm.

1.11 The World Health Survey showed **inactivity levels** (defined as “some but insufficient” physical activity—less than 2.5 hours per week) to be around 24% with younger age groups being more active than those over 50 years old. The RFS found the range in inactivity levels between 28-54%, depending on the city. Physical inactivity tends to be a greater problem in large cities, where traffic, low air quality, few parks and

recreation facilities, and crime make leisure physical activity hard to do. But even in rural areas, sedentary activities, such as television watching, are increasing. Physical inactivity doubles the risk of cardiovascular disease, type II diabetes, and obesity. It increases the risks of high blood pressure, depression, anxiety, breast and colon cancer, lipid disorders, and osteoporosis.⁴

1.12 The RFS survey also looked at **overweight and obesity**. It found that about 45 percent of men and 30 percent of women were overweight. And about 10 percent of adults were obese. The prevalence of overweight increased with age. Overweight and obesity has increased over time. Monteiro and colleagues found that, for women, the percent obese increased from 6.5% to 12.4% from 1975/76 to 1996/97.⁵ In men, the numbers are lower but also increasing, from 2.1% to 6.4% over this same time period. The RFS survey also found that 35% of the population (range by city: 19-49%) were consuming low levels of **fruits and/or vegetables**, less than 5 per week.

1.13 The **poor in Brazil suffer a double burden**. They are more affected by communicable diseases, as well as non-communicable diseases. This double burden helps propagate the cycle of poverty. Non-communicable diseases are sometimes—mistakenly—called “diseases of affluence” because they are associated with urbanization and modernization. However, the association between NCDs and poverty is strong. In some cases, this is because the poor have markedly higher risk factors, such as smoking rates. In other cases, risk factors may not be higher but NCD disease-related disability and mortality are higher because the poor are much less likely to have early detection and proper management. Disease progression can be much faster, and coping with the disease can push the household more deeply into poverty. The links between poverty and NCDs must be considered in policy design. For example, increasing tobacco taxes are effective in reducing tobacco consumption. But policy makers might consider making widely available smoking cessation programs in poorer neighborhoods, as the poor have higher smoking rates and less income to cope with increased taxes.

What can be done?

1.14 The growing burden of non-communicable diseases is increasingly stressing the Brazilian health system. Once they develop, NCDs are generally not curable and most become chronic diseases. The ongoing medical care necessary to treat NCDs has substantial costs for the health system as well as for the individual and their family.

1.15 Fortunately, randomized prevention trials, prospective epidemiological studies, and short-term studies have contributed richly to our understanding of the dietary and lifestyle determinants of major NCDs. This research shows that the large share of NCD determinants is modifiable. Furthermore, low rates for many NCDs—coronary heart disease, stroke, diabetes, and many cancers, can be achieved without drugs or expensive medical interventions. Cynics may question the ability to change individual behaviors or the diet of a population—but other countries have shown that this is possible. Take the example, often cited, of Finland. Finland had one of the highest rates of coronary heart disease in the world in 1972. The government introduced a comprehensive program to educate the population about smoking, diet, and physical activity, first in North Karelia,

and then nationwide. It supported anti-smoking legislation, increased availability of low-fat dairy products, and improved school meals. Age-standardized coronary heart disease mortality fell over the period 1969/71 to 1995 by a remarkable 73% in North Karelia, where the program was first introduced, and by 65% nationwide.⁶

1.16 Many of the most effective non-communicable disease control and prevention interventions do not require individual behavior changes because they take a population-based approach. An example would be to reduce—through legislation or voluntary industry action--the salt content in manufactured foods. This lowers blood pressure levels, which can produce significant and long run changes in disease incidence. While population-based approaches can be highly effective, some individual-based approaches are as well, especially if they target those at high absolute risk for a disease rather than those with a single risk factor level (such as hypertension or obesity).

1.17 Prevention interventions can be classified as primary or secondary. Primary prevention refers to actions that prevent the development of NCDs in the first place. This is done mainly by decreasing exposure to risk factors. Secondary prevention refers to early detection of a disease to minimize or interrupt its progression, such as blood pressure checks and cholesterol screening. **The focus of the analysis in this volume is on primary prevention as the most cost-effective way to address the NCD epidemic.** Actions can also be described as population/community-based or individual (that is to individuals through health care providers). Risk reduction tends to be more affordable and often more effective when oriented to the population rather than individuals.

1.18 There is little information in Brazil about the financial and economic impact of its growing non-communicable disease burden and the costs and effectiveness of alternative policy approaches. To start to fill this gap, this report examined four examples of primary prevention activities: a comprehensive community campaign to promote physical activity (*Agita São Paulo*), the treatment of arterial hypertension with first-line drugs, a tax increase for tobacco resulting in a 10% price increase, and medical counseling of smokers. These activities target three risk factors: physical inactivity, arterial hypertension, and smoking, that are key to the incidence and prevalence of five NCDs, including ischaemic heart disease, cerebrovascular disease, diabetes mellitus, chronic obstructive pulmonary disease, and cancer of the trachea, bronchi, and lungs.

1.19 The analysis estimated the costs of scaling up these preventive interventions, their impact on disease, and the financial and economic cost savings relative to a baseline scenario. **The analysis found that providing anti-hypertensive treatment to 25% of those with hypertension, scaling up comprehensive community physical activity campaigns similar to *Agita São Paulo*, and a tax increase on cigarettes would, as a package, reduce Brazil's NCD burden by 845,000 DALYs, equivalent to a 5% decrease of the baseline DALY disease burden. It would generate about \$1 billion in savings in treatment costs, equivalent to about 3% of the costs of treating NCDs. And it would save about \$3.1 billion in treatment and productivity losses.** The annual medical counseling of smokers turned out to be a less desirable intervention in terms of costs and impact. **For both comprehensive community physical activity campaigns and the cigarette tax increase, the savings in treatment costs well**

outweighed the intervention costs. **The tobacco tax increase was extraordinarily cost-effective at about \$1 per DALY gained.** (The cost-effectiveness refers to the incremental intervention costs per DALY averted). *Agita São Paulo* was also a remarkably cost-effective “buy” at only \$246 per DALY averted. Anti-hypertensive treatment had lower cost-effectiveness, at \$1,498 per DALY, but still very worthwhile. The medical counseling of smokers was less cost-effective compared to the others, at \$9,360 per DALY averted. (Interventions with costs per DALY of less than twice a country’s per capita GDP are, as a rule-of-thumb, considered highly cost-effective).

1.20 Overall, the analysis showed that scaling up community campaigns to promote physical activity, the treatment of uncomplicated hypertension with first-line drugs, and tobacco tax increases should be financially and economically attractive, and will help lessen Brazil’s burden of non-communicable disease in the future. **However, much more could be done beyond scaling up the three interventions used as examples. There are many other effective interventions that have been applied in developed countries.** A good place to start would be considering which of these interventions might be effective in Brazil as well.

1.21 Table 1.2 presents recommendations for the short to medium term for reshaping Brazil’s health system more fundamentally towards NCD prevention and control. The first broad recommendation is to further **develop and implement health strategies to prevent NCDs by focusing on risk factors.** This includes measures to strengthen capacity in NCD policy formulation, regulation, monitoring, implementation, and research. Specific measures to be considered for support as soon as possible include the preparation of a national plan for NCD and NCD risk factor prevention, supported by a multisectoral national advocacy body, and clear focal points in the MOH. Regulatory and legislative action will be needed on tobacco tax levels, food content and labeling, and smoke-free environments. Effective communication of health messages is important in NCD risk factor prevention but this requires improved capacity in health communication and social marketing. **As shown by the economic analysis, population-based interventions are cost-saving in the long term but they require up front investment.** These interventions could, in part, be self-financing if increases in taxes related to risk factor control such as for tobacco and alcohol are implemented and earmarked for health.

1.22 Much more could be done to reduce exposure to risk factors over the coming years. The report has focused on diet, physical activity, and smoking as these risk factors contribute so much to Brazil’s non-communicable disease burden. Brazil has implemented food labeling to help raise consumer awareness, but much more could be done at a population-based level to improve diet. For example, legislation to reduce the use of partially hydrogenated fat and the salt content of food could be considered.

1.23 Increases in cigarette taxes could be helpful in reducing smoking prevalence even further. This could be complemented by measures to reduce smuggling and sales of tobacco to minors, and more support for smoking cessation programs, particularly among the poor and less educated.

1.24 In terms of physical activity, scaling up comprehensive community physical activity campaigns similar to *Agita São Paulo* throughout Brazil could have a huge impact as the analysis in this report has shown. Among other measures in Table 1.2, better city planning and infrastructure design could profoundly change patterns of daily living and physical activity levels (better public transportation, car-free zones in cities, separate and safe bicycle paths, well-lit sidewalks, and other measures).

1.25 While population-based interventions tend to be more cost-effective, primary care providers can also deliver NCD and risk factor prevention / health promotion activities to individuals under their care. Health promotion is one of eight priorities for the FHP, but this area has not been adequately developed. An assessment of which interventions should be financed by the FHP is needed. They should then be included in an FHP health promotion strategy and activities monitored using appropriate performance indicators.

1.26 Better information is required to address the NCD challenge in Brazil. The second broad recommendation is to **improve surveillance and monitoring of NCD and risk factor prevention strategies**. Regular risk factor surveillance needs to be supported in order to monitor trends, provide input for policy and program design, and monitor impact. Appropriate NCD indicators need to be devised for inclusion in the bipartite and tripartite “*pactos*” that monitor performance at the state and municipal levels.

1.27 The third broad recommendation is to **improve secondary prevention of NCDs through better health care and screening**. The report only briefly touches on some key issues. More work is needed to assess the strengths, weaknesses, needs and gaps of the health system in this area. Table 1.2 recommends measures to scale up screening and increase demand for treatment of hypertension and diabetes. The FHP teams need improved capacity to treat and control NCDs. Issues that should be addressed include long-term adherence to treatment, continuity of care, integrated care, and the ability of patients to self-manage their own disease.

1.28 The final recommendation is to **strengthen research on effective NCD / risk factor prevention in Brazil, particularly among the poor**. Many of the interventions require changes in lifestyle and behaviors or are applied in settings like schools, communities and workplaces where the cultural context is important. There is very little information specific to Brazil on the effectiveness of prevention interventions, and it is needed if scarce resources are to be used efficiently. Research is particularly urgently needed on the effectiveness of prevention interventions among the poor, who carry a higher burden of NCDs, since many interventions – such as those using mass media, written information, screening, and taxes – often either do not reach the poor or have a deleterious impact on the poor.

1.29 On current trends, the burden of NCDs in Brazil will generate enormous costs in terms of disability and suffering, premature mortality, lost productivity, and health care expenditures. Fortunately, a large share of the determinants of NCDs is modifiable—through appropriate public policies, programs, and partnerships. Brazil has already had some remarkable successes, for example, in reducing smoking prevalence and in

increasing physical activity in São Paulo. But much more needs to be done. The more quickly Brazil can reshape and strengthen its health system and develop multisectoral policies for more effective NCD prevention and control, the more quickly Brazil's NCD epidemic will take a lower trajectory.

Table 1.2: Recommendations on Key Strategies for the Short and Medium Term			
	Short Term (next three years)	Medium Term (four to seven years hence)	Expected Impact
Policy Formulation Capacity	<p>Develop a national action plan for NCD / risk factor prevention.</p> <p>National action plan to include measurable goals and targets.</p> <p>Create National Advocacy Body that is multisectoral, involving civil society, NGOs, academia.</p>	<p>Finalize and disseminate national plan. Create action plans at the state level.</p> <p>Implement action plan in partnership with stakeholders.</p>	Increased activities related to NCD and risk factor prevention with measurable decrease in prevalence of risk factors and NCDs.
Regulatory Capacity	<p>Inter-ministerial forum to assist in accelerated decision-making on regulatory aspects of NCD prevention</p> <p>Key regulatory recommendations made and legislation developed and passed (e.g. tobacco and alcohol taxes, food content and labeling, smoke-free environments)</p>	Regulatory and legislative work related to NCD prevention and control continues.	Decreased prevalence of smoking and exposure to smoke with decreasing lung cancer rates; decreased alcohol abuse; lower salt and unhealthy fat content of processed food with lower rates of hypertension and heart disease.
Monitoring Capacity	<p>Improve risk factor surveillance.</p> <p>Introduce indicators related to priority NCD / risk factor prevention and control programs in the bipartite and</p>	<p>NCD / risk factor surveys carried out periodically and continuous surveillance implemented in some states / municipalities.</p> <p>NCD / risk factor surveillance provides better information about population sub-groups including the poor</p> <p>States and municipalities are carrying out population-based health promotion</p>	<p>Information on risk factor prevalence available to policy makers.</p> <p>Impact of interventions assessed, including impact among population sub-groups.</p> <p>NCD risk factor prevention recognized as a priority public health issue. Activities to reduce RF prevalence increase and are having an impact on population health.</p>

	tripartite “pactos” for performance at the state and municipal levels Include indicators for health promotion in FHP performance monitoring. Improve monitoring related to capacity of FHP to control NCDs.	activities. FHP is more actively engaged in health promotion. Performance monitoring related to FHP NCD control has improved.	Individual health promotion activities are having an impact on RF and NCD prevalence in FHP catchment areas. More patients have adequate control of their chronic diseases.
Implementation Capacity	Training for primary prevention increased in multiple sectors. Training to provide adequate care for people with chronic conditions.	Increased number of health personnel and other partners with skills to implement primary NCD / risk factor prevention activities. More effective care for people with chronic conditions.	Increase in activities leading to lower risk factor prevalence and ultimately lower NCD prevalence. Multisectoral involvement in NCD / risk factor prevention. Improved care for AH and DM patients leading to less disability. Lower health care costs due to fewer hospitalizations.
Research Capacity	Training for prevention research increased. Centers specialized in prevention research established and financed.	Research on the effectiveness of interventions for primary and secondary prevention in different regions and among a variety of sub-populations including the poor.	Increased knowledge about the effectiveness of interventions in Brazil. More effective interventions being implemented. More efficient use of financing.
Reduction in Exposure to Risk Factors			
• Diet	Consider alternatives to reduce the use of partially hydrogenated fat by the food industry through either voluntary industry action or regulation.		Reductions in overweight, obesity, blood pressure, cholesterol. Reductions in coronary heart disease, hypertension, stroke, diabetes, and many cancers. Reductions in associated productivity

	<p>Continue to support and strengthen health school lunches, with fruits and vegetables.</p> <p>Promote healthy food choices through mass media, health providers, and community groups.</p> <p>Legislation to decrease the salt content of processed food.</p>		losses.
<ul style="list-style-type: none"> Physical Activity 	<p>Scale up comprehensive community campaigns for physical activity promotion similar to other major metropolitan areas</p> <p>Ensure physical activity and exercise in school physical education programs</p> <p>Encourage workplace programs to encourage physical activity (for example, use of stairs instead of elevators)</p> <p>Evaluate impact of currently ongoing municipal and state physical activity programs</p>	<p>Further scaling up of comprehensive community-based physical activity programs.</p> <p>Integrate messages about physical activity, healthy diet in school curriculum.</p> <p>Incorporate measures to encourage walking and bicycling in city planning—well-lit sidewalks, separate bicycle paths, car-free areas in cities, cross-walks, and speed bumps and other measures to reduce automobile speed.</p> <p>Create “walkable” communities.</p>	<p>For all measures: Increased physical activity, reductions in overweight and obesity. Reductions in coronary heart disease, stroke, diabetes, and many cancers. Reductions in associated productivity losses.</p> <p>Cost savings being realized.</p> <p>Comprehensive community campaigns are cost saving (programs like <i>Agita São Paulo</i> cost well below savings in treatment). Analysis in this report calculates that expanding these programs to cover 25% of the population would save 135,800 DALYs and have a cost-effectiveness of \$247 per DALY.</p>
<ul style="list-style-type: none"> Smoking 	<p>Ratify Framework Convention for Tobacco Control.</p> <p>Increase tobacco taxes further at least resulting in 10% price increase.</p>	<p>Further increases in tobacco taxes.</p>	<p>All measures will contribute to further reducing smoking prevalence, especially of youth. This will reduce over the long run cardiovascular disease, lung cancer, and chronic obstructive lung disease. Reductions in associated productivity</p>

	<p>Ban smoking in all public places.</p> <p>Control tobacco sales to minors</p> <p>Strengthen measures to control smuggling, given that 30-35% of consumption from smuggled cigarettes.</p> <p>Strengthen support for smoking cessation programs, including nicotine replacement therapy.</p>	Improved enforcement of smoking laws.	<p>losses. The tobacco tax increase will increase government revenue. Tobacco measures are cost saving (program costs are a fraction of saved treatment costs). Analysis in this report calculates that a tobacco price resulting in a 10% increase in the price of cigarettes would save 63,700 DALYs and have a cost-effectiveness of \$1 per DALY.</p>
Secondary prevention	<p>Increase demand for screening and treatment of hypertension and diabetes.</p>	<p>Increase in number of people with diabetes and hypertension being treated.</p> <p>Increase in detection of cervical cancer in early stages.</p>	<p>NCDs particularly diabetes, hypertension and cervical cancer being diagnosed earlier leading to fewer premature deaths, less disability, and lower hospital costs. Reductions in associated productivity losses.</p> <p>Analysis in this report calculates that 25% coverage of hypertensives with front line drug treatment would save 645,900 DALYs and have a cost-effectiveness of \$1498 per DALY.</p>
	<p>AH and DM Care Reform Plan is fully implemented.</p> <p>Improve capacity of FHP teams to control NCDs addressing issues related to long-term treatment and patient self-management through training and supply of adequate resources.</p>	<p>Increase number of people with diabetes and hypertension under control.</p> <p>More effective care of people with NCDs.</p>	<p>Fewer complications from diabetes and hypertension leading to fewer premature deaths, less disability, and lower hospital costs.</p> <p>Reductions in associated productivity losses.</p>

2. SCOPE OF THIS REPORT

2.1 Non-communicable diseases account for a large and growing share of Brazil's burden of disease. Non-communicable diseases account for a large and growing share of Brazil's burden of disease. Currently, about 66% of the disease burden in Brazil is due to non-communicable diseases, compared to 24% from communicable diseases and 10% from injuries. Brazil's shift towards non-communicable diseases is a consequence of urbanization, improvements in health care, changing lifestyles, and globalization. Most of this disease burden is not an inevitable result of a modern, aging society, but preventable—very often at low cost. The purpose of this report is to provide an overview of the changing non-communicable disease burden in Brazil and its root causes, to examine the economic costs of the disease burden, and costs and effectiveness of alternative policy interventions to address this growing burden. Chapter 3 reviews the latest demographic, epidemiological, and burden of disease trends in Brazil and places these trends in the broader context of Latin America. Chapter 4 examines how much of the disease burden is avoidable, and examines the evolution of the major risk factors, such as smoking, obesity, and diet, in Brazil. Chapter 5 assesses how the poor are faring in the epidemiological transition, given that they are hit by a double burden of both excess communicable and non-communicable diseases. Chapter 6 reviews the interventions that Brazil might consider to address non-communicable diseases, based on international and Brazilian experience. Chapter 7 examines four interventions that address physical activity, tobacco use, and hypertension in more detail, developing cost-effectiveness estimates for Brazil of a scaled up response. Chapter 8 is a summary of the conclusions and policy recommendations of the report.

2.2 Non-communicable diseases is a huge topic. It includes a multitude of chronic diseases that affect every organ in the body. And there are many different ways to address these diseases. NCDs are receiving more attention because they are a growing global health threat. There are several recent reports that examine the many interventions available to address NCD prevention and control. This report draws on these studies' findings.

2.3 There are two major challenges in the field of NCDs: preventing them from occurring in the first place (primary prevention) and assuring that people who have NCDs receive adequate treatment thus preventing complications and disability (secondary prevention). This report reviews the situation in Brazil, and summarizes interventions that have great potential to address the problems in Brazil. The report emphasizes primary prevention because of the greater social and economic benefits that are often associated with prevention. However, given the magnitude of the existing burden already, the report also briefly discusses some of the more important issues and interventions related to the treatment and control of NCDs. Finally this report considers some of the implications of the NCD burden for the Brazilian health system.

2.4 The report pays special attention to two diseases out of the large domain of NCDs: hypertension and diabetes. These two diseases have been identified by the MOH as top priorities. Two areas that are important for Brazil but not examined in detail in this

report simply due to time constraints are mental health and alcohol as a risk factor. These are important topics and need to be addressed in subsequent studies.

2.5 What about the unfinished agenda of MCH and communicable diseases?

While there is still an unfinished MCH and communicable disease agenda in Brazil, most of these problems are being successfully managed. The remaining issues in these areas are related to inequities and gaps within and between states rather than knowledge / program content at the national level.

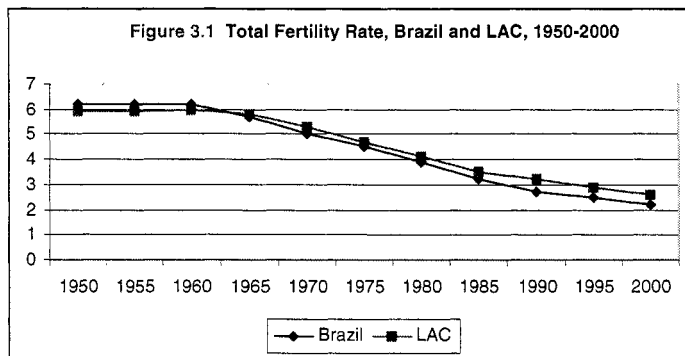
2.6 The World Bank has included in its Country Assistance Strategy for Brazil achievement of a longer, healthier life for Brazilian people. The findings and recommendations from this report can contribute this goal, and inform activities in World Bank health projects including the VIGISUS, Family Health and state health projects. Adolescence is an important time for forging lifelong habits related to healthy lifestyles, and this report dovetails some of the recommendations made by the Report on Youth at Risk in Brazil. The work on the quality of health care (QUALISUS) will expand on some of the findings about the need for a shift in the way health care services are provided to people with chronic diseases.

2.7 The Brazilian MOH has taken steps to address the challenge of NCDs. It has included hypertension and diabetes as priorities in its national health plan. It has also included the screening and treatment of these two diseases as priorities within the Family Health Program, Brazil's principle vehicle for health care delivery. In the area of primary prevention, Brazil has begun to assess the prevalence of risk factors, and smoking prevention and tobacco control activities have been underway for some time. This report aims to provide evidence, economic and epidemiological, to support the further expansion of these activities, particularly those related to primary prevention, and to summarize some of the key issues to be tackled for this effort to have the most impact.

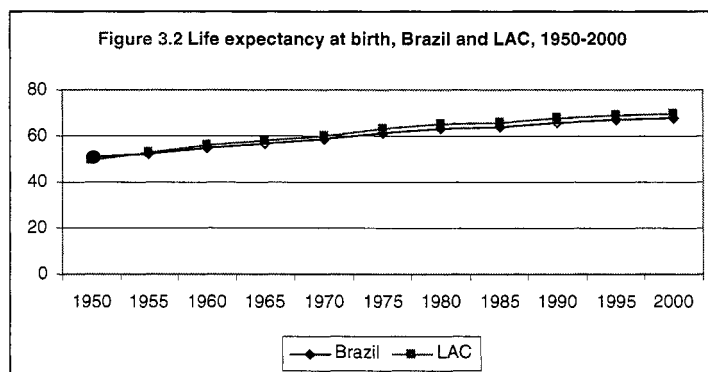
3. THE HEALTH TRANSITION AND BURDEN OF DISEASE IN BRAZIL

THE DEMOGRAPHIC TRANSITION IN BRAZIL

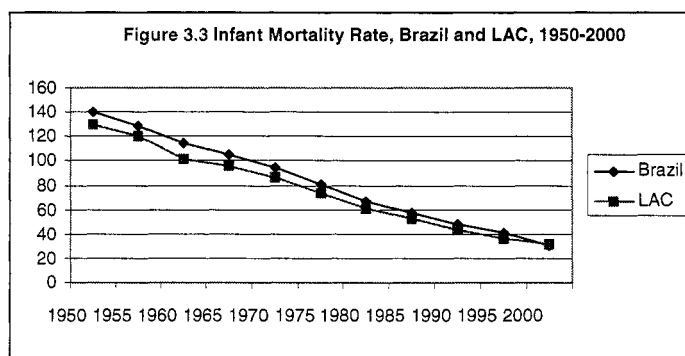
3.1 Brazil is undergoing a rapid demographic transition due to falling birth and mortality rates, and increasing life expectancy. This transition differs from the classic model based on European experience in that it is occurring over a very compressed time frame. A transition that took approximately two hundred years in Europe is taking place over a few decades in Brazil. The rate of progress of the demographic transition influences the epidemiological transition and burden of disease and will therefore be



briefly reviewed here. In 1950, the total fertility rate (TFR) in Brazil was about 6.2 children per woman, compared with about 5.9 for LAC (Figure 3.1).^{7,8} Starting about 1960, the fertility transition has been very rapid. The current TFR for Brazil is estimated at 2.1 children, compared to 2.5 children for LAC as a whole.



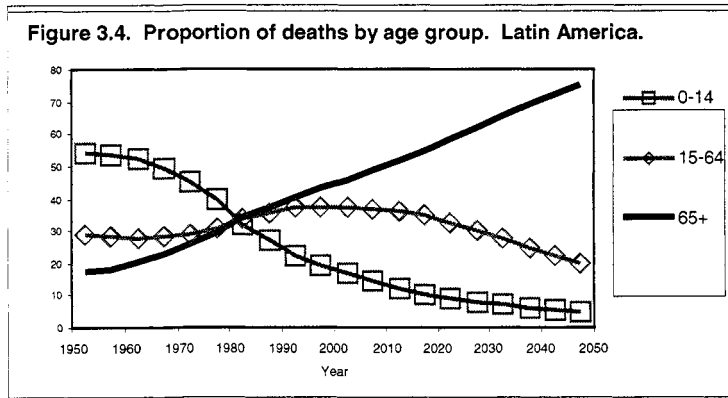
3.2 Mortality rates decreased and life expectancy steadily improved between 1950-2000 in Brazil. Brazil's life expectancy was 51 in 1950 and rose to 68 in 2000—slightly below the LAC average (Figure 3.2).⁷ This trend should continue with further improvements during the next 50 years.



3.3 The main explanation for the rapid rise in LEB during the past fifty years is the dramatic reduction in infant and child (under 5) mortality rates. Figure 3.3 shows the evolution of the Infant Mortality Rate (IMR) which decreased more than 75 percent since 1950,

from 140 per 1000 live births (LB), to 30 in 2000.ⁱ The IMR has been one of the main beneficiaries of improved health conditions to date. As the room for improvement in IMR declines, gains in LEB will have to come from decreasing mortality in older age groups.

3.4 Figure 3.4 depicts this transition in LAC overall by showing the share of deaths for each age group with respect to total deaths.⁷ This indicator is based on two factors: the evolution in mortality and changes in the populations' age structure. In 1950, children under 15 accounted for more than half of all deaths (54 percent), and only 17 percent

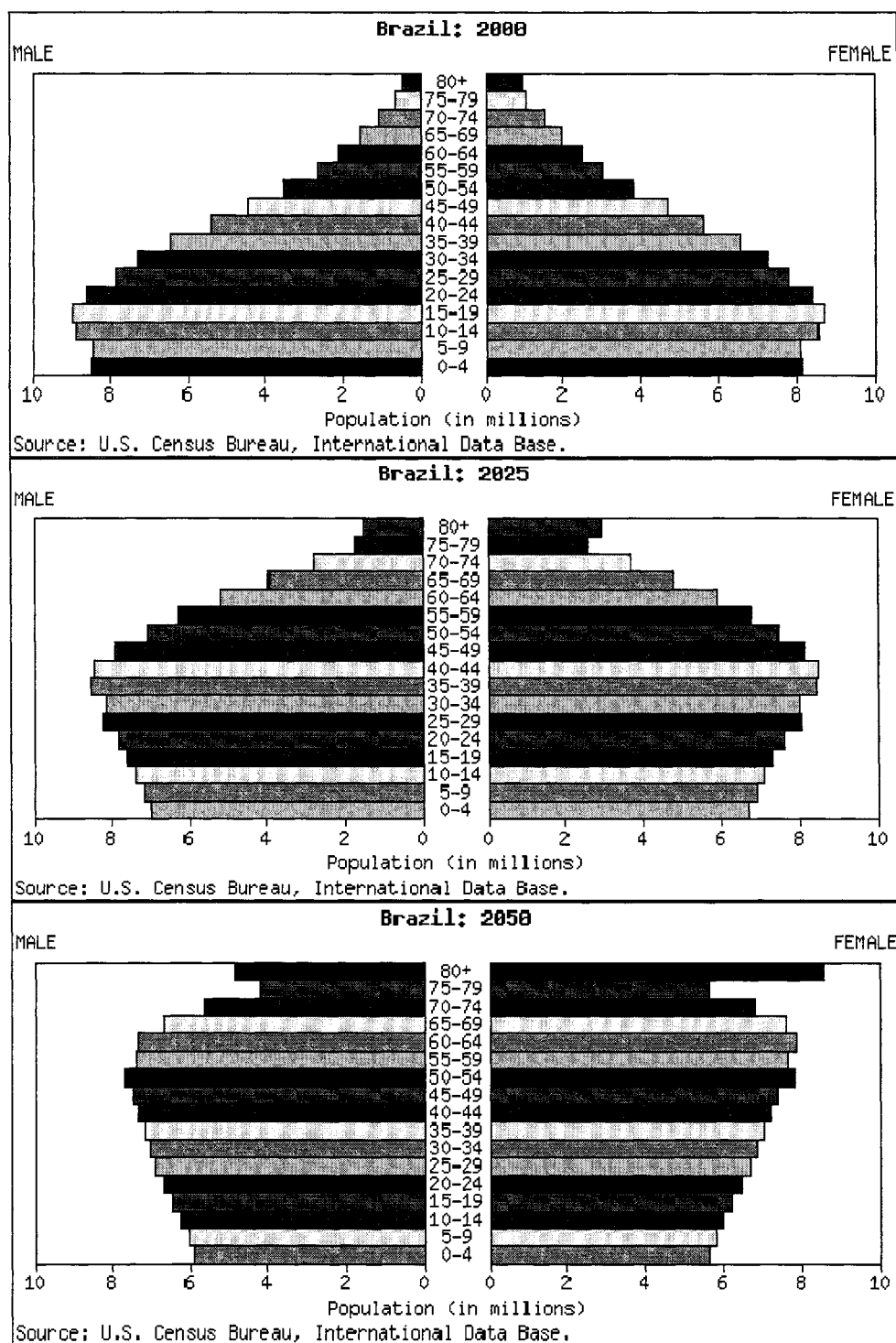


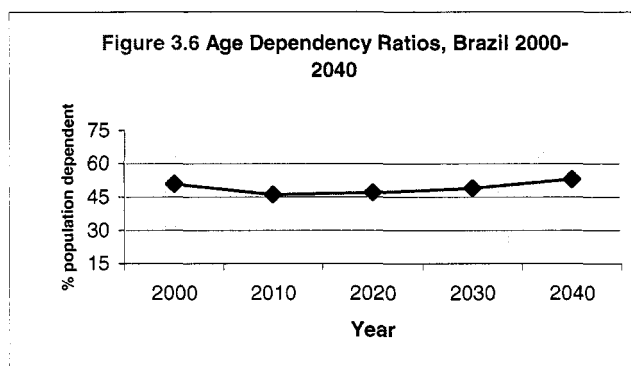
were 65 years or older (65+). Currently (2000-05), these shares are reversed: 17 percent of deaths for children and 46 percent for the elderly. The share of child deaths will further decrease in the future (5 percent by 2050), and three-fourths will be for people 65 and older.

3.5 Figure 3.5 depicts the dramatic changes that have already occurred and are projected to occur in the age structure of the population. In 2000, an estimated 15% of the population was aged 50 and over. This is projected to increase to 29% by 2025 and 42% by 2050. The increase in absolute numbers is even more dramatic. In 2000, about 27 million Brazilians were 50 or over. By 2025, this is projected to increase to 63 million, and to 96 million by 2050. The median age of the Brazilian population was 26 in 2000 and is projected to rise to 36 by 2025, and 44 by 2050.

ⁱ Data from the Brazilian Institute of Geography and Statistics (IBGE)

Figure 3.5 The rapid aging of Brazil's population: 2000 to 2050



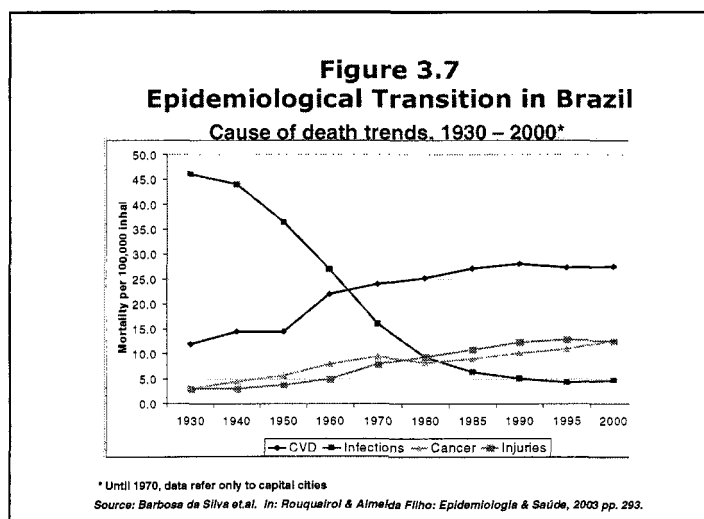


3.6 The evolution in the age structure is producing enormous changes in the age-dependency indexⁱⁱ. During the next decade Brazil will experience a new and probably irreplaceable situation: an optimum demographic ratio between dependent population – children and the elderly – and working age population (Figure 3.6).⁹ This situation, called the “demographic bonus”,¹ should

succeed in triggering regional development provided social and economic conditions can absorb the large amount of labor. *The health status of this population will have a major impact on Brazil's economic and social development.*

THE EPIDEMIOLOGICAL TRANSITION IN BRAZIL

3.7 Epidemiological transitions occur as living standards, education levels, and access to health services improve, and urbanization and modern lifestyles among others contribute to changing disease and mortality patterns. The demographic and epidemiological transitions in Brazil are linked. Shifts in the age distribution of Brazil's population have contributed to shifts in its burden of disease. At the same time, the epidemiological transition in Brazil is associated with major changes in the probability and causes of illness, disability and death at different ages. These changes are also reflected in two types of summary health measures: the Healthy Life Expectancy (HALE) and the Disability-Adjusted Life Years (DALYs). Brazil has carried out a Burden of Disease study and the focus of this chapter will therefore be on DALYs.



3.8 A major factor in the epidemiological transition is a reduction in mortality and illness from infectious diseases. Since infectious diseases mainly strike children, at the beginning of the epidemiological transition infant and child (<5) mortality rates are greatly reduced. This results in an accelerated increase in LEB. Subsequently, youth and middle age adult mortality declines, and in the last phase a fall in the mortality

ⁱⁱ The age-dependency ratio is the total number of dependent people (those younger than 15 plus those older than 64) divided by the number of people considered economically productive (ages 15-64).

of the elderly is noted. These changed are due both to reduced mortality from infectious diseases in adults, as well as to ongoing mortality reductions from many NCDs and injuries. Figure 3.7 shows the rapid drop in mortality rates from infections rapidly between 1940 and 1980 while CVD, cancer and injury rates increased. In 2000, mortality rates from infectious were only 5 per 100,000 inhabitants compared to 27 from CVD, 12 for cancer, and 12 for injuries.

Burden of Disease

3.9 Brazil carried out its first burden of disease study in 2001 using mortality and disability data from 1998.¹⁰ Findings for the entire country are seen in Table 3.1 and show a country that has advanced significantly in its epidemiological transition with 66 percent of the burden of disease (measured by DALYs) due to non-communicable diseases and 10% due to injuries. The three principal causes of mortality in Brazil are cardiovascular disease, intentional injuries (violence) and cancer. In 1998 these three causes accounted for 60% of all deaths in Brazil.

Table 3.1 YLL, YLD, DALY Rates* and Percent, Brazil 1998						
Causes	YLL		YLD		DALY	
	Rate	%	Rate	%	Rate	%
ALL	111	100	120	100	232	100
Communicable, maternal, perinatal, nutritional	31	28	24	20	54	24
Infectious, parasitic	11	10	10	9	21	9
Respiratory infections	6	5	2	2	8	4
Maternal	<1	0	5	4	6	2
Perinatal	12	11	3	2	15	6
Nutritional	1	1	3	3	5	2
Non-communicable	64	58	90	75	154	66
Cancer	13	12	1	1	15	6
Diabetes	3	3	9	7	12	5
Neuro-psychiatric	2	2	41	34	43	19
Cardiovascular	28	25	3	3	31	13
Chronic respiratory	5	5	14	11	19	8
Other**	13	10			34	15
Injuries	17	15	7	6	24	10
Unintentional injuries	9	8	6	5	15	6
Intentional injuries	9	8	<1	<1	9	4

* per 1000 inhabitants
 ** Includes benign neoplasias, endocrine, sensory, digestive, genito-urinary, skin, musculoskeletal, oral, and congenital disorders.

3.10 While there is still an unfinished health agenda in Brazil with preventable DALYs related to communicable, maternal, perinatal and nutritional disorders, the burden due to non-communicable diseases and injuries is much greater. The burden of non-communicable diseases is large for both years of life lost (YLL) and years lost to disability (YLD). Cardiovascular disease is far and away the most important cause of years of life lost, with cancer another significant contributor. Neuro-psychiatric disorders predominate the years lost to disability with chronic respiratory disease and diabetes also important.

3.11 The overall table for Brazil masks differences in health outcomes by sex, socioeconomic status and other determinants of health. For instance, the study showed that the burden of disease due to injuries among Brazilian men is nearly four as high as among Brazilian women (38 DALYs/1000 men vs. 10 per 1000 women). However, no burden of disease data is available by socioeconomic status. Regional data provide some

information about potential differences related to poverty, although they also reflect urban and rural differences.

Table 3.2 DALY Rates* and Percent for major causes by region										
	North		Northeast		Center-west		Southeast		South	
Cause	Rate	%	Rate	%	Rate	%	Rate	%	Rate	%
ALL	209	100	250	100	201	100	236	100	210	100
Communicable, maternal, perinatal, nutritional	66	32	75	30	46	23	45	19	39	19
Non-communicable	124	59	156	62	129	65	163	69	148	70
Injuries	19	9	19	8	26	13	28	12	23	11

* per 1000 inhabitants

3.12 Table 3.2 shows that all regions of Brazil are well advanced in their epidemiological transitions with the highest proportion of NCD burden, not surprisingly, in the South and Southeast (70, 69%). However, more of a surprise is the fact that, while the less developed, poorer regions of the North and Northeast still have relatively high rates of DALYs due to communicable/maternal/perinatal/nutritional diseases (66, 75 per 1000) compared to the South and Southeast (39, 45 per 1000), the second highest rate of NCD burden is in the Northeast (156 per 1000). This double burden contributes to the fact that the Northeast has the highest overall burden of disease among Brazilian regions. Injuries are also important contributors to the burden of disease with rates and proportions highest in the Center-west and Southeast. Two-thirds of injury DALYs are unintentional, primarily due to motor vehicle accidents. Overall the picture is one of a high burden of disease related to NCDs and injuries in all of the regions.

3.13 Table 3.3 shows the top ten specific causes of burden of disease in Brazil. While it is likely that these causes vary from region to region, overall NCDs and injuries occupy eight of the top ten causes. They include diabetes, two cardiovascular diseases (ischaemic heart disease and stroke), various injuries and chronic lung disease. These eight causes account for 29.4% of all DALYs.

Table 3.3 Top 10 specific causes of DALYs Brazil 1998	
Perinatal conditions	5.4%
Diabetes mellitus	4.9%
Ischaemic heart disease	4.3%
Stroke	4.0%
Road traffic accidents	3.7%
Falls	3.5%
Homicide	3.3%
Chagas	2.9%
Chronic obstructive lung disease	2.8%
Lower respiratory infections	2.5%

Burden of disease due to disability

3.14 In Brazil (as in other LAC countries with advanced health transitions) a majority of the DALYs are now due to YLDs (52%).¹¹ This is because while the

communicable disease and injury groups of causes of BOD are dominated by mortality, for the NCD group disability is a greater contributor to the BOD than mortality. This has important implications for health policy in Brazil. NCDs are chronic diseases that require ongoing medical care, and improved medical care means people live longer with chronic diseases. The increasing NCD burden will therefore increasingly stress the Brazilian health system if actions are not taken to reduce it. Furthermore, this burden affects productive age groups with economic and social consequences.⁹

4. THE LINK BETWEEN RISK FACTORS AND AVOIDABLE BURDEN OF DISEASE IN BRAZIL

4.1 Brazil DALY rates can be compared with low child and adult mortality countries to get a sense of the scope for reducing the burden of disease in Brazil. Table 4.1 compares DALY rates in Brazil to those in a country grouping that includes Canada, Cuba, and the United States ("America-A").¹¹ DALY rates in Brazil are higher for all three major disease groups suggesting that a large part of the burden in all three groups

Table 4.1 Avoidable DALYs: Brazil compared to Amer-A*		
	Brazil**	Amer-A**
Causes	Rate / 1000	Rate / 1000
ALL	232	125
Communicable, maternal, perinatal, nutritional	54	10
Infectious, parasitic	21	4
Respiratory infections	8	1
Maternal	6	<1
Perinatal	15	3
Nutritional	5	2
Non-communicable	154	100
Cancer	15	13
Diabetes	12	3
Neuro-psychiatric	43	42
Cardiovascular	31	14
Chronic respiratory	19	8
Other***	34	20
Injuries	24	15
Unintentional injuries	15	10
Intentional injuries	9	5

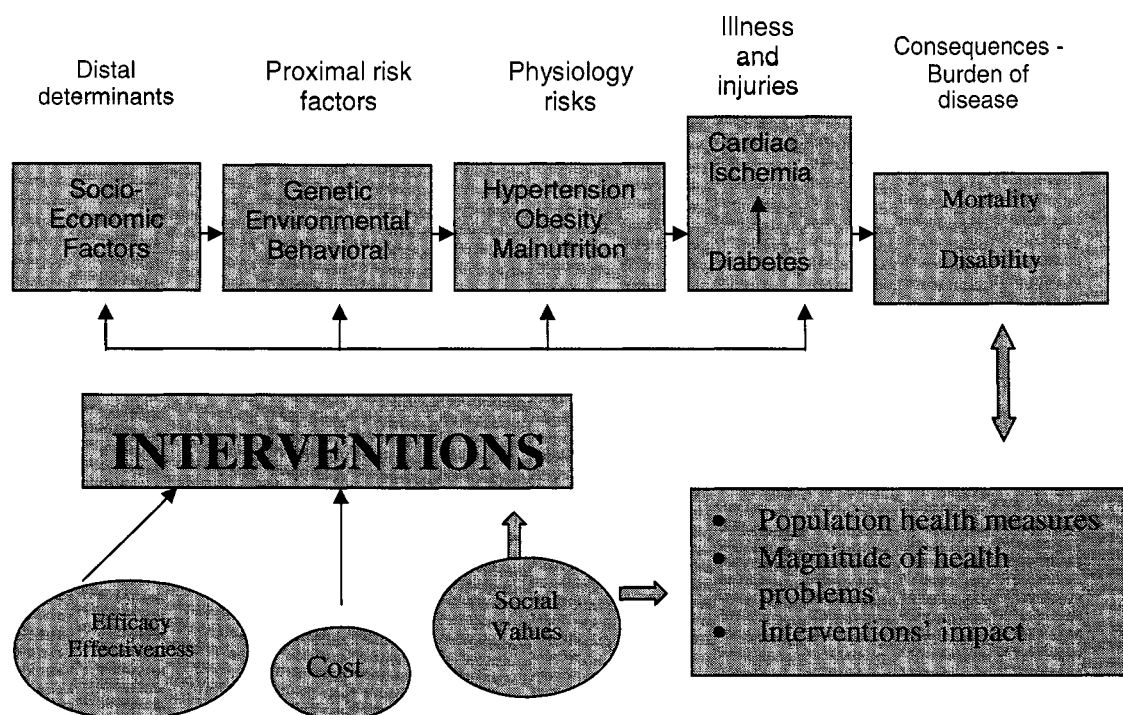
* Very low child and adult mortality stratum: Canada, Cuba, USA
 ** Brazilian data is age-standardized across Brazilian regions but not to a global standard; Amer-A data is standardized to a global age standard with an age distribution similar to that in Brazil; crude Amer A DALY rates are also lower than in Brazil.
 *** Includes benign neoplasias, endocrine, sensory, digestive, genito-urinary, skin, musculoskeletal, oral, and congenital disorders.

can be avoided. The burden of disease rate for infectious and parasitic diseases is about five times higher in Brazil than in the America-A country grouping. Some of this is due to the prevalence of malaria and other tropical disease not found in America-A countries. Nevertheless most of the burden is clearly avoidable. The avoidable burden in the injuries grouping is primarily due to unintentional injuries (dominated by motor vehicle accidents) but there are also significant avoidable DALYs due to intentional injuries, primarily violence/homicides. Finally, there is a significant avoidable burden due to non-communicable diseases particularly for diabetes, cardiovascular disease and chronic respiratory diseases. At

the same time, it should be noted that there is still considerable avoidable mortality even in America-A countries. The burden of disease from non-communicable diseases in more developed countries has been slowly falling as effective interventions to prevent them or ameliorate their consequences are implemented, and this trend is expected to continue.

4.2 Figure 4.1 shows the sequence of risk factors that precondition the emergence of diseases and injuries. The burden of disease can be prevented by reducing exposure to distal, proximal and physiologic risk factors. One way to prioritize prevention programs for the population or for high-risk individuals^{12,13} is to estimate the burden of disease caused by the most relevant risk factors in different parts of the world.

FIGURE 4.1 CAUSAL CHAIN OF ILLNESS



4.3 Brazil has not carried out a study of the proportion of its burden of disease that is attributable to specific risk factors. But WHO did so in its 2002 Global Burden of Disease Study (GBDS). In this study, WHO estimated the impact of 26 risk factors (RFs)¹⁴ on mortality and burden of disease.ⁱⁱⁱ The study shows the estimated prevalence of RFs by world regions, risk shares attributable to the different populations, and mortality and burden of disease attributable to these factors. Brazil is included in the country grouping “America-B”—indeed makes up nearly half of the population in this group. The GBDS study results most relevant to Brazil are summarized here. More detailed information can be found in the Annex to this report (A2-A4).

4.4 Table 4.2 shows mortality attributable to the top ten risk factors in the three Americas country groups (A, B and D). As noted above Brazil is considered a low mortality LAC country (America-B). However, areas of Brazil have higher mortality rates and probably are more similar to the America-D group of countries with high mortality rates (e.g. Bolivia, Peru, Guatemala) and for that reason they are also shown.

ⁱⁱⁱ This study looked at attributable mortality and DALYs for specific risk factors. Not all known risk factors are included. One important factor missing is the use of seat belts and helmets to prevent deaths and disabilities from motor vehicle accidents.

The America-A group includes Canada, Cuba, and the United States. Brazilian mortality and disability trends suggest that over time they will increasingly look like the America-A group. Indeed, it is likely that some areas of Brazil (e.g. parts of the South and Southeast) already have this type of profile.

4.5 The group of RFs associated with a poor diet (low fruits and vegetables, high cholesterol), overweight (but not undernutrition), physical inactivity and hypertension are causing more than one out of three deaths in low mortality LAC countries like Brazil, one out of four in high mortality LAC countries, and nearly half of all deaths in America-A countries. Thus, these are the most relevant RFs in Brazil. The above RF group, together with addictive substances including tobacco and alcohol, are causing more than one half of all deaths in low mortality LAC countries like Brazil, nearly one out of three in high mortality LAC countries, and 7 out of 10 deaths in America-A countries. Factors associated with undernutrition, together with the lack of safe water, sanitation, hygiene, and indoor smoke, account for an additional 17 percent of deaths in high mortality LAC countries and 6 percent in low mortality LAC countries. Sexual and reproduction-related risks cause 6 percent of deaths in high mortality LAC countries and 2 percent of deaths in low mortality LAC countries. The 10 main risk factors account for 61% of the deaths in low mortality countries like Brazil, and 73% of deaths in America A countries. That is to say in countries like Brazil two-thirds of its premature deaths could be prevented by eliminating exposure to these risk factors.

Table 4.2 Ten main risk factors for attributable mortality in the Americas						
	High mortality LAC countries (America-D)		Low mortality LAC countries (America-B - includes Brazil)		Canada, USA and Cuba (America-A)	
	Risk factor	% deaths		% deaths		% deaths
1	Blood pressure	7.8%	Blood pressure	12.8%	Tobacco	23.3%
2	Overweight	6.5%	Overweight	10.1%	Blood pressure	13.3%
3	Unsafe sex	5.5%	Alcohol	9.5%	Cholesterol	12.6%
4	Alcohol	5.5%	Tobacco	8.5%	Overweight	9.8%
5	Underweight	4.9%	Cholesterol	6.5%	Low fruit, vegetable intake	6.2%
6	Water, sanitation, hygiene	4.5%	Low fruit, vegetable intake	5.4%	Physical inactivity	5.6%
7	Cholesterol	3.7%	Physical inactivity	4.1%	Urban air pollution	1.0%
8	Low fruit, vegetable intake	2.7%	Unsafe sex	1.9%	Illicit drugs	0.6%
9	Physical inactivity	2.4%	Water, sanitation, hygiene	1.2%	Unsafe sex	0.6%
10	Indoor smoke from solid fuels	2.0%	Urban air pollution	1.2%	Airborne particulates	0.5%
	Total attributable mortality	45.5%	Total attributable mortality	61.2%	Total attributable mortality	73.4%

4.6 A different, but complementary analysis is the attributable burden of disease (DALYs) due to the RFs investigated (Table 4.3). When disability is included in the assessment as well as mortality, the findings differ somewhat:

- A poor diet (but not undernutrition), overweight, inactivity and hypertension account for 1 of every 4 DALYs in countries with very low mortality, 1 of every 7 DALYs in low mortality LAC countries and 1 of 13 DALYs in high mortality LAC countries.
- Conversely, RFs associated with undernutrition, together with environmental risks resulting from the lack of safe water and sanitation and indoor smoke, account for 1 of every 6 DALYs in high mortality LAC countries, 1 of every 20 in low mortality countries and 1 of every 100 in very low mortality countries.
- Among the addictive substances tobacco the pattern is similar to that for mortality. However, alcohol and illicit drugs contribute more to DALYs in all three country groups because of the high disability they cause, either directly or through the diseases they are responsible for.
- Finally, unsafe sex accounts for 1 out of 20 DALYs in high mortality LAC countries and 2 and 1 out of a hundred in low and very low mortality LAC countries, respectively.

Table 4.3 Ten main risk factors for attributable DALYs in the Americas, by mortality stratum						
	America-D: LAC countries high mortality		America-B: LAC countries low mortality (includes Brazil)		America-A: Canada, USA y Cuba	
	Risk factor	% DALYs		% DALYs		% DALYs
1	Alcohol	5.7%	Alcohol	11.7%	Tobacco	13.4%
2	Underweight	5.5%	Overweight	4.3%	Alcohol	7.9%
3	Unsafe sex	4.9%	Blood pressure	4.1%	Overweight	7.6%
4	Water, sanitation, hygiene	4.5%	Tobacco	3.8%	Blood pressure	6.1%
5	Overweight	2.5%	Cholesterol	2.4%	Cholesterol	5.4%
6	Blood pressure	2.3%	Unsafe sex	2.2%	Low fruit, vegetable intake	3.0%
7	Iron deficiency	2.0%	Lead exposure	2.1%	Physical inactivity	2.8%
8	Indoor smoke from solid fuels	2.0%	Low fruit and vegetable intake	1.9%	Illicit drugs	2.6%
9	Zinc deficiency	1.9%	Water, sanitation, hygiene	1.6%	Unsafe sex	1.1%
10	Illicit drugs	1.6%	Physical inactivity	1.5%	Iron deficiency	1.0%
	DALYs attributable to top 10 RF	32.9%	DALYs attributable to top 10 RF	35.5%	DALYs attributable to top 10 RF	50.8%

Likely risk factor trends

4.7 Differences among the three Americas country groups in terms of their mortality rates and DALYs reflect the future evolution that will likely take place in Brazil and within its disparate regions if no appropriate preventive measures are implemented and/or health care services fail to face the new needs and demands of the population. Overall the following can be expected for the next years:

- A significant increase in the burden of risk factors associated with a poor diet, overweight and inactivity will give rise to an increased prevalence of high blood pressure, high cholesterol, and diabetes, which in turn cause heart disease, strokes, kidney disease, cancer, and other NCDs.

- The current, relatively small share, of mortality and burden of disease for smoking will increase as the lag time for its related illnesses catches up with the population (heart disease, strokes, chronic lung disease, cancer).
- Illegal drugs are closely associated with violence and regular consumption is increasing in large cities; hence, their relevance as risk factors is expected to increase. Alcohol will continue to be an important cause of mortality and DALYs.
- Unsafe sex could decrease its relevance to the extent that effective education campaigns and AIDS prevention program are expanded in the region.
- Risks associated with malnutrition (underweight) and environmental factors (mainly availability of safe water and basic sanitation) will continue to decrease to the extent that social and economic development reaches the poorest populations.

4.8 The rapid demographic transition in Brazil means that the proportion of adults in the population is increasing quickly and consequently the weight of RFs that mainly affect middle age people will also increase. Cost-effective interventions are available to face these challenges and reduce the burden of disease due to RFs. They are discussed in Chapters 6 and 7.

RISK FACTOR PREVALENCE IN BRAZIL – THE PRINCIPLE ISSUE FOR NCD PREVENTION

4.9 Brazil has not carried out a comprehensive national study assessing the attributable burden of disease from risk factors. However, there are two household surveys of the prevalence of key risk factors that provide important information. One is the 2003 WHO World Health Survey³ that provides nationally representative findings on the prevalence of risk factors and other health issues. And another is the Risk Factor and NCD Survey (RFS) carried out between 2002 and 2003 in 16 Brazilian capital cities.² Results are shown in Tables 4.4 and 4.5. Where comparable these two studies showed similar results. Inactivity was slightly higher in the urban studies and ‘at risk’ alcohol intake was slightly higher in the national study. Findings on specific risk factors are discussed together with other available data below.

Smoking

4.10 Sporadic studies carried out in Brazil during the 1980s and 90s showed a very high prevalence of tobacco use: 40-50% in men and 20-30% in women. By 1989, 30% of the population over the age of 15 smoked.¹⁵ The more recent RFS carried out in 16 capital cities shows a lower overall prevalence of around 20%.² This is similar to the finding of 18% in the World Health Survey.³ While these studies are not comparable to previous studies making assessment of trends difficult, they suggest that smoking prevention and cessation activities programs in Brazil are having an impact.

4.11 The RFS also found smoking rates among adults 25 or older of around 20% and for adolescents and young adults aged 15-24 they were around 15%. (Data not shown). Surveys in 10 Brazilian capital cities showed an increase in the percentage of school children aged 10-18 using tobacco for the first time between 1987 and 1997. This increase was especially striking among girls. It is not possible to assess the impact of Brazilian tobacco programs on adolescent smoking with available data. The adolescent

group is a key target of anti-smoking interventions as it has been shown that those who do not start smoking in adolescence are much less likely to start smoking in adulthood.

Table 4.4 Range of prevalence (%) of risk factors in 16 Brazilian cities, 2002/3*			
Risk Factor	Male	Female	Total
Smoking	17 – 28	10 – 23	13 - 25
Obese	8 – 13	8 – 14	NA
All overweight (includes obese)	37 – 52	28 – 40	NA
Inactivity	27 – 49	26 – 58	28 - 55
At risk alcohol intake	NA	NA	5 - 12
Fruits or vegetables <5 X / week	21-53	17-48	19-49
No PAP last 3 yrs. (ages 25-59)		7-27	
No Mammogram last 2 yrs. (ages 50-69)		23-63	
* Household survey of behavioral risk factor related to non-communicable diseases, 15 capital cities and the federal district, Brazil, 2002/3.			

Table 4.5 Prevalence of risk factor by age group, Brazil 2003*				
Risk factor	18-34	35-49	50+	Total
Smoking	15	23	17	18
Obese	6	12	14	10
All overweight (includes obesity)	25	46	51	39
Inactivity	22	20	32	24
At least 5 alcohol drinks in past week	17	16	15	15
* World Health Survey, Brazil 2003.				

Overweight and Obesity

4.12 The nationally representative World Health Survey 2003 found a high prevalence of overweight in Brazil (39%). About 10% of adults were obese. The prevalence of both overweight and obesity increased with age. The prevalence of overweight was higher among men in all age groups than women. The prevalence of obesity, on the other hand, while similar among men and women of younger ages, was higher among women fifty and older than among men in that age group. The RFS (16 capital cities) found a similar pattern though the differences were greater. Around 45% of men and 30% of women were overweight, and around 10% of each sex was obese. The prevalence of overweight increased with age in all cities. Among adolescents and young adults the prevalence of overweight ranged from 12-23%.

4.13 Monteiro and colleagues examined the prevalence of obesity over time from nationwide surveys.⁵ In women, the percent obese increased from 6.5% to 12.4% from 1975/75 to 1996/97. In men, the numbers were lower but also increasing, from 2.1% to

6.4% over the same period. The following chapter on poverty discusses how much these numbers systematically vary not just by gender but also by region and income group.

Healthy Diet - Fruits and Vegetables

4.14 The RFS assessed the percentage of the population consuming a healthy diet by asking about the consumption of fruits or vegetables. It used a relatively low intake - at least 5 times per week – as a point of comparison. The generally accepted dietary recommendation is 5 portions per *day*. Even with this low threshold around 35% of the population (range: 19-49%) was not consuming fruits or vegetables 5 times per week. Low consumption of fruits and vegetables is a risk factor for heart diseases, diabetes and cancer.

Physical activity

4.15 The World Health Survey show inactivity levels to be around 24% with younger age groups being more active than those over 50 years old. In this study, women and men had similar patterns and levels of inactivity. The recently completed RFS (using questions that have been internationally validated) in 16 capital cities also found inactivity levels to be similar among men and women. The range among the 16 cities studied varied from 28-54% of the population reporting inactive lifestyles. Previous findings of studies in urban settings showing women to be at greater risk were not corroborated. In most of the cities in the RFS, physical inactivity increased with age. Nevertheless, even among adolescents and young adults aged 15-24 the prevalence of inactivity was high ranging from 26 to 53%. The fact that inactivity levels are higher in urban settings than in Brazil overall is hardly surprising.

Conclusions

4.16 The prevalence of NCD risk factors is high in Brazil. These risk factors are a root cause of NCDs and major contributors to the high burden of disease. Addressing this high prevalence is an important strategy in decreasing the avoidable burden from NCDs. Unfortunately, good trend data are not available and interpretation of available data is complicated. The prevalence of risk factors related to diet, physical activity and overweight/obesity appears to be increasing as Brazilian life styles change to those of more developed countries. Measures to reduce smoking appear to have been effective. Nevertheless, smoking prevalence is still around 20 percent and this, along with other RFs, will continue to cause considerable mortality and disability in the future.

PREVALENCE OF HYPERTENSION AND DIABETES IN BRAZIL

Table 4.6 Percent of people reporting chronic health problems, Brazil, 2003*

Health Problem	Percent
Angina	6.7
Arthritis	10.6
Asthma	12.1
Diabetes	6.2
Depression	19.3
Schizophrenia	1.7

*World Health Survey, Brazil, 2003

4.17 There are few national data on the prevalence of NCDs Brazil. The 2003 World Health Survey assessed the prevalence of a limited number of NCDs including mental health. These findings are presented in Table 4.6. In this paper we will focus on diabetes and hypertension. Their prevalence in Brazil is high and growing, and they lead to cardiovascular disease – the major cause of mortality in Brazil. The prevention and improved management of hypertension and diabetes have been identified as high priorities by the Brazilian MOH. As

noted previously, interventions for their prevention are well-known and are cost-effective. Much is also known about their treatment, which, particularly in the case of hypertension, is highly cost-effective. These two diseases are important causes of cardiac disease as well as kidney disease, strokes, and, in the case of diabetes, various disabilities (blindness, amputations). Efforts to prevent or effectively treat hypertension and diabetes will contribute to reductions in cardiovascular disease and its impact on the burden of disease.

Hypertension

4.18 There are no national data on the prevalence of hypertension. A review of the Brazilian literature from 1990 to 2003 found that the prevalence of hypertension among adults in Brazilian cities varied between 20 and 30%. It was noted to increase with age¹⁶, and was higher among men. Several studies assessed the association of hypertension with socioeconomic status. Prevalence was highest among those with the lowest income, with the lowest education, and among Afro-Brazilians;¹⁷ prevalence was 21% among those with less than 5 years of education compared with 7% among the college-educated;¹⁸ and it was 45% among those with less than a minimum wage;¹⁹ The 2002/3 Behavioral Risk Factor and NCD Morbidity Study included questions on whether the individual had had their blood pressure checked in the last two years and whether they had been told to have high blood pressure. It found that most people had had their blood pressure checked and that 7-16% of people aged 25-39, 26-36% of those aged 40-59, and 39-59% of those aged 60 or older had been told they had hypertension (Table 4.7). Prevalence of hypertension was consistently higher among people with incomplete schooling and ranged from 30 to 130 percent higher compared to those with completed schooling.

Diabetes

4.19 In the 1980s the prevalence of diabetes noted in several studies was around 2%.^{16,20,21} Studies in the 1990s found a higher prevalence of around 7-13%.^{16,22} The World Health Survey found an overall reported prevalence rate for diabetes of 6.2 percent (Table 4.6). The RFS included questions about whether the individual had had their blood sugar checked, and among those who had had it checked, whether they were told they

had diabetes. It found that many people had had their blood sugar checked (particularly those over the age of 39) and that the prevalence of diabetes increased with age (Table 4.7). The range of prevalence in the 16 capital cities varied from 0-5% in people 25-39, 5%-9% among those 40-59, and 12%-25% among those 60 years or older. While it is difficult to gauge trends using these disparate sources of data there seems to be an increase in the prevalence of diabetes over time, as well as with increasing age, and that both of these trends are associated with an increase in overweight/obesity and inactivity. Prevalence of diabetes was higher among people with incomplete schooling, ranging from 1.5 to 5 times higher compared to those who had completed schooling.

Table 4.7 Findings from the 2002/3 Household Survey on NCD Behavioral Risk Factors and Morbidity; Range of reported prevalence (%) in 16 Brazilian cities*			
NCD	25-39	40-59	60 or more
Hypertension			
BP measured last 2 years	66-92	87-96	93-98
Hypertension diagnosed (among those with BP measured)	7-16	26-36	39-59
Diabetes			
Blood sugar (BS) measured	40-62	70-85	79-92
Diabetes diagnosed (among those with BS measured)	0-5	5-9	12-25
Diagnosis of heart attack or coronary disease	1-3	3-7	9-21
* 16 capital cities and the federal district			

Heart Attacks and Coronary Disease

4.20 The 2002/3 RFS also asked participants whether they had been told by a doctor that they had had a heart attack or coronary artery disease. Prevalence rates in the sixteen cities ranged from 1-3 percent in those 25-39 years of age, to 9-21 percent in those over 59 years of age. The World Health Survey found a comparable overall prevalence rate of 6.7 percent.

Conclusions

4.21 The prevalence rates for diabetes and hypertension in Brazil are high, and they contribute to the relatively high rate of heart attacks and coronary artery disease. While screening for these diseases appears to be good, their management will increasingly place a burden on the Brazilian health care system. Their improved control through better medical management in primary care will require considerable investment in human resources, training, and treatment through primary care. Together with cancer and the chronic lung disorders, if not prevented and managed well, they will require costly hospital care.

5. NCDS AND POVERTY IN BRAZIL

5.1 Being poor is bad for your health. This holds true for both non-communicable as well as communicable diseases. Table 5.1 shows age-adjusted mortality rates by income zone in São Paulo. The poor are much more likely than the wealthy to die from an infectious or parasitic disease, with a relative risk of 1.9. But the poor are also percent more likely to die from cardiovascular disease with mortality rates that are 20 percent higher (a relative risk of 1.2).

5.2 The links between poverty and the risk of communicable diseases tend to receive much more attention than the links between poverty and non-communicable diseases. Non-communicable diseases are sometimes—mistakenly--called “diseases of affluence” because they are associated with the health transition accompanying economic development and urbanization. But the association between poverty and non-communicable diseases is strong. In some cases, this is because the poor have higher rates of exposure to risk factors, such as smoking. For instance, in Brazil, the likelihood of smoking is strongly inversely correlated with income. In other cases, risk factors, such as obesity, vary by region and are not always higher among the poor. But obesity-related non-communicable disease mortality rates are nonetheless higher for the poor, most likely because they are less likely to have early detection and proper management. Disease progression can be much faster, and coping with a chronic disease can push the household more deeply into poverty.

5.3 What does this mean for NCD prevention and control strategies? Policy makers need to be aware of differentials in NCD risk factors and disease rates among income groups (as well as by other important subgroups--geographic, gender, and racial) to design effective policies. This is especially important for Brazil given its highly unequal income distribution. A given policy can impact income groups in different ways:

- Some prevention and control strategies may be most effective in changing behaviors in better educated, higher income subgroups of the population who have the time and disposable income to, for example, choose from a wide variety of foods and to exercise.

Table 5.1 Differences in Age-standardized mortality rates per 10,000 and Relative Risk by socioeconomic zones in São Paulo, 1991.			
Urban zone (1=lowest income, 4 highest)	Cardiovascular Disease	Infectious and Parasitic Diseases	Respiratory Diseases
1	23.0 (1.2)	2.7 (1.9)	8.4 (1.2)
2	22.4 (1.2)	2.2 (1.6)	7.7 (1.1)
3	19.1 (1.0)	1.9 (1.4)	7.1 (1.0)
4	19.4 (1.0)	1.4 (1.0)	7.2 (1.0)

Source: Stephen et al.²³

- Other strategies, such as replacing trans fats in processed foods with “healthy” fats or reducing their salt content, can help all segments of society who consume those foods (as long as the change is not accompanied by price increases).
- Increasing tobacco taxes are effective in helping stop or reduce smoking, especially for the poor whose utilization is more susceptible to price increases. Quitting or reduced smoking would also increase their available discretionary budget. However, for those people who do not quit or reduce cigarette consumption it will have the additional impact of hitting the poor’s pocketbook much harder than the more wealthy groups.

Non-communicable Disease Risk Factors and Poverty

5.4 Brazil’s existing risk factor studies contain considerable information about non-communicable disease risk factors and the poor.

5.5 Obesity. In many developed societies, the prevalence of obesity is increasing, and, in at least some population subgroups, tends to be inversely related to income: the lower the income the higher the obesity levels. In low income countries, the opposite is generally true. The likelihood of obesity increases with income. This is the overall pattern for Brazil, with an important exception. Monteiro and colleagues found that the pattern is starting to change among women in Southeastern Brazil. There, since the late 1990s, obesity has become inversely related to income.

5.6 A review of trends in developed countries is relevant to Brazil because it may predict what the future has in store if preventive interventions are not put in place. In the United States, as in Canada and Europe, the prevalence of obesity in the adult population is increasing. Obesity and overweight have increased dramatically in the United States over the past 40 years. In 1997/98, about 20% of adults were obese and more than one-half were overweight.²⁴ Men (63%) were more likely to be overweight than women (47%) but there were no differences in the obesity rates. Among ethnic/racial groups, obesity was highest among black non-Hispanic adults (29%). Obesity prevalence decreased with education: about 25% of adults who had not graduated from high school were obese compared to 11% with a graduate degree, and this association is even stronger for women. About 26% of adults in poverty were obese, compared to 16% for adults with incomes four or more times the poverty level. Partly as a consequence of these patterns, many obesity-related diseases—hypertension, cardiovascular disease, and diabetes, and certain types of cancers—are found at much higher rates in certain racial-ethnic minorities compared with whites, and at higher rates among the poor.

5.7 Obesity Trends in Brazil by Income Group. Profound changes in employment, modes of transportation, and diet are occurring in Brazil, leading to more sedentary lifestyles and higher fat diets. Monteiro and colleagues have studied changes in the prevalence of obesity by region, gender, income, and education in Brazil.^{25,26,27} The picture that emerges by income group is complex but indicates that among women, the prevalence of obesity is now greater in low-income groups in the more developed Southeast, and in urban areas (Table 5.2). This trend is not yet observed in men.

5.8 Obesity is much less prevalent in Brazil than in the United States, but its prevalence has increased over time, from about 6% of women in 1974/75 to 12.4% in 1996/97. For men, the increase was from 2.1% to 6.4% over this same period. Higher income men—in both the Northeast and the Southeast—are more likely to be obese than lower-income men. But these findings are strikingly different among women. By 1997 in the more developed Southeast, the prevalence of obesity was significantly higher among lower income women (14.1%) compared to higher-income women (8.9%) ($p < 0.0001$). This difference was enough to drive down the overall prevalence of obesity in women in the Southeast from 14% in 1989 to 12.3% in 1996/97. In the Northeast, while obesity prevalence increased for both income levels, higher income women were still more likely to be obese than lower income women in 1996/97 (14.5% versus 7.7%).

Table 5.2 Prevalence in Obesity in Male and Female Adults by Region and Income Group, Brazil, 1974/75, 1989, and 1996/97

Region and Income Group	Women			Men		
	1974/75	1989	1996/97	1974/75	1989	1996/97
North-eastern	4.1	7.8	12.5	1.2	2.4	4.4
25% poorest	3.1	5.2	7.7	0.7	0.8	1.8
25% richest	6.7	9.8	14.5	2.5	5.1	8.4
Southeastern	7.8	14.0	12.3	2.9	5.8	8.4
25% poorest	6.1	11.2	14.1	1.6	2.9	3.8
25% richest	7.9	14.4	8.9	5.4	8.2	10.2
Brazil	6.0	10.9	12.4	2.1	4.1	6.4

Note: Prevalence is age-adjusted by the age distribution in the 1997 survey. Obese refers to BMI greater or equal to 30. Source: Monteiro C, Conde W, and Popkin B.²⁵

5.9 Data recently released from the 2003 Family Income Survey confirms the increasing link between obesity and poverty for women in Brazil. For the first time, national obesity rates among women in the lowest quintile were found to be higher than for women in the highest quintile (11.8 vs 11.1%).²⁸ If Brazil follows trends in Europe and North America, obesity will eventually become linked with poverty in all regions, at least in women. Obesity prevention needs to be an important public health goal. As lower educational levels, and even illiteracy, impede access to information by the poor, and the poor have fewer choices about their diet, prevention strategies need to be designed to help all social classes have a healthier diet and adequate physical activity.

5.10 Consumption of Fruits and Vegetables and Physical Activity. The 2002/03 Brazil RFS showed that a higher education level was correlated with greater consumption of fruits and vegetables. Physical activity, however, had a more mixed pattern—in some

state capitals, physical activity was greater among the least educated, and in other states it was greater among the higher educated. The World Health Survey, on the other hand, showed higher activity levels among the poor. Monteiro and colleagues studied the likelihood of reporting recommended or higher leisure-time physical activity from the 1996/97 Brazil Living Standards Measurement Survey. They found that, for women, there was a positive and significant association between recommended leisure-time physician activity and increasing age, family income, and formal education. For men, the association was positive and significant only for formal education.²⁹

5.11 Smoking. The likelihood of smoking is closely related to poverty in Brazil as shown by the Brazil World Health Survey from 2003. Table 5.3 shows the prevalence of smoking for men and women, by age, and income (the proxy for income is number of assets). For every age group for both men and women, the fewer the assets, the higher the smoking rates. One-third of men aged 35 and older with 0-3 assets smoke daily, compared to about 13-14% of men with 8 or more assets. The RFS also showed a close relationship between smoking and poverty with the likelihood of smoking higher among people with lower levels of education.

Table 5.3 Prevalence of Daily Smoking, by Age, Gender, and Number of Assets, 2003				
	Age	Number of Assets		
		0-3	4-7	8+
Women	18-34	17.1	9.5	8.7
	35-49	24.9	21.2	14.3
	50+	13.6	11.4	7.1
Men	18-34	25.8	17.3	12.2
	35-49	33.1	.2	12.6
	50+	33.3	23.3	14

Source: Brazil World Health Survey, 2003. N=approximately 5000 adults aged 18+.

Further links between Poverty and NCDs

5.12 In addition to the risk factors, such as smoking prevalence, discussed above, poverty may contribute directly to the higher prevalence of NCDs and higher mortality rates from NCDs in various ways, including:

- **Low birthweight increases likelihood of chronic diseases in adulthood.** Many women in poor households were malnourished as children and are more likely to give birth to a low birthweight baby. There is growing evidence that the predisposition to some NCDs can begin in utero when fetuses are trying to adapt to undernutrition.³⁰ This theory, previously known as the “Barker hypothesis” is now more commonly referred to as the “fetal origins hypothesis”. Infants with low birth weight have a higher prevalence of obesity, cardiovascular disease, stroke, diabetes, and hypertension in adulthood. Interestingly, this hypothesis was investigated in a population in Rio de Janeiro. Sichieri and colleagues looked at short stature (which is strongly associated with low birthweight)

and hypertension.³¹ They found that after controlling for known risk factors (age, income, smoking, sodium and alcohol intake, and race), short stature was strongly associated with the risk of hypertension among women.

- **Chronic stress, which poverty can induce, is linked to non-communicable diseases.** Hypertension is more prevalent among the poor and is hypothesized to be related to the chronic stress that poverty produces. Similarly, chronic stress increases the likelihood of developing diabetes by chronically increasing cortico-steroid levels.
- **Poverty restricts food choices.** The poor are likely to buy the cheapest food available, which, in urban areas, tend to be foods with a high fat, high carbohydrate, often high salt content.
- **Exercise choices are reduced in slum areas** which have few parks and green spaces. If violence is a threat in the neighborhood, exercise choices may be reduced because of fear of increased exposure to violence.
- **Lower education levels, and particularly illiteracy, mean that messages on health often do not reach the poor.**

5.13 NCDs can also cause poverty. NCDs are a cause of ‘financial shocks’ that can drive a household into poverty. Once a non-communicable disease develops it has a variety of affects on the poor. An adult with a non-communicable disease is often not as productive as a healthy adult. His/her care may require medications, visits to the clinic, hospitalization all requiring money which may tip a family into poverty or further impoverish a family. Finally, the death of a breadwinner may also be devastating to the household’s income.

Policy Implications

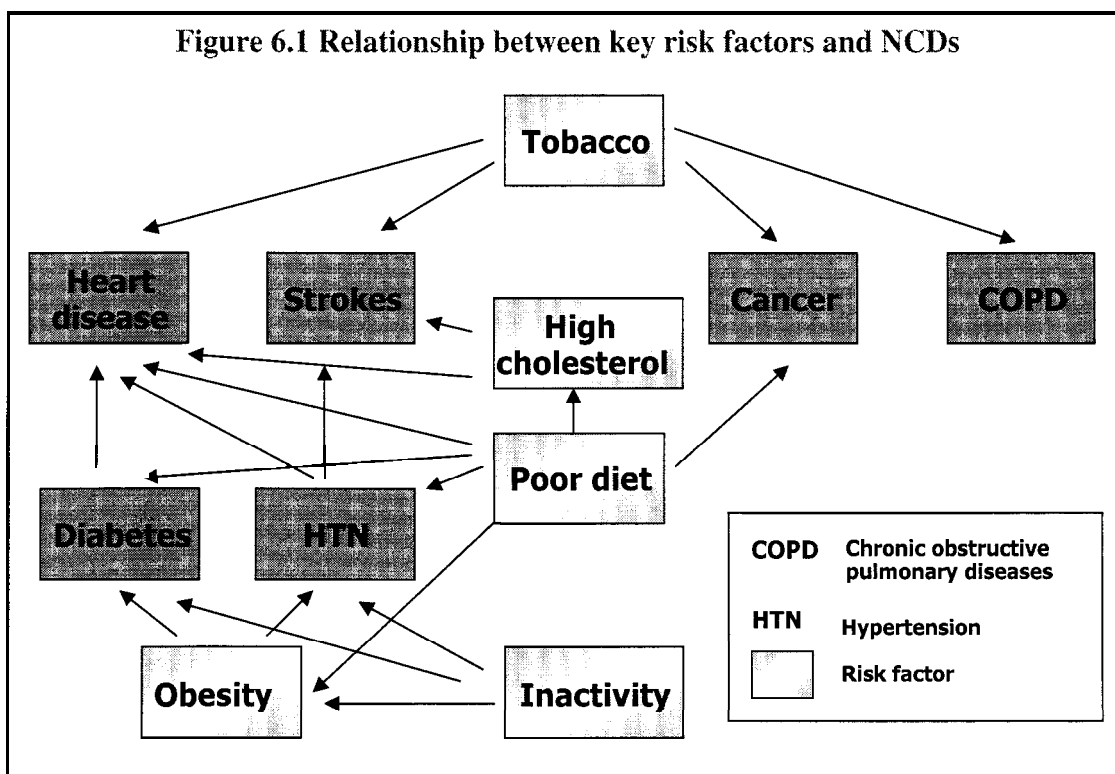
- Unless carefully targeted to low income groups, NCD prevention strategies that require changes in behavior at the individual level will often reach better educated/higher income groups first. Policies that do not require changes in individual behavior (such as industry regulation to replace trans fats in processed foods with “healthy” fats) will likely be more effective at reaching the poor.
- Smoking prevention strategies related to tobacco taxation have variable impacts on the poor. These strategies tend to be more successful among the poor and lead to reduced tobacco consumption and increase money available to those who quit. However, for those among the poor who do not reduce consumption they have a deleterious income effect, and this should be considered in program design. This could be ameliorated by supporting smoking cessation programs in low-income areas.
- Primary prevention of NCDs by decreasing exposure to risk factors is particularly important among the poor who are less likely to receive early and adequate medical treatment and more likely to develop disabilities and premature mortality.

- School-based efforts to increase physical activity and increase the consumption of fruits and vegetables via school lunches could be worth considering, especially in low-income areas.
- Efforts to improve maternal nutrition in poor women could have far-reaching positive consequences on the long run health, including NCDs, of their children, given the “fetal origins” hypothesis.
- Given the important differences in risk factors and NCDs in subgroups of the population, surveillance systems need to regularly and systematically provide information by these subgroups (gender, income, education, region, racial/ethnic group) to better monitor trends and provide information for policy design.

6. PREVENTION OF NCDs: INTERNATIONAL EXPERIENCE AND CURRENT PROGRAMS IN BRAZIL

6.1 The growing burden of non-communicable diseases is increasingly stressing Brazil's health system. Once they develop, most non-communicable diseases are not curable and they become chronic diseases. A chronic diseases is defined as "*a condition that requires ongoing medical care, including monitoring, treatment and co-ordination among multiple providers, limits what one can do and is likely to last more than one year*" (IOM).³² The ongoing medical care necessary to treat NCDs has substantial costs for the health system as well as the individual and their family. Prevention of NCDs is therefore a primary objective.

6.2 As discussed in Chapter 4, NCDs have many determinants, some distal and some more proximal, some modifiable and some not. NCDs and the disability and mortality they cause are largely preventable. More than two-thirds of the burden of cardiovascular disease can be attributed to three factors: hypertension, cholesterol and overweight. More than three-fourths of the burden of diabetes can be attributed to overweight. This chapter will discuss interventions to prevent the development of NCDs in the first place (primary prevention). It will also discuss the early diagnosis and treatment of NCDs to prevent disability and premature mortality (secondary prevention). The focus of the chapter is on primary prevention, the most cost-effective way to address the NCD epidemic.



6.3 *Primary prevention* refers to actions that prevent health events, in this case chronic diseases, from occurring. They reduce the prevalence of chronic disease. These actions take place before the onset of disease. The focus is on health promotion and disease prevention through reduced exposure to risk factors. (Figure 6.1) Examples include actions that promote smoking cessation, regular physical activity, good nutrition, clean air etc. Policy interventions such as food labeling and anti-smoking laws are important primary prevention interventions. Reducing exposure to risk factors also positively influences the outcomes of diseases like diabetes, hypertension and heart disease once they occur. Therefore, this review touches on some aspects of secondary prevention.

6.4 *Secondary prevention* involves the early detection of disease that can minimize or interrupt its progression, and thereby prevent irreversible damage and disability. It includes various kinds of screening (e.g. blood pressure checks, cholesterol checks) and improved health care for chronic diseases. In some cases, primary and secondary prevention are closely related (e.g. secondary prevention of hypertension is the primary prevention of strokes).

6.5 Interventions can also be described as those that are *population* or *community-based* and those that are *individual*. Population-based interventions target the entire population or community, or a large sub-segment of the population. Risk prevention is usually more effective and affordable when oriented to the population rather than to individuals.⁴ This includes activities such as regulations, information campaigns, education, communication, and working in a variety of settings like schools or workplaces. These types of interventions often enable people to reduce their exposure to risk factors by creating supportive environments. Population-based interventions can have an impact on primary and secondary prevention. Individual interventions are usually directed through health care providers to individuals receiving care. Both primary and secondary prevention can be delivered thru individual interventions.

PRIMARY PREVENTION OF MAJOR NCDs – DECREASING EXPOSURE TO RISK FACTORS

6.6 This section will review interventions that have been shown to be effective in developed countries. There are very few studies from developing countries. A literature review did not reveal any well-designed studies from Brazil. It focuses on population-based activities since they are usually more cost-effective. Population-based activities can be vertical (focusing on only one risk factor) or comprehensive (including a spectrum of risk factors that contribute to chronic diseases). Comprehensive programs often involve settings like schools, workplaces and communities. The Healthy Municipalities strategy promoted by WHO/PAHO is also comprehensive and population-based.

Smoking, Physical Activity, Diet and Weight

6.7 Lack of physical activity, obesity, poor diet, and smoking are major risk factors for coronary heart disease, stroke, diabetes, and many cancers. Changes in behavior in these areas could prevent the large majority of these diseases.³³ There is compelling

evidence that changes in lifestyle are possible and that population-based interventions can support these changes. Perhaps the most famous success story is in Finland, which had one of the highest rates of coronary heart disease in the world in 1972. The government introduced a comprehensive program to educate the population about smoking, diet, and physical activity, first in North Karelia, and then expanded nationwide. It supported anti-smoking legislation, increased availability of low-fat dairy products and improved school meals. Age-standardized coronary heart disease mortality fell over the period 1969/71 to 1995 by a remarkable 73% in North Karelia, where the program was first introduced, and by 65% nationwide.⁶ Public health policies and programs related to education, advertising, taxation, food policy, and city planning and infrastructure can help encourage and facilitate healthy behaviors. Brazil has developed some programs in these areas, but could do much more, especially by adapting and building on successful international experiences. This section summarizes interventions that are likely to be most effective in the areas of smoking, physical activity, diet and weight, and where possible, includes cost-effectiveness information about the interventions.

Public Health Policies: Anti-Smoking

6.8 There have been many reviews to determine effective strategies for tobacco control, probably more than in any other single area of health promotion. There is a general consensus among many organizations in the United States (e.g., the Task Force on Community Preventive Services, the Office of the Surgeon General, the U.S. Preventive Services Task Force, the Agency for Healthcare Research and Quality) and internationally (such as the World Bank, World Health Organization, International Union against Cancer- UICC) that the following strategies are effective:³⁴

To reduce youth initiation of smoking:

- Increase the unit price for tobacco products, particularly through increases in state and federal excise taxes.
- Develop extensive and extended mass media campaigns, particularly in concert with other actions, as part of a comprehensive strategy. Increase the unit price for tobacco products, particularly through increases in state and federal excise taxes.
- Ban all tobacco advertising and promotion, and if this must be done in phases, require counter-advertising so that all tobacco industry messages are accompanied by factual information on health risks of tobacco use and health benefits of cessation.
- Ban all free cigarette distribution, with strong sanctions for non-compliance.
- Ban vending machine sales of cigarettes.

To decrease the effects of environmental tobacco smoke:

- Develop and enforce laws and regulations to ban tobacco consumption in workplaces and other public spaces, especially enclosed spaces.

To assist with smoking cessation from a population orientation:

- Increase the unit price of tobacco products.
- Educate healthcare providers and have providers implement self-reminder systems to ensure that this issue is raised during clinical examinations.

- Use broadcast and print media and cigarette package labeling to encourage people to quit and to publicize available cessation services such as a telephone quitline.
- Consider offering telephone counseling and support services as one channel for delivering cessation support.
- Consider reducing patient out-of-pocket costs for effective pharmaceutical and other cessation treatments.

To assist with smoking cessation from a clinical perspective:

- Screen patients for tobacco use and deliver brief advice to quit
- Offer or refer smokers for more intense counseling or assistance to quit.
- Use pharmacological treatments (nicotine replacement therapy or bupropion as first-line therapies).
- Focus individual smoking cessation efforts on the poor and less educated who have a higher smoking prevalence.

6.9 Brazil is the world's fourth largest producer of tobacco leaf in the world. The National Cancer Institute (INCA), a part of DPHC is responsible for national programs for the prevention and detection of cancer. The National Tobacco Control Program established in 1987 was developed under its leadership. This program is considered one of the more successful national tobacco control programs.³⁵ It is responsible for strong anti-tobacco legislation and a nationwide, decentralized program. While a rigorous evaluation of the impact on smoking prevalence of this program is not available, the recent RFS suggests that prevalence is decreasing. Nevertheless, prevalence is still at around 20% overall, and it is higher among the poor. [See Chapter 5]

6.10 The cornerstone of Brazil's program is sweeping legislation which started in 1996 by restricting tobacco use in public places. It includes, for example, bans on smoking in theaters, schools, government offices, and on public transportation, warning on cigarettes, and extensive mass media campaigns. Brasilia recently became the first smoke free city in Brazil. Brazil is one of a few countries with a regulatory authority that regulates tobacco products including comprehensive regulation of tobacco product marketing, content and distribution.

6.11 Taxes make up about 74% of cigarette prices, and are made up of value-added and other taxes. However, cigarette prices are still relatively low in Brazil, despite fairly high taxes.³⁶ The following chapter contains an economic analysis of the cost-effectiveness of increasing the tobacco tax further in Brazil, and compares it to the cost-effectiveness of physician counseling of smokers. The tobacco tax increase is found to be highly cost-effective, at about \$1 per DALY. Individual counseling was over \$9000 per DALYs.

6.12 The global consensus on the importance of reducing tobacco use and the best ways of doing so is reflected in the Framework Convention on Tobacco Control (FCTC), unanimously adopted by WHO member states in May 2003. Brazil recently ratified this treaty. While Brazil is already complying with many of its provisions, it will need to take the steps necessary to bring it into full compliance with the treaty's provisions including those related to tobacco taxes.

Public Health Policies to Support Daily Physical Activity

6.13 Regular physical activity helps prevent people from becoming overweight or obese. Regular physical activity improves metabolic functioning (improvements in bone density, lipid profiles, insulin levels, and immune function), aerobic capacity, muscular strength, body agility, and coordination.³⁷ Lifestyle changes accompanying urbanization and economic development have resulted in profound reductions in physical activity. Physical labor is no longer as common in employment. There is more automobile use instead of walking or using public transportation. More leisure time is spent in sedentary activities, such as watching television. This is true not just for adults, but for children as well. Dramatic changes have occurred in how children spend their time, with more television watching. The number of hours that both adults and children watch television is associated with the risk of obesity³⁸ and, for adults, type 2 diabetes.³⁹ Educational interventions through the media, schools, workplaces, and health care providers can encourage physical activity. Environmental design is another powerful way to encourage physical activity. Specific interventions that the Brazil could consider initiating or scaling up are described below.

6.14 Community based efforts to increase exercise. There are several activities underway in Brazil to promote physical activity. One of the longest standing is a community based intervention called *Agita São Paulo*. It is recognized internationally as a model for promoting physical activity.^{40, 41, 42} *Agita* is around 10 years old, and is a comprehensive intervention reaching schools, worksites, older adults, and hundreds of partner organizations and communities across the state of São Paulo. A main goal is to expand physical activity by 30 minutes of moderate activity at least five times a week. Physical activity is promoted not just in leisure time but also in the home (chores, gardening) and in transport (walking, taking stairs). As part of the preparation for this document a background study was carried out to assess its cost-effectiveness. The intervention and its cost-effectiveness are summarized in Box 6.1 and discussed further in chapter 7.⁴³ The analysis found that *Agita São Paulo* is an excellent investment in public health. It is cost saving, and estimated to be an excellent “buy” in terms of cost-effectiveness (cost per DALY saved). Activities similar to *Agita* that have begun in other states are also likely to be cost-effective. Given these results states and municipalities without physical activity interventions should consider starting similar programs. It will be important to continue evaluating these programs and gathering evidence about what is effective in Brazil and what is not.

6.15 In-school programs. In-school physical education can be a major source of exercise for children. School programs can also be designed to discourage television watching, increase physical activity, and increase the consumption of fruits and vegetables. “Planet Health” is an example of a school program that includes messages—across many curricula areas--about reducing television watching and substituting more enjoyable activities. In an evaluation of the program in Massachusetts, Planet Health was shown to be effective: it reduced television watching and weight gain in girls (but not boys) relative to the control schools. In fact, girls who were obese at the start of the program more than doubled their chances of not being obese at the end of the study.⁴⁴

Box 6.1 – *Agita São Paulo*

Agita São Paulo (Move São Paulo) is a comprehensive community-based campaign to promote physical activity launched in the state of São Paulo in 1996. It involves a multi-level partnership with many community organizations and NGOs coordinated by the Physical Fitness Research Center from São Caetano de Sul (CELAFICSZ) and the São Paulo State Health Secretariat. It targets the entire state population of 37 million with special emphasis on school children, workers, and older adults. Multiple strategies are employed including mass media, large promotional events, exercise and walking classes and groups, worksite health promotion programs, stage-based behavior change, school events and physical education, and environmental and policy changes.

A study estimated the cost-effectiveness of the *Agita* program in increasing physical activity and reducing costs of medical care for 5 diseases (coronary heart disease, ischaemic stroke, type 2 diabetes, breast and colon cancer) among adults. It utilized (i) population-based surveys of physical activity levels in the São Paulo metropolitan region from 1999 to 2003, (ii) intervention cost data available from *Agita São Paulo*, and (iii) medical cost data from the MOH.

The *Agita São Paulo* community campaign for physical activity promotion was found to be extremely cost-effective. In fact, it was found to save costs over the 40 year time period of the model. Very few public health or clinical interventions actually save money. *Agita* is one of a small number of very effective interventions that produce benefits that outweigh the investment to improve health. The threshold for cost effectiveness is often set at US\$50,000 - 100,000 / QALY. Thus, a cost saving intervention is an especially good investment in public health.

Why is *Agita* and programs like it so cost effective? There are at least four reasons for the very positive results found in this model. First, comprehensive community campaigns to promote physical activity are effective population-based interventions. Based upon a thorough review of the scientific evidence the U.S. Task Force on Community Preventive Services strongly recommends comprehensive community campaigns. *Agita São Paulo* is a good example of this type of intervention strategy. Second, *Agita* is comprehensive, reaching schools, worksites, older adults, and hundreds of partner organizations and communities across the state. The reach and effects of *Agita* are multiplied many fold through mobilization and partnering. Third, *Agita* is applied at a very large scale across one of the biggest metropolitan areas in the world and in a state that is larger than most countries in Latin America. There are clearly economies of scale that enhance the implementation of *Agita*. Finally, *Agita* is delivered at low cost. A combination of economies of scale, excellent management, creative partnerships, extensive use of volunteer networks, and the relatively low cost of materials and labor in Brazil allow *Agita* to be effectively implemented at a very low per capita cost. In sum, *Agita São Paulo* uses a proven strategy, creatively adapted to the local circumstances and culture and delivers it at a low cost to a huge population, resulting in a highly cost effective public health intervention.

Comprehensive community campaigns to promote physical activity are an excellent investment in the health of the public. These campaigns are an important strategy to increase physical activity and prevent chronic diseases and conditions including obesity, diabetes, cardiovascular disease, and colon and breast cancer. The results of this study suggest that campaigns similar to *Agita São Paulo* should be considered in other large metropolitan areas in Latin America and the developing world. It is very likely that similar campaigns tailored to local situations and efficiently administered would also be highly cost effective.

6.16 Work-place programs. Major employers have introduced innovative programs to encourage physical activity, recognizing the pay-off in terms of employee health. Some of these programs include healthier foods in the cafeteria, encouraging using the stairs instead of elevators (and making the stairwells wide, safe, clean, and attractive environments), providing bicycle parking, sponsoring walks, and other measures.

6.17 City planning to increase walking and bicycling. What officials and city planners achieved in Curitiba is also seen as an international model of increasing public transport, reducing auto use, and hopefully, also increasing walking. A master plan was developed in 1965 and subsequently implemented that introduced an efficient system of express buses and minibuses. As a result, gasoline use is about 30 percent lower per capita even though car ownership is high. The master plan was introduced largely for environmental reasons, but increased walking is hypothesized to be an important byproduct as those who use public transportation, in general walk more than drivers.

6.18 The municipality of Rio de Janeiro passed an innovative law in 1998 to establish “healthy streets”. Traffic is interrupted on healthy streets and public security is provided so that people can exercise in safe conditions. Local communities select the “healthy streets”.⁴⁵ Another recent municipal experiment to increase physical activity is the *City Academy* program begun in Recife which not only encourages physical activity through counseling and increased knowledge about its importance, but actually offers programs for physical activity in communities during key hours like early morning and evening.

6.19 Many other cities in the world have tried to discourage automobile use and encourage public transportation, walking, or bicycling. Safe environments for walking and bicycling can be developed with well-lit sidewalks, separate bicycle paths, car-free areas in cities, cross-walks, and speed bumps and other measures to reduce automobile speeds. Measures to discourage automobile use include vehicle taxes, limited parking, narrow streets, unsubsidized gasoline, and the like. Increasingly, “healthy cities” are a concern of city planners. This idea is to develop transportation patterns and land use so that walkable communities are created, with greenways and shopping nearby.

6.20 The CDC has reviewed the evidence of effectiveness of alternative interventions to promote physical activity. The review uses rigorous criteria for effectiveness. It is not complete, but interim results are summarized in Table 6.1. Community-wide campaigns such as *Agita São Paulo* are strongly recommended, along with school-based physical education, among others.

Table 6.1. Recommendations of Effectiveness for Interventions to Promote Physical Activity from the Task Force on Community Preventive Services (Centers for Disease Control and Prevention, 2001)	
Intervention	Recommendation
Informational Approaches to Increasing Physical Activity	
Community-wide campaigns	Strongly Recommended
“Point-of-decision” prompts to encourage stair use	Recommended
Classroom-based health education focused on information provision	Insufficient Evidence
Mass media campaigns	Insufficient Evidence
Behavioral and Social Approaches to Increasing Physical Activity	
School-based physical education	Strongly Recommended
Non-family social support	Strongly Recommended
Individually-adapted health behavior change	Strongly Recommended
Health education with TV/Video game turnoff component	Insufficient Evidence
College-age physical-education/health education	Insufficient Evidence
Family-based social support	Insufficient Evidence
Environmental and Policy Approaches to Physical Activity	
Creation and/or enhanced access to places for physical activity combined with informational outreach activities	Strongly Recommended
Transportation policy and infrastructure changes to promote non-motorized transit	Review Underway
Urban planning approaches – zoning and land use	Review Underway

Source: CDC⁴⁶

Public Health Policies to Promote a Healthy Diet

6.21 Diet is related to many non-communicable diseases. The most well known is the relationship of saturated fats in the diet and cardiovascular disease. But diet is also related to specific cancers, diabetes, cataracts, macular degeneration, renal stones, dental disease, and birth defects.⁴⁷ And obesity is related to both diet and physical activity. Priority public actions to promote a healthy diet include measures described below.

6.22 Measures to replace saturated and trans fat with unsaturated fats, including sources of N-3 fatty acids. Replacing saturated fats with unsaturated fats helps to reduce cholesterol. Unsaturated fats appear to have other benefits, including preventing fatal ventricular arrhythmias.⁴⁷ In the manufacturing process, partial hydrogenation of vegetable oils eliminates the beneficial omega-3 fatty acids and creates the “bad” trans fatty acids. In Europe, manufacturers have altered production methods to eliminate trans fatty acids—resulting in a dramatic reduction in the trans fat content of the food supply. In 1987 the government of Mauritius mandated a change in the

composition of the most commonly used cooking oil from mostly palm oil (high in saturated fatty acids) to soybean oil (high in unsaturated fatty acids). (Note that in parts of the Northeast of Brazil, palm oil is the preferred cooking oil). Uusitalo and colleagues found a significant decrease in cholesterol in men and women over the following five years.⁴⁸ The U.S. has required trans fatty acid content on food labels. Food labeling is not as effective as mandating or getting industry cooperation to replace saturated fats with unsaturated fats, but it does help some consumers. And, perhaps more importantly, it may help promote industry action. Following the U.S. announcement that trans fats would be on standard food labels, several large food companies pledged to reduce or eliminate trans fats. Brazil now requires that packaged foods list calorie, protein, carbohydrate, total fats, saturated fats, cholesterol, calcium, iron, sodium, and dietary fiber. It could consider requiring industry to eliminate partially hydrogenated fat in processed foods, or encouraging voluntary action by industry. Denmark has taken the first approach, and Holland has taken the second.

6.23 Willet and colleagues have modeled the cost-effectiveness of first, encouraging consumers, through a community education campaign, to consume unsaturated fats, and secondly, of eliminating partially hydrogenated fat by industry.⁴⁷ For the first approach, the cost-effectiveness was estimated at \$3,297 per DALY for Latin America and the Caribbean. The second approach, not surprisingly, has a much higher cost-effectiveness ratio (at \$40 per DALY for Latin America and the Caribbean). The second approach has the strong advantage of not requiring changes in behavior at the individual level.

6.24 Promotion of healthy food choices. Nutrition education can be through mass media, the schools, from health providers, and community groups. Schools are a key setting. Recognizing this, Brazil has tried to build the capacity of schoolteachers for nutrition promotion.⁴⁶ It also legislated changes in the school meal in 2000, making it mandatory that a minimum of 70% of the annual budget of \$0.5 billion be spent on fresh vegetables, fruits, and minimally processed foods.⁴⁶

Comprehensive programs shown to prevent cardiovascular disease (CVD) and strokes

6.25 Much of the learning about primary prevention of CVD has come from five large community prevention trials conducted over the last 30 years:³⁴ the Stanford Three-City Project,⁴⁹ North Karelia Project,⁵⁰ Stanford Five-City Project,⁵¹ Minnesota Heart Health Program⁵² and the Pawtucket Heart Health Program.⁵³ Although a limitation of these studies is that they were not true experimental designs, the evidence is consistent enough to be useful in guiding policy decisions. They have been shown to be cost-effective and easily transferable to other community settings.⁵⁴

6.26 The five projects established that CVD is preventable through modifications of established risk factors such as cigarette smoking, elevated blood lipids, elevated blood pressure and sedentary lifestyle. The projects were based on the premise that community-wide strategies lead to a reduction in disease rates through changes in individual and community risk factors.³⁴

6.27 These projects used a similar combination of three primary categories of interventions: mass media, program-specific prevention initiatives that provided education and/or skill-building for health behavior modification in multiple settings, and environmental support through policy development and site-based program development. Three of the programs used strategies that involved extensive community involvement (through trained lay volunteers, as well as partnerships with community organizations such as schools, workplaces and religious organizations).³⁴

6.28 Three of the initiatives were successful in reducing smoking rates, two reported reductions in obesity/body weight, four reported a coronary heart disease risk reduction, three reported a reduction in cholesterol, and three reported a reduction in blood pressure. The North Karelia Project was the only one of the five trials that demonstrated a reduction in coronary heart disease reduction (a drop in the age-adjusted coronary heart disease mortality rate of 72% for men 35-64 years, compared to a 64% drop in all Finland, for the period 1969-1995). In the three studies in the 1980s, decreases in the prevalence of risk factors were often small but even a reduction of a few percentage points in a primary CVD risk factor has considerable impact at a population level.³⁴

Diabetes Prevention

6.29 The WHO and FAO convened an expert committee to develop recommendations for reducing the risk for diabetes, many of which echo those for reducing obesity and CVD.⁴ Measures to support people in achieving healthy diets and regular physical activity were felt to be particularly relevant for the poorest regions of the world, where resources for treatment are severely limited.^{34,55}

- Prevention/treatment of overweight and obesity, particularly in high risk groups.
- Maintaining an optimum BMI, i.e. at the lower end of the normal range. For the adult population, this means maintaining a mean BMI in the range 21--23 kg/m² and avoiding weight gain (>5 kg) in adult life.
- Voluntary weight reduction in overweight or obese individuals with impaired glucose tolerance (although screening for such individuals may not be cost-effective in many countries).
- Practicing an endurance activity at moderate or greater level of intensity (e.g. brisk walking) for one hour or more per day on most days per week.
- Ensuring that saturated fat intake does not exceed 10% of total energy and for high-risk groups, fat intake should be <7% of total energy.
- Achieving adequate intakes of NSP through regular consumption of wholegrain cereals, legumes, fruits and vegetables. A minimum daily intake of 20 g is recommended.

6.30 Three studies in diabetes prevention demonstrate the effectiveness of lifestyle changes and community interventions in the prevention of Type 2 diabetes.^{47,56,57,58} The studies used combinations of dietary treatment and/or an increase in physical activity for individuals at high risk of diabetes. Each of the three studies was able to demonstrate significant decreases in Type 2 diabetes among high risk subjects (i.e. those with impaired glucose tolerance).⁵⁴

CARMEN Strategy

6.31 Many of these strategies are being supported through CARMEN (*Conjunto de Acciones para la Reducción Multifactorial de las Enfermedades No transmisibles*), an international network to support the prevention of NCDs throughout LAC, organized by WHO/PAHO. CARMEN focuses on supporting municipalities within its member states in three main strategies: integrated prevention, promotion of health equity, and demonstrative effect (the testing of interventions in a demonstrated area to determine effectiveness and acceptability, before expanding the intervention). Several Brazilian municipalities are participating in the CARMEN project. An evaluation of their successes and failures, and recommendations for their expansion to other Brazilian municipalities would be useful.

SECONDARY PREVENTION OF MAJOR NCD

6.32 There is a large and growing body of literature on the effective treatment of chronic diseases. Here we will briefly review some of the major findings with application to Brazil for hypertension and diabetes only. These two diseases have been prioritized under the National Health Plan. They are very important precursors of cardiovascular disease and their control will contribute significantly to reductions in CVD mortality.

6.33 Many, but not all, cases of hypertension and diabetes can be prevented. Once these diseases occur it is vital that they be controlled through a combination of low-cost medications and lifestyle changes that reduce exposure to risk factors. This review of secondary prevention of NCDs will focus on diabetes and hypertension for several reasons. These two diseases are precursors for more serious problems. Adequate blood pressure and blood sugar control leads to a longer and better quality life, and prevents many serious sequelae such as heart attacks, heart failure, strokes, and kidney failure, and in the case of diabetes good control prevents amputations and blindness. When these complications occur, they usually leave a person significantly disabled, requiring more costly medications and treatments, and more frequent hospitalizations placing a burden on the family and on the health care system. The Brazilian MOH has highlighted the importance of the management and control of these two diseases as one of its six major national health goals. In line with these goals, the Family Health Program, the principal vehicle for primary health care delivery provided by SUS includes as one of eight priorities the control of diabetes and hypertension among people under its care. The interventions discussed here will be primarily *individual* interventions. Nevertheless, it is important to keep in mind that population-based interventions to decrease exposure to risk factors discussed in the section on primary prevention will also have a positive impact on the control of diabetes and hypertension.

Hypertension

6.34 As noted previously, hypertension is an important risk factor for cardiovascular disease and its treatment and control can prevent the occurrence of heart attacks, heart failure, coronary artery disease, and strokes. The treatment of hypertension is one of the

most cost-effective interventions available.⁴⁴ Effective interventions to lower BP include:

- BP screening for adults 18 years and older
- DASH diet – rich in fruits and vegetables and low in fat
- Weight loss
- Physical activity
- Reduced salt intake
- Stress management
- Pharmaceutical treatment including diuretics, beta blockers, calcium antagonists, alpha blockers, and angiotensin II antagonists.
- A variety of multifactorial interventions involving biofeedback, lifestyle changes and psychosocial interventions

6.35 The effectiveness of hypertension treatment to reduce heart attacks and strokes is related to the individual's underlying risk of having coronary artery disease or a stroke. Not all individuals with a given elevated blood pressure have the same risk. Identifying those with higher risks substantially increases the cost-effectiveness of treatment. Such strategies have been explored in developed countries and the factors included in a 'high risk' CVD profile are elevated blood sugar, waist circumference, and high cholesterol, in addition to hypertension. Patients with all four risk factors are at particularly high risk for CVD and it is generally considered particularly cost-effective to control their blood pressures. It is not clear how applicable these findings are to the Brazilian context. The utilization of this type of risk score has not been studied in Brazil.

Hypertension control in Brazil

6.36 There are multiple Brazilian studies assessing various aspects of the care of people with hypertension. They tend to corroborate findings in developed countries. Some of the principal findings from this review include:

- The importance of continuity of care in blood pressure control⁵⁹
- Lack of adherence to treatment was noted as a major obstacle to blood pressure control⁶⁰
- Variable effects of education programs with some demonstrating an impact on blood pressure,^{61,62,63} others on knowledge,⁶⁴ and others showing little effect.^{65,66,67}
- Knowledge of risk factors and availability of health services (among workers at the Bank of Brazil) did not guarantee treatment⁶⁸
- A study of "Centros de Saúde Escola" (Health Centers with Schools/Education) carried out over a period of one year in 90/91 among 3793 adult users found that (i) there was much lower than expected coverage of hypertension and diabetes and (ii) patients seen in rapid care settings and found to have hypertension did not return for follow-up care and often did not receive appointments⁶⁹
- One cost-effectiveness study was identified related to the treatment of hypertension in Pelotas, Brazil (Costa et.al. 2002).⁷⁰ It found that treatment with

diuretics and beta-blockers was more cost-effective than treatment with ACE inhibitors and calcium channel blockers.

Diabetes

6.37 Several trials have shown that lifestyle interventions can delay or prevent diabetes by 40-60% among people at risk.⁷¹ In the U.S., a large randomized, controlled trial showed that the lifestyle intervention group (weight loss and moderate physical activity) had a significantly lower incidence of diabetes than a treatment and placebo group.

6.38 In a review of the cost-effectiveness of interventions for preventing and treating diabetes and its complications in developing countries, the following interventions were found to be cost-saving (cost/QALY): glycemic control in persons with HbA1c > 9%; blood pressure control in person with >95/160 mm Hg; foot care in person with high risk of ulcer; and preconception care for preventing birth defects.

Diabetes in Brazil

6.39 Education was noted to be an important factor in improving control of diabetes. In one study planning and development of interventions related to nutrition education was based on a biopsychosocial evaluation of women with type 2 diabetes that showed an impact on weight reduction, and glucose and cholesterol control.⁷² In another study education provided by a multidisciplinary team was shown to be protective in preventing people with diabetes from developing complications requiring amputation (Gamba, 2001).⁷⁰ While these studies are limited they corroborate the importance noted in developed countries of assuring knowledge required in self-care, as well as adherence to treatment that is necessary for improved outcomes in chronic diseases.

Cardiovascular Disease (CVD) and Strokes

6.40 As the main risk factors for CVD and strokes are the same (i.e. hypertension, smoking, overweight and hypercholesterolemia), prevention initiatives will be considered together. Reduction of exposure to risk factors such as smoking and overweight promote both primary prevention of CVDs and also secondary prevention by reducing the likelihood of complications.

6.41 A review of effective strategies for CVD in the United States⁷³ found that:

- A key strategy for reducing risk factors is to educate the public and health care practitioners about the importance of prevention. People can reduce their risk for CVD by controlling high blood pressure and high blood cholesterol levels.
- A class of drugs called statins can reduce deaths from heart disease by reducing cholesterol levels, and medications that reduce blood pressure levels can reduce the risk for heart disease, strokes, and other coronary events.
- Patients who take beta blockers within days or weeks of a heart attack have a greater chance of surviving the heart attack.

- People should be educated about the signs and symptoms of heart attacks and stroke and the importance of calling for help (“911”) quickly. Research indicates that nearly 70% of deaths from heart disease occur before a person can be admitted to a hospital, and about 48% of stroke victims die before emergency medical personnel arrive.
- Other important ways that people can reduce their risk for heart disease and stroke are to avoid smoking, adopt healthier diets, and increase their physical activity.

Cost-effectiveness of Interventions

WHO has carried out a review of the cost-effectiveness of interventions to prevent and control NCDs. The findings for the most cost-effective interventions in the Americas are summarized in Table 6.2. While all these interventions are considered cost-effective, the table shows that those that are population-based are better when using cost-effectiveness criteria. The three interventions that are most expensive are those that are provided by health services to individuals.

Table 6.2 Cost-effectiveness of selected NCD interventions, WHO analyses for "Americas-B" region*	
Intervention	Average Cost Effectiveness (international \$)
Increasing tobacco taxes to the highest regional tax rate (75%)	\$19
Legislation to decrease salt content of processed foods, plus appropriate labeling and enforcement	\$127
Legislation and health education to reduce cholesterol	\$135
Health education through mass media to reduce cholesterol	\$136
Voluntary cooperation for food manufacturers with government to decrease salt in processed foods, plus appropriate labeling	\$244
Information dissemination	\$436
Hypertension-lowering drug treatment and education on lifestyle modification including dietary advice, delivered by physicians to individuals with systolic blood pressure > 140 mmHg	\$811
Clean indoor air law enforcement	\$972
Cholesterol-lowering drug treatment (statins) and education on lifestyle modification including dietary advice, delivery by physicians to individuals whose serum cholesterol concentration exceeds 220 mg/dl	\$1.326
Nicotine replacement therapy	\$3.083
* For more information, see the World Health Report 2002 and the WHO website on cost-effectiveness analysis, or www.who.int/whosis/cea	

Issues Related to Chronic Care

6.42 While evidence on the effectiveness of interventions for the control of specific NCDs is important, it is becoming increasingly clear that health systems will need to shift the way they operate if they are to address the needs of chronic patients. Most health systems are organized to provide care for acute illnesses that resolve quickly. Several publications including a recent WHO report summarize some of the steps necessary for the shift to better chronic care to occur.^{74,75} A major issue is adherence to treatment. The effectiveness of any treatment is greatly diminished by low adherence rates. It is estimated that overall adherence to long-term therapies for chronic illnesses is approximately 50% in developed countries, and it tends to be much lower in developing countries.⁷⁶ Adherence is not just a matter of individual compliance. Interventions that are poorly designed (i.e. those that do not take into account the social, cultural, and economic realities of the patient, the capacity of the health care system to support the intervention, the characteristics of the disease) have little chance of succeeding. The support of family members and community organizations also plays a key role in maintaining adherence. (WHO, 2003b).

6.43 Other steps necessary to improve care for chronic conditions include integrated health services (integrated across primary and specialty as well as hospital care), adequate follow-up and continuity of care, emphasis on enabling self-management, utilization of ancillary personnel to educate and support people with chronic conditions, community support services, standardized treatment protocols, and consistent financing.

Brazil's Arterial Hypertension and Diabetes Mellitus Care Reform Plan

6.44 The chronic nature of these conditions and their enormous impact on the morbidity and mortality of the Brazilian population poses a challenge for the Unified Health System (SUS). The SUS must create an environment that protects the population from risk factors for those diseases, offer early detection, and ensure systematic treatment and monitoring of individuals identified as suffering from these diseases. In response, the federal government coordinated the elaboration of an Arterial Hypertension and Diabetes Mellitus Care Reform Plan that was approved in 2001. Its major objective was to organize and expand high-quality, solution-oriented care for people suffering from arterial hypertension (AH) and diabetes mellitus (DM) within the public health services network. The plan also includes objectives related to primary prevention through risk factor reduction. To reinforce the plan and ensure its implementation Congress introduced and passed various bills including one that sets forth guidelines for the prevention and comprehensive health care of people with diabetes within SUS and ensures protection of the rights of those who suffer from this disease. In 2004 a Working Group representing experts from the various levels of SUS, academia, patient associations and NGOs was established to update recommendations for DM and AH and comprehensive care.

6.45 The Care Reform Plan consists of four implementation states including i) multiplier training of professionals in the primary care network, ii) media campaign and identification of suspected cases of AH and DM, iii) confirmation of diagnosis, and iv)

registration and referral of confirmed cases to primary care facilities. During the National Campaign for DM detection in 2001 blood glucose tests were conducted on nearly 21 million individuals. A campaign in 2002 screened 12 million people for AH and 36% of these were elevated and referred to health care facilities. The essential drug list contains medications recommended in a standard of care manual for AH and DM.

6.46 Under the current administration the Care Reform Plan was updated and includes: i) ongoing on-site education in primary care techniques; ii) incentives for expanding the information system registry used to refer people to PHCs; iii) monitoring and assessment indicators to improve oversight of AH and DM-related treatment activities; iv) clinical protocols and training; v) policies that promote healthier lifestyles, well-being, and prevent the risks associated with illness and the related complications; vi) combining primary care approaches with moderately and highly complex procedures in order to reduce the risks of complications. However, it is not clear how fully the plan has been implemented, nor whether the quality is adequate. Campaigns to screen and detect diabetes and hypertension continue to be a major NCD activity.

Limitations

6.47 The vast majority of studies reported in the literature test efficacy rather than effectiveness. The above review tries, wherever possible, to locate more comprehensive reviews in order to formulate conclusions on the types of interventions that are likely to be most effective.

6.48 A review of the literature from LAC of health promotion identified 131 studies published in the international and Latin American literature. However, in two-thirds the type of evaluation carried out was not described.⁷⁷ And most of the papers with well-carried out methodology were related to maternal and child or reproductive health. The relative lack of published conducted in LAC in the field of NCDs and risk factors means that the review relies on studies from developed countries for evidence of interventions potentially effective in LAC. However, many factors should be considered before attempting to generalize interventions designed in North America and Europe to the LAC context. They include socio-cultural factors that are relevant in deciding how best to enable and promote behavior change, socioeconomic factors, and other economic and infrastructure factors (e.g. public health/primary care/educational/municipal infrastructure).

Studies related to the treatment of NCDs among the poor

6.49 No studies were identified that specifically assessed the impact of interventions to reduce exposure to risk factors among the poor, nor were studies identified that assessed the impact of treatment modalities, associated support services, or the impact of education or communication interventions.

NCD / RISK FACTOR PREVENTION POLICIES AND ACTIVITIES IN BRAZIL

6.50 Prevention of NCDs through interventions that decrease exposure to risk factors is carried out in the context of disease prevention or more broadly in the context of health promotion.^{iv} Health promotion goes beyond the prevention of NCDs and other illnesses and has “a state of complete physical, mental and social well-being” as a goal. In this section we will review policies, activities and responsibilities of different departments within the MOH related NCD prevention.

National level

6.51 Health promotion activities have been carried out by the Ministry of Health since the late 1980s. A unit specifically dedicated to Health Promotion was first established in 1998, under the Health Policy Secretariat. After the elections of 2002, the MOH was restructured and the technical areas related to health promotion were first moved to the Executive Secretariat, and in 2005 to the Health Surveillance Secretariat.

6.52 The Health Surveillance Secretariat (SVS) was created in June 2003 and absorbed what was previously the Epidemiology Center (CENEPI). It has a Department of Situation Analysis (DHSA) that is responsible for collecting and analyzing information about NCD mortality, morbidity and risk factors. The DHSA provides epidemiological information related to NCDs and risk factors. It also monitors information related to service delivery including preventive services. This area is just beginning to be developed in Brazil. CENEPI carried out the first Brazilian Risk Factor and NCD Survey in 16 capital cities and the results were recently published (2004).² The challenge now is for the MOH to develop a coherent plan to address its findings.

6.53 The DHSA includes a Coordinating Unit for NCDs and Injuries, and a Coordinating Unit for Information and Epidemiological Analysis. The CU for NCDs and Injuries will carry out surveillance related to these health outcomes. Health promotion activities in the MOH will be coordinated out of this CU. One of its first actions was to finalize a National Health Promotion Policy (NHPP) which emphasizes NCD and injury prevention (and includes some communicable disease health promotion activities e.g. dengue, malaria). The policy will be launched in late 2005 and includes objectives, actions and specific activities, many related to the primary prevention of NCDs. The new health promotion section in the NCD CU should play a key role in implementing, monitoring and evaluating the interventions outlined in the NPHP.

6.54 The Health Care Secretariat (SAS) has activities related to health promotion and NCD prevention in primary care settings. The Department of Primary Health Care (DPHC) has included health promotion as one of the 8 major priorities of the Family

^{iv} Health promotion was defined at the first International Conference on Health Promotion meeting in Ottawa in 1986 as “the process of enabling people to increase control over, and to improve, their health”. Health promotion actions are multi-sectoral and include i) building healthy public policy, ii) creating supportive environments, iii) strengthening community actions, iv) developing personal skills, and v) reorienting health services. (Ottawa Charter for Health Promotion)

Health Program. As noted earlier, while not generally as effective as population-based health promotion activities, there are effective interventions that are recommended at the individual/clinical level. However, the FHP has focused more on screening and identifying people with NCDs, particularly diabetes and hypertension. Health promotion activities within the FHP are not well-developed.

6.55 The National Cancer Institute (INCA) is also part of the SAS and is responsible for cancer prevention and detection activities. The National Tobacco Control Program established in 1987 was developed under its leadership. This program is considered one of the more successful national tobacco control programs.⁷⁸ It is responsible for strong anti-tobacco legislation and a nationwide, decentralized program. While a rigorous evaluation of the impact on smoking prevalence of this program is not available, the recent RFS suggests that prevalence is decreasing.

6.56 Other Secretariats with the MOH with some responsibility for health promotion include the Secretariat for the Management of Work and Education in Health which trains health workers in health promotion and NCD prevention and treatment. It is also responsible for popular education in health an important area for health promotion. The Secretariat for Science and Technology is responsible for evaluating the implementation and impact of health policies including health promotion through research and investigations.

6.57 In response to the health transition, the MOH has developed a variety of intersectoral health promotion policies. These include:

- National tobacco and anti-drug policy
- National and state policies on cancer control
- National policy for the reduction of morbi-mortality from accidents and violence
- National and state policies related to occupational health
- National food and nutrition policy
- Food security policy

However, most of these policies have not yet been operationalized in concrete national, state or municipal health plans.

NCD and Risk Factor Surveillance

6.58 NCD surveillance in Brazil includes mortality and hospitalization rates for specific diseases. It also includes a Cancer registry in 19 cities. However, risk factor surveillance has only recently begun in Brazil. The first step was publication in 2004 of results from the NCD Risk Factor Survey – carried out in 15 capital cities and the DF. This survey is expected to be repeated approximately every five years. In addition, plans are currently in the works for a school-based adolescent risk factor survey (also in capital cities) to monitor the exposure to and uptake of risk factors among youth. These surveys will provide a base for NCD risk factor surveillance. However, they are limited because they do not represent the entire population, particularly people living in rural areas.

Extending surveillance to the entire population is an important challenge for Brazil, given its geographic size, many demands, and limited resources. Likewise, extending the surveillance system in time to one that provides continuous (instead of periodic) information will also be a challenge. Such information is invaluable for monitoring the effectiveness of interventions. It is also important as a source of information on which to base timely public health decisions. Waiting five years to find out whether interventions are having the desired impact does not permit efficient or effective allocation of resources to address these public health problems.

Monitoring State and Municipal Performance on NCD Prevention and Control

6.59 As part of the decentralization process the MOH has developed a system in which bipartite (national/state) and tripartite (national/state/municipal) ‘*pactos*’ or agreements are reached on a set of indicators for monitoring performance in improving health outcomes. Health budget disbursements are tied to achievement of these indicators

Table 6.3 Health Performance Indicators Related to NCDs for State of Goiás
<ol style="list-style-type: none"> 1. Average annual number of doctor visits per inhabitant (basic specialties) 2. Average monthly number of home visits per family 3. Percent of the population covered by the PSF 4. Proportion of hospitalizations for ketoacidosis and diabetic coma 5. Proportion of hospitalizations for diabetes 6. Ratio of number of PAP smears in women 25-59 / total number women 25-59 7. Hospitalization rate for strokes in people aged 30-59 years 8. Hospitalization rate for ketoacidosis and diabetic coma 9. Hospitalization rate for strokes 10. Hospitalization rate for congestive heart failure 11. Female mortality rate for cervical cancer 12. Female mortality rate for breast cancer 13. Mortality rate for strokes

which are generally agreed to for areas considered to be priorities (e.g. infant mortality). Among these are indicators related to NCDs. The NCD indicators for the State of Goiás (Table 6.3) are typical of other states. While there are multiple indicators related to NCDs, there are no indicators related to decreasing exposure to risk factors, primary prevention or health promotion. All of the indicators are related to individual medical care, hospitalization and disease rates. The emphasis is on the management of diseases and decreasing morbidity / mortality, and there is no monitoring of the factors related to the primary prevention of these diseases.

6.60 The inclusion of indicators related to health promotion and prevention of risk factors is important to assure that states are performing well not only in the delivery of individual health services, but also in the delivery of population-and community-based programs that as already noted are generally more effective and less costly in reducing the burden of NCDs.

7. FINANCIAL AND ECONOMIC IMPACT OF EXPANDING KEY NCD PREVENTION ACTIVITIES – FOUR EXAMPLES

Introduction

7.1 There is little information in Brazil about the financial and economic impact of its growing non-communicable disease burden and the costs and effectiveness of alternative courses of policy action. This chapter presents analysis to start to fill this critical gap. It first projects, given current levels of prevention, care, and treatment, the consequences in terms of future burden of disease, financial and economic costs (the baseline). It then estimates the incremental costs and impact of an expanded non-communicable disease prevention program using four interventions as examples. The costs of the expanded response are then compared with the baseline in order to identify net cost savings. Then cost-effectiveness and benefit-cost ratios are calculated for the expanded response.

Interventions Included for the Expanded NCD Prevention Program

7.2 Although there are a large number of non-communicable diseases, risk factors and possible prevention activities, for reasons of practicality and data availability, the analysis examines only three risk factors: physical inactivity, arterial hypertension, and smoking (Figure 4.1). These three are key risk factors that determine, to a large extent, the incidence and prevalence of five non-communicable diseases: ischemic heart disease, cerebrovascular disease, diabetes mellitus, chronic obstructive pulmonary disease, and cancer of the trachea, bronchi and lungs. The expanded response is made up of four primary prevention activities of proven effectiveness that address these three risk factors. These are: a comprehensive community campaign to promote physical activity (using *Agita São Paulo* as an example), the treatment of arterial hypertension with first-line drugs, a tax increase for tobacco prompting a 10% increase in cigarette prices, and medical counseling of smokers. These interventions are described in Table 7.1. For this analysis, all four interventions are presented individually, and then three of them—comprehensive community campaign, treatment of arterial hypertension, and a tobacco tax increase—are presented as a “package”. As these three interventions address different risk factors, their costs, and impact can simply be added without the risk of double counting. In Tables 7.4 through 7.7, this “package” is shown in addition to the individual interventions. The tobacco tax increase was selected for the “package” over medical counseling of smokers because, as will become clear in this analysis, it is much more cost-effective than medical counseling of smokers.

Methodology

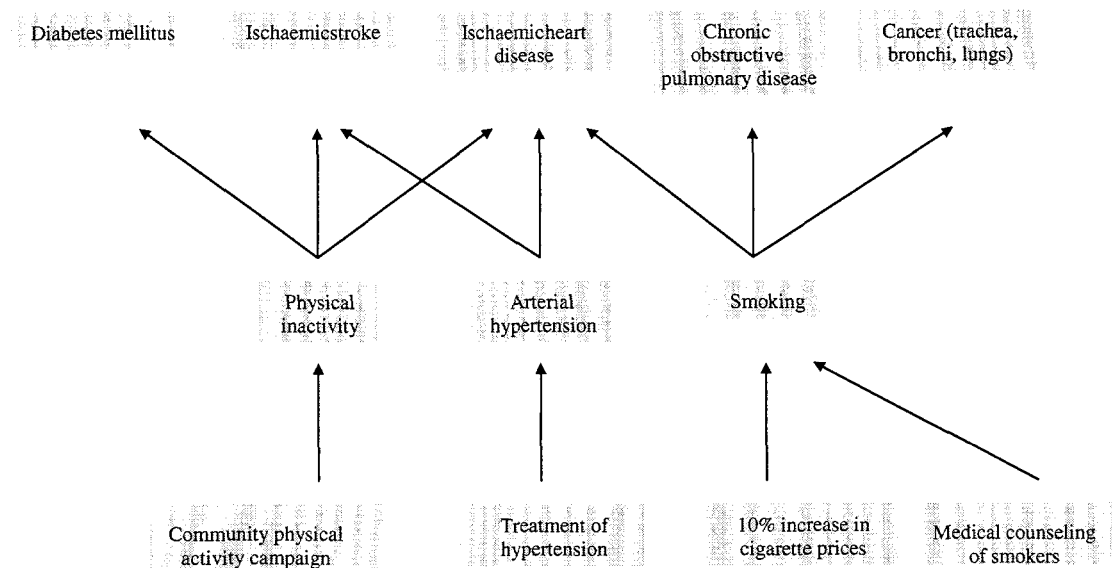
This section summarizes key methodological issues. Annex 2 present more detailed information on the methods and data used in this economic analysis.

Time horizon and measurement of impact

7.3 The analysis estimates the costs of scaling up preventive interventions and the changes in noncommunicable disease incidence over the period **2005 to 2009**. However, non-communicable diseases, once they are manifest, cause years of lost life or disability over a time horizon of many years. Therefore, the analysis estimates the long term benefits (DALYs averted, savings in treatment costs, and productivity losses averted) that stem from the changes in disease incidence from 2005 to 2009.

7.4 Benefits of an expanded response were expressed in DALYs avoided, financial, and economic cost savings relative to the baseline scenario. For this analysis, financial costs are the cost of treating patients with non-communicable diseases. Economic costs are the productivity losses due to non-communicable diseases. Disease burden was calculated in disability-adjusted-life years. Financial and economic costs were expressed in 2000 US\$. Costs and consequences of scaling up preventive interventions were calculated as variations from the baseline scenario.

Figure 7.1 Modeling the impact of preventive interventions – Interventions, risk factors and non-communicable diseases



7.5 In the baseline scenario, future burden of disease was calculated building on the findings of Global Burden of Disease Study (GBDS).⁷⁹ The GBDS provides country-specific projections of disease burden in disability adjusted life years (DALYs) based on historical data prior to 1996. The GBDS estimates of future burden of disease were adjusted by more recent information on country-specific burden of disease provided by the *Projeto de Carga de Doença do Brasil* (PCDB).⁸⁰

7.6 The analysis of future economic costs in the baseline scenario hinged also on the information provided by the GBDS and PCDB. For each non-communicable disease, the average number of years of life lost and years of inability to work was estimated by

age and sex. The conversion of years of life lost and years of inability to work into monetary terms followed the human capital approach, assuming productivity losses per year of life lost and per year of inability to work as per capita GDP. Information on current GDP per capita was drawn from the World Development Indicator Database and adjusted for future years based on information about current real GDP growth from the same source.⁸¹

7.7 Financial costs were based on information about the average length of life with a certain disease retrieved from the GBDS and PCDB and average annual treatment costs for individual diseases.⁸²

Costs of scaling up preventive interventions

7.8 If not otherwise indicated, cost data include the incremental cost accruing to agencies responsible for implementing or scaling up the intervention (Table 7.1). Cost estimates do not include costs to patients, such as time or travel costs. Unit cost data were drawn from the literature and project reports. When Brazilian data were expressed

Table 7.1 Intervention design, scope of coverage increase, unit costs and lag time	
Intervention	Intervention design, scope of coverage increase, unit costs and lag time between implementation and impacts
Comprehensive community campaign to promote physical activity	<p>Design: <i>Agita São Paulo</i> is a comprehensive community campaign to promote physical activity. It targets the entire population of São Paulo State with special emphasis on school children and workers. It employs multiple strategies, including mass media campaigns, large promotional events, exercise and walking classes and groups, worksite health promotion programs, stage-based behavior change, school events, physical education, and environmental and policy changes.⁸³</p> <p>Scope of coverage increase: The analysis estimates the cost and benefits of covering an additional 25% of the Brazilian population.</p> <p>Unit costs: The low unit cost estimate of US\$ 0.004 per person covered reflects the financial costs of the program.⁸² The high unit cost estimate of US\$ 0.06 per population includes voluntary contributions of organizations and individuals.⁸²</p> <p>Lag time: none</p>
Provision of anti-hypertensive treatment	<p>Design: treatment of uncomplicated arterial hypertension with first-line drugs through the Brazilian Family Health Program (<i>Programa da Saúde da Família</i>, PSF). The PSF includes regular home visits of enrollees by 'enhanced health teams'.</p> <p>Scope of coverage increase: 25% of all cases of arterial hypertension.</p> <p>Unit costs: The low unit cost estimate of US\$ 0.72 per person per month reflects drug costs, assuming provision can be piggy-backed on the PSF at no cost.⁸⁴ The high unit cost of US\$ 2.69 reflects the costs of drugs and service.⁸⁵</p> <p>Lag time: none</p>
Tobacco tax increase	<p>Design: The intervention includes lobbying and advocacy activities sufficient to sponsor and implement a tobacco tax increase resulting in a 10% increase of cigarette prices.</p> <p>Costs: The monthly costs for lobbying and advocacy were estimated as US\$ 5,050.⁸⁶ It was assumed that the activities must be sustained over a period of 18 months to achieve the intended result.</p> <p>Lag time: 18 months</p>
Medical counseling of smokers	<p>Design: The intervention includes the one-time counseling of smokers by a physician. It excludes the provision of nicotine-substitution therapy.</p> <p>Scope of coverage increase: The analysis estimates the costs and benefits of providing counseling services to 25% of all smokers.</p> <p>Unit costs: The costs of an individual counseling session were estimated as US\$ 11.40.⁸⁷</p> <p>Lag time: none</p>

in Reais, data were inflated or deflated to the base year 2000 and converted to U.S. dollars using the average conversion rate in 2000. When data originated from studies outside Brazil, data were adjusted for purchasing power parity and converted into Reais, inflated or deflated to the base year 2000 and converted into U.S. dollars. Future costs were discounted at an annual rate of 3%.

Estimated effectiveness of preventive interventions

7.9 The likely impact of the preventive interventions used as examples in this analysis was estimated based on an extensive review of the literature, including publications from Brazil.⁸²

Table 7.2 The estimated effectiveness of preventive interventions		
Risk factor	Intervention	Effectiveness in reducing risk factor (likely scenario)
Arterial Hypertension	Treatment with antihypertensive drugs	40%
Physical Inactivity	<i>Agita São Paulo</i>	3.2%
Smoking	Tobacco Tax increase	5%
	Medical counseling	3%

Table 7.2 presents the estimates of effectiveness derived from this review and used in the 'likely' scenario. In the cases of arterial hypertension and smoking these reflect rather

conservative estimates of the evidence found in the literature. In the case of physical inactivity, they reflect the results of the impact study of *Agita São Paulo*.⁴⁶

Allowing for uncertainty: sensitivity analyses

7.10 Likely, high and low estimates were made for the costs and impact of scaling up preventive interventions. For costs, the variation across scenarios reflects different assumptions about unit costs (Table 7.1). For impact, the variation reflects different assumptions about the effectiveness of interventions on the prevalence of risk factors. Assumptions are primarily based on information drawn from the literature. For net cost savings, cost-effectiveness ratios and benefit-cost ratios, the analysis includes likely, worst and best case scenarios. The likely case scenario used likely cost and impact estimates in the nominator and denominator. The worst case scenario compares high cost estimates with low impact estimates and, conversely, the best case scenario compares low cost estimates with high impact scenarios.

Results

The Baseline scenario

7.11 Under current levels of prevention, care and treatment, the future disease burden attributable to the five secondary diseases and the three risk factors was estimated as 16.9 million DALYs over the long run from the disease incidence from 2005-2009 (Table 7.3). (For comparison, the total burden of non-communicable diseases totaled approximately 24 million DALYs in 1998.) Around 44% of the future disease burden was attributable to a single disease--ischemic heart disease. And about 56% of the disease burden was attributable to a single risk factor--arterial hypertension.

7.12 The estimated financial costs of treating patients with either one or a combination of the five diseases were US\$ 34 billion. The total financial and economic

costs were US\$ 72 billion. The financial and economic costs of the baseline scenario are huge—about 10% of GDP in 2003. Smoking as a risk factor accounted for 35% of the financial costs. The risk factor arterial hypertension accounted for 31% of financial costs. More than 75% of the financial costs would be spent on the treatment of ischemic heart disease. Ischemic heart disease also accounted for the majority of combined financial and economic costs (55%).

Table 7.3 Baseline scenario - burden of disease, financial and economic costs							
Risk factor	Disease	Burden of disease [DALYs, 2000]		Financial costs [Billion US\$, 2000]		Financial and economic costs [Billion US\$, 2000]	
Physical inactivity	IHD	2,107,000	12.5%	\$8.82	25.8%	\$12.79	17.7%
	CVD	786,000	4.7%	\$1.35	3.9%	\$3.53	4.9%
	DM	1,277,000	7.6%	\$1.20	3.5%	\$3.78	5.2%
	Subtotal	4,171,000	24.7%	\$11.36	33.2%	\$20.10	27.9%
Arterial hypertension	IHD	4,433,000	26.3%	\$8.63	25.2%	\$17.00	23.6%
	CVD	5,074,000	30.1%	\$2.12	6.2%	\$16.22	22.5%
	Subtotal	9,507,000	56.4%	\$10.75	31.4%	\$33.22	46.1%
Smoking	IHD	767,000	4.5%	\$8.82	25.8%	\$10.24	14.2%
	COPD	1,653,000	9.8%	\$3.17	9.3%	\$6.78	9.4%
	Cancer	761,000	4.5%	\$0.16	0.5%	\$1.73	2.4%
	Subtotal	3,181,000	18.9%	\$12.14	35.4%	\$18.75	26.0%
TOTAL		16,859,000	100.0%	\$34.25	100.0%	\$72.07	100.0%

Abbreviations: IHD: Ischaemic Heart Disease; CVD: Cerebro-vascular disease; DM: Diabetes mellitus; COPD: Chronic obstructive pulmonary disease. Note: In the case of physical inactivity, CVD reflects ischaemic stroke only; Cancer includes cancer of the trachea, bronchi and lung.

Costs of scaling up preventive interventions

7.13 Costs of scaling up preventive interventions reflect net present values over the time period 2005 and 2009 discounted at a rate of 3% and expressed in US\$ 2000 (Table 7.4). The most expensive intervention by far is the anti-hypertensive treatment, at \$967 million. Medical counseling of smokers by physicians was also costly, at \$474 million. *Agita São Paulo* and the tobacco tax increases were the least costly, at \$33 million and 0.9 million, respectively.

Table 7.4 The costs of scaling up selected preventive interventions [US\$, 2000]				
	Intervention	Low cost scenario	High cost scenario	Likely scenario
A	Comprehensive community campaign to promote physical activity (25% of population)	\$4,186,000	\$62,784,000	\$33,485,000
B	Antihypertensive treatment (25% coverage)	\$158,515,000	\$1,776,849,000	\$967,682,000
C	Tobacco tax increases (10% increase in prices)			\$90,000
D	Medical counseling of 25% of smokers			\$473,844,000
	Total for Package A+B+C			\$1,001,257,000

Consequences of scaling up preventive interventions

7.14 Table 7.5 presents the long run benefits (averted disease burden, financial, and economic costs) stemming from the reduction in disease incidence from 2005 to 2009 due to the preventive interventions carried out over those same five years. Each intervention has a likely, low and high impact scenario, reflecting different assumptions about the impact of the intervention on the reduction of the risk factor. Financial and economic data are presented as net present values discounted at a rate of 3%.

Table 7.5 Scaling up selected preventive interventions
Reductions in (1) burden of disease; (2) financial costs; and (3) financial and economic costs

(1) Burden of disease [DALYs]

	Intervention	Low impact	High impact	Likely impact
A	Comprehensive community campaign for physical activity (25% of population)	118,800	152,800	135,800
B	Anti-hypertensive treatment: 25% coverage	554,800	737,000	645,900
C	Tobacco tax increases (10% price increase)	25,500	127,400	63,700
D	Medical counseling of 25% of smokers	44,300	50,600	47,500
	Total for Package A+B+C	699,100	1,017,200	845,400

(2) Financial costs [Million US\$, 2000]

	Intervention	Low impact	High impact	Likely impact
A	Comprehensive community campaign for physical activity (25% of population)	\$304	\$391	\$348
B	Anti-hypertensive treatment: 25% coverage	\$401	\$454	\$482
C	Tobacco tax increases (10% price increase)	\$69	\$343	\$171
D	Medical counseling of 25% of smokers	\$30	\$34	\$32
	Total for Package A+B+C	\$774	\$1,188	\$1,001

(3) Financial and economic costs [Million US\$, 2000]

	Intervention	Low impact	High impact	Likely impact
A	Comprehensive community campaign for physical activity (25% of population)	\$545	\$700	\$622
B	Anti-hypertensive treatment: 25% coverage	\$1,844	\$2,462	\$2,153
C	Tobacco tax increases (10% price increase)	\$122	\$612	\$306
D	Medical counseling of 25% of smokers	\$53	\$61	\$57
	Total for Package A+B+C	\$2,512	\$3,775	\$3,082

Note: Benefits reflect variations from the baseline scenario

7.15 Key findings:

- Providing anti-hypertensive treatment 25% of hypertensives would have the biggest impact on both disease burden and costs: it would reduce the burden of non-communicable diseases by 646,000 DALYs, would reduce treatment costs by US\$ 482 million and avoid financial and economic losses of US\$ 2,153 million.

- Scaling up comprehensive community campaigns to promote physical activity would generate the second largest impact on both disease burden and costs. It would result in a reduction of the non-communicable disease burden by approximately 135,000 DALYs. It would reduce treatment costs for non-communicable diseases by US\$ 348 million and avoid financial and economic losses of US\$ 622 million.
- A tax increase resulting in a 10% increase in cigarette prices would reduce the burden of non-communicable diseases by 63,700 DALYs, save US\$ 171 million in treatment costs, and avoid financial and economic losses of US\$ 306 million.
- Medical counseling of 25% of smokers would decrease the burden of non-communicable diseases by 48,000 DALYs—about a quarter fewer DALYs than the increase in cigarette prices, above. Savings in treatment costs would amount to US\$ 32 million and US\$ 57 million of financial and economic losses would be avoided.
- The first three interventions as a package would reduce the burden of non-communicable diseases by 845,000 DALYs—equivalent to a 5% decrease of the 16.9 million DALY disease burden estimated for the baseline. It would generate savings of financial costs of roughly US\$ 1 billion, equivalent to 3% of the costs of treating non-communicable diseases. Avoided financial and economic losses would total US\$ 3,082 million, or 4.3% of the expected economic costs of the baseline scenario.

Potential net cost savings of scaling up preventive interventions

7.16 The agencies' costs of scaling up preventive interventions were compared with the expected treatment in order to identify potential net cost savings for three different scenarios (Table 7.6). The scaling up comprehensive community campaigns for physical activity like *Agita São Paulo* and the increase in cigarette prices promised net cost savings (savings in treatment costs outweigh the costs of implementing the intervention). In the likely cost scenario, *Agita São Paulo* yielded net cost savings of US\$ 310 million and the increase in tobacco taxes yielded savings of US\$ 170 million (note this does not take into account additional tax revenue from tobacco tax increases). **Note:** In the likely case

Table 7.6 Potential net cost savings of scaling up preventive interventions (costs of scaling up less than resulting savings of financial costs)				
	Intervention	Worst case	Best case	Likely case
A	Comprehensive community campaign for physical activity	\$(241,560,000)	\$(387,120,000)	\$(314,340,000)
B	Anti-hypertensive treatment	\$1,375,510,000	\$(295,820,000)	\$485,880,000
C	Tobacco tax increases	\$(68,470,000)	\$(342,710,000)	\$(171,310,000)
D	Medical counseling of smokers	\$444,100,000	\$439,850,000	\$441,970,000
	Total for Package A+B+C	\$227,010,000	\$(187,180,000)	\$220,000

scenario, the likely cost scenario for scaling up is compared with the likely impact scenario for financial cost savings. The worst-case scenario reflected the high cost scenario for scaling up and the low impact scenario for financial cost savings. Conversely, the best-case scenario compared the low cost scenario for scaling up and the high impact scenario for financial cost savings. In the absence of low and high cost estimates, cost estimates of the likely scenario substituted for missing data.

For the anti-hypertensive treatment, net cost savings only occurred in the best case scenario. For medical counseling of smokers, the costs of scaling up the intervention outweighed savings in treatment costs in all three scenarios.

Cost-effectiveness ratios for the scaling up of preventive interventions

7.17 Cost-effectiveness ratios (incremental intervention costs/DALYs averted) varied considerably across interventions. Tobacco taxes and *Agita São Paulo* were the “best buys”, at only US\$1 per DALY averted and US\$246, respectively (Table 7.7). Anti-hypertensive treatment was a moderately “good buy” at US\$1,498 per DALY averted. And the medical counseling of smokers was a relatively “poor buy” at US\$9360 per DALY averted. Considering the first three interventions as a package, the cost-effectiveness ratio is US\$1,184, a “good buy”.

Table 7.7 Cost-effectiveness ratios [US\$, 2000 per DALY] and benefit-cost ratios for selected preventive interventions							
	Intervention	Cost-effectiveness ratios			Benefit-cost ratios		
		Worst case	Best case	Likely	Worst case	Best case	Likely
A	Comprehensive community campaign for physical activity	\$528	\$27	\$247	8.7	> 100	18.6
B	Anti-hypertensive treatment	\$3,203	\$215	\$1,498	1.0	15.5	2.2
C	Tobacco tax increases	\$4	\$1	\$1	> 1,000	> 1,000	> 1,000
D	Medical counseling of smokers	\$10,697	\$9,360	\$9,984	0.1	0.1	0.1
	Total for Package A+B+ C	\$1,432	\$984	\$1,184	2.5	3.8	3.1

Note: In the likely scenario, the likely cost scenario for scaling up is compared with the likely impact scenario for reductions in burden of disease. The worst-case scenario reflected the high cost scenario for scaling up and the low impact scenario for reductions in disease burden. Conversely, the best-case scenario compared the low cost scenario for scaling up with the high impact scenario for reductions in disease burden. In the absence of low and high cost estimates, cost estimates of the likely scenario substituted for missing data.

Benefit-cost ratios for the scaling up of preventive interventions

7.18 Benefit-cost ratios are estimated as the ratio of savings of economic costs over the costs of scaling up the interventions. Benefit-cost ratios were greater or equal to one for all interventions and in all scenarios except in the case of medical counseling for smokers (Table 7.7). In the latter case, benefit-cost ratios consistently fell in the range of 0.1. The increase in tobacco taxes produced across all scenarios benefit-cost ratios above 1,000. *Agita São Paulo* generated a ratio of roughly 20 in the likely case scenario. In the same scenario, the ratio was approximately 3 for the package of interventions and 2 for the provision of anti-hypertensive treatment.

DISCUSSION AND CONCLUSIONS

7.19 Continuing with the status quo would be a costly proposition. For the baseline scenario, the model predicted, for the period 2005 and 2009, the future disease burden at 16.9 million DALYs for the three risk factors and five related diseases. For comparison, the total burden of disease was 24 million DALYs in 1998. Most notably, roughly 50% of the future disease burden was attributable to a single risk factor--arterial hypertension.

The predicted future disease burden due to physical inactivity, arterial hypertension and smoking would cause treatment costs of US\$ 34 billion and additional US\$ 38 billion of productivity losses. Expected treatment costs and productivity losses amounted to 10% of GDP in 2003.

7.20 Interventions exist that, if introduced or scaled up, would significantly reduce the burden of disease. The evaluation included four of them: scaling up *Agita São Paulo* and anti-hypertensive treatment, introducing higher tobacco taxes and providing medical counseling to smokers. The first three would reduce the future burden of non-communicable diseases by roughly 850,000 DALYs or 5% of the future disease burden attributable to the three risk factors. While this reduction seems minor in relative terms, the financial implications are significant. More than US\$ 1 billion of treatment costs and US\$ 2 billion of productivity losses would be avoided. Furthermore, it is important to note that the model used a conservative approach to scaling up with rather small increases in coverage of few interventions.

7.21 The model predicted that the scaling up of comprehensive community campaigns similar to *Agita São Paulo*, the increase in cigarette prices and, under favorable assumptions, the scaling up of anti-hypertensive treatment would create net savings. In other words, these interventions would generate savings in treatment costs that would outweigh the costs of scaling up or implementing the intervention. In the likely scenario, these savings would amount to US\$ 310 million for comprehensive community campaigns and US\$ 170 million of the increase in tobacco taxes. For the same scenario, the combination of all three interventions would be cost neutral.

7.22 Investing in the tested interventions promises good value for money. Interventions with costs per DALY of less than twice the GDP are generally considered highly cost-effective.⁸⁸ The cost per DALY for *Agita São Paulo*, the treatment with anti-hypertensive drugs and an increase in tobacco taxes were estimated as ranging between US 1.40 and US\$ 1,500, thus, falling clearly below this threshold. Similarly, benefit-cost ratios for these interventions seem highly attractive with quotients of 2.2, 18.6 and >1,000. The cost-effectiveness of the package of all three interventions was estimated as approximately US\$ 1,200, the corresponding benefit cost ratio as 3.1.

7.23 The option of scaling up medical counseling of smokers proved economically less attractive. However, the assumptions regarding the effectiveness of the intervention were conservative and cheaper delivery models might be feasible.

7.24 Overall, the study showed that the scaling up of community campaigns to promote physical activity, the treatment of uncomplicated hypertension with first-line drugs, and tobacco tax increases should be financially and economically attractive, and will help lessen Brazil's burden of non-communicable diseases in the future. However, much more could be done beyond scaling up these three key interventions. A more comprehensive reform program would involve refocusing the health system much more fundamentally towards non-communicable disease prevention and control. The tools presented in this chapter could be used to explore the likely impact of more fundamental reforms, as well.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Brazil, along with nearly all of the countries of the region, is undergoing a demographic and epidemiological transition that is a consequence of urbanization, improvements in health care, changing lifestyles and globalization. In some region of Brazil the transition carries a double burden in that there are high rates of both communicable diseases and NCDs (Northeast) while the more developed regions (South and Southeast) have reduced the burden from communicable diseases but still have a high burden from NCDs. The double burden is also found among the poor who carry an unfair share of both communicable diseases and NCDs.

8.2 Emerging information from Brazil confirms what is found in OECD countries and puts to rest the myth that NCDs are a problem of the rich and not the poor. Recent studies in Brazil reveal that many risk factors that cause NCDs such as heart disease, strokes, cancer and diabetes are more prevalent among the poor and less educated (a proxy for socioeconomic status). Among Brazilian women obesity is increasingly linked to poverty and this trend is worsening. RFS data show that less educated Brazilians are more likely to smoke and less likely to eat a healthy diet that includes fruits and vegetables. Less educated women are less likely to have PAP smears and mammograms. RFS data also suggests a higher prevalence of hypertension, diabetes and heart diseases among the less educated. While good data from Brazil on morbidity and mortality by income, social class, or education levels are not available, the presence of higher levels of these risk factors is almost certainly associated with higher disease and disability levels.

8.3 Unlike communicable diseases, NCDs are chronic conditions that place a burden both on the individual—who must obtain treatment on a continual basis to control the disease and prevent, if possible, disability—and on the health care system. Where the primary health care system does not function properly, chronic diseases are more likely to progress to unnecessary disability, costly hospitalizations, and premature mortality.

8.4 Fortunately, most NCDs can be prevented. The evidence for interventions that are likely to have decrease exposure to risk factors and prevent NCDs is reviewed in this document. Interventions can target the entire population or community, or they can target individuals. Population or community-based interventions generally have greater impact and are more cost-effective. These are interventions that promote health and contribute to the primary prevention of NCDs.

8.5 In cases where NCDs cannot be prevented, the disability and early mortality they cause can often be prevented. Population-based interventions can contribute to reductions in morbidity from NCDs but need to be accompanied by interventions in primary care settings that provide effective, long-term treatment to people with NCDs.

8.6 In the case of Brazil, the cost of treating NCDs accounts for nearly half the cost of hospital admissions. Demand will only increase as the health transition continues to evolve. At the same time, NCD burden of disease rates for Brazil are much greater than those for Canada, Cuba and the USA suggesting that much of the burden is avoidable.

8.7 An important question relates to the potential financial and economic impact of implementing effective health promotion/NCD prevention activities in Brazil. This study carried out the first such assessment looking at the impact of four specific interventions. The analysis predicted that the increase in cigarette taxes, the scaling up of comprehensive community campaigns to promote physical activity similar to *Agita São Paulo*, and, under ‘favorable’ assumptions, the scaling up of anti-hypertensive treatment would create *net savings*. In the ‘likely’ scenario with more conservative assumptions, these savings would amount to US\$ 310 million for comprehensive community physical activity campaigns and US\$ 170 million of the increase in tobacco taxes, and the combination of all three interventions would be cost neutral. They would reduce the burden of NCDs by 845,000 DALYs or approximately 5% of the total when compared to maintaining the status quo.

8.8 Primary prevention activities that are targeted at broad populations are generally more effective in preventing NCDs and less costly than those targeted at individuals. However, in Brazil until recently such activities have been scattered and unfocused. There is no national plan for NCD / risk factor prevention or health promotion. NCD prevention activities tend to be run by vertical programs with limited coordination between them. INCA has led the tobacco control program for over ten years. Brazil has established many of the tobacco control activities considered cost-effective, including limitations on advertising and promotion, health education, warning labels, and bans on smoking in certain public places. (Tax increases – the most cost-effective – have been minor). Cigarette smuggling remains a major issue. Information to measure the tobacco control program’s success is not available. Attempts to scale up to a nation-wide level comprehensive community programs similar to the highly cost-effective *Agita São Paulo* program are just now being considered. Few other activities related to NCD prevention are being promoted at the national level. The recent transfer of responsibilities for the coordination of health promotion activities to the SVS/DHSA is a hopeful sign. This department has responsibility for surveillance and control of NCDs and injuries, among others, and has more of the technical capacity necessary to lead a program for NCD prevention.

8.9 Brazil has responded to the health transition with measures to improve secondary prevention. It has focused on increasing the coverage and quality of primary care services via the Family Health Program (FHP). It has developed plans to improve care for those with diabetes and hypertension and has carried out national screening campaigns to identify people with these diseases. Coverage is still reported to be very low – only approximately 10%. At the same time the FHP has included health promotion as one of its priorities. However, there are no guidelines for how this should be carried out.

8.10 The bipartite and tripartite ‘pactos’ for performance measurement at the state and municipal levels have very few indicators related to NCDs and no indicators related to exposure to risk factors. While the ‘pactos’ are in jeopardy of being overloaded, the fact that there is not one indicator related to NCD risk factors suggests that addressing them is not seen as a priority. Changes in NCD levels (for example, heart disease from smoking) may lag several years behind the implementation of interventions. However,

changes in risk factors (for example, smoking prevalence) can occur much more quickly so can be useful as annual indicators of performance.

8.11 At this time an information system to assess the prevalence of risk factors and NCDs does not exist. It is required in order to measure the intervention impact. The dearth of information both contributes to the lack of activity in this area (out of sight, out of mind) and also makes it impossible to know whether programs are having an impact (for example, tobacco control). The Brazil Risk Factor and NCD Survey carried out for the first time in 2002/3 provides a baseline in 16 cities and this is a start, along with the World Health Survey.

RECOMMENDATIONS

8.12 Table 8.1 at the end of this chapter provides a summary of recommendations on key strategies for the short and medium and their expected impact.

Develop and implement health strategies to prevent NCDs by focusing on risk factors

8.13 Primary prevention of NCDs is achieved by preventing exposure to the risk factors that cause these diseases. This is generally more cost-effective than trying to provide good health care for the diseases after they occur. Primary prevention is carried out in two ways: i) population-based activities such as regulation, education, communication, and interventions in communities, schools, and workplaces; and ii) information and activities directed at individuals by their health providers. Specific priority interventions to reduce smoking, promote dietary change, increase physical activity, and strengthen screening and treatment of hypertension and diabetes are detailed in Table 7.1, along with other policy recommendations from this paper, and in Chapter 5. For smoking, priority actions include increasing taxes, better controlling tobacco sales to minors, and strengthen measures to control tobacco smuggling. For diet, promoting healthy dietary choices through schools, community groups, and the media, legislation and/or encouraging voluntary action to reduce the use of partially hydrogenated fats and salt levels in processed foods, and continuing to strengthen the dietary quality of school lunches are key measures. For physical activity, scaling up the successful Agita São Paulo to cover much more of Brazil, supporting physical activity in the schools, and encouraging environmental design that facilitates walking, bicycling, and greenways for exercising are key. Together these measures could make a huge change in reducing the projected burden from coronary heart disease, strokes, diabetes, and certain cancers in Brazil.

8.14 *Population-based prevention requires effective leadership.* The focus of NCDs in Brazil has been on improving treatment, with the important exception of smoking. How can the focus best shift to the prevention of exposure to risk factors and increased emphasis on primary prevention? A first step has been taken with the formation of a health promotion section in the SVS/DHSA and its *clear definition and recognition as the focal group within the MOH* at the national level is needed to provide leadership on development, implementation, and evaluation of cost-effective population-based NCD

/ risk factor prevention activities. Many NCD / risk factor prevention activities are multi-sectoral and this group will need to coordinate not only with state and municipal departments of health and other health agencies such as INCA, but other ministries, academia, and civil society all of whom are important in a multi-sectoral approach to NCD / risk factor prevention. The mandate of this group should be to develop strategies and provide leadership on population-based activities. The close links this group has to the developing Brazilian population-based risk factor information systems is ideal since these systems will provide part of the evidence base for the development of well-directed actions as well as information for the evaluation of their impact.

8.15 One of the first tasks of the group assigned to NCD prevention would be to develop a ***national health plan for NCD / risk factor prevention***. The NHPP soon to be launched will form the basis for such a plan. Specific short and medium term goals will need to be set at the national and state levels to assess whether the plan is being successfully implemented and having an impact. The elaboration of a plan would benefit from the formation of a ***multisectoral national advocacy body*** consisting of civil society, NGOs, academia and others who have critical roles to play if such policies are to be effectively implemented and evaluated. Their involvement as key stakeholders and partners in NCD /risk factor prevention efforts is important earlier rather than later. Furthermore, the implementation of effective regulatory policies for NCD / risk factor prevention may encounter obstacles from related industries and lobbies. A national advocacy body could be a counter-force to such pressures.

8.16 ***Strengthen capacity.*** The current capacity to address NCD / risk factor prevention and scale up primary prevention activities is weak and will need to be strengthened within the MOH at each of its three levels (national, state and municipal), as well as in other sectors. Primary prevention involves communication and information for promoting changes in behavior. These require special skills in a relatively new area of social sciences including the behavioral sciences. Increasing regulatory capacity will also be important. Capacity building and the development of training institutions that can partner with the government to assure the necessary skills for primary prevention require a long-term strategy and commitment for its implementation, and would be an important component of the national NCD prevention plan.

8.17 ***Provide financing*** for development of primary prevention activities that are identified as potentially effective in Brazil and that address the present and emerging risk factors including, among other, smoking, physical inactivity, poor dietary intake and obesity. The economic analysis shows that some population-based interventions are actually cost-saving in the long term. However, to obtain these cost-saving benefits requires up front investment either by increasing the budget or reallocating budget. Risk factor prevention activities could, in large part, be self-financing if increases in taxes related to risk factor control such as for tobacco and alcohol are implemented and earmarked for health.

8.18 ***Improve FHP / primary care providers' capacity to deliver primary prevention / health promotion activities to individuals under their care.*** While not generally as cost-effective as population-based interventions, primary care providers have an

important role to play in promoting health behaviors and preventing NCDs. In Brazil, one of eight priorities for the FHP is health promotion. However, this area of work is still in the early stages of development. Cost-effective interventions to assist individuals in reducing exposure to risk factors are available. An assessment of which of these interventions can be financed by the FHP is necessary, included in an FHP health promotion strategy, and implemented. The FHP is developing and implementing a performance management system using multiple indicators. *Performance indicators for health promotion* should be developed and included in the system.

Improve surveillance and monitoring of risk factors and prevention strategies

8.19 *Improve NCD / risk factor surveillance.* Information on the prevalence of NCD risk factors in Brazil is limited. At the present there is no systematic, ongoing system for obtaining risk factor information. Given the current and growing burden of NCDs the surveillance of risk factors is as important as the surveillance of communicable diseases. Information is required to assure that the prevention interventions that are implemented are having the desired impact. The World Health Survey provides a national baseline for several risk factors, and the RFS, with more extensive risk factor information, provides a baseline for the 16 capital cities in which it was carried out. The frequency and sampling of future risk factor surveys needs to be determined as part of the national NCD prevention plan. Ideally, a system providing continuous information on risk factor prevalence will eventually be implemented. Similar to communicable disease, NCD / risk factor surveillance information should be linked to actions for their prevention and control. Information obtained from NCD / risk factor surveillance should include information about socioeconomic status, education levels, ethnicity and other population characteristics that could help target appropriate interventions.

8.20 *Include risk factor prevention indicators in the bipartite and tripartite 'pactos'.* The fact that none of the state or municipal 'pactos' include indicators to measure a reduction in exposure to risk factors reflects the lack of national and state policies and strategies for their control and the lack of information on their prevalence. NCD indicators currently included in the pactos are related to improvements in health care delivery at the primary care level. Inclusion of indicators to measure success in the more cost-effective area of primary prevention would be important incentives to implement and prioritize these activities.

Improve secondary prevention of NCDs through better health care and screening

8.21 The focus of this paper is on the primary prevention of NCDs by decreasing and eliminating exposure to risk factors. However, until this is achieved the burden of NCDs in the population will continue to grow. Premature mortality, disability, and the costs of hospitalizations can be prevented through better health care particularly at the primary care level. The Brazilian MOH recognized the growing importance of NCDs when it included the control of diabetes and hypertension as national health priorities.

8.22 *Strengthen the FHP's capacity to respond to the NCD epidemic.* Actions to improve the clinical management and control of hypertension and diabetes are already

underway in Brazil. Cost-effective interventions are available, particularly for hypertension. However, the context of long-term chronic diseases requires shifts in the way health care is provided. Issues that need to be addressed and enhance effectiveness of disease control are related to long-term *adherence* to treatment, *continuity* of care, *integrated care* and the ability of patients to *self-manage* their own disease. These in turn require more effective use of personnel (particularly non-physicians), training, and improvements in organizational and management aspects of primary care.

8.23 Furthermore, the prevention of premature mortality and disability is more likely with early detection of NCDs. This requires *investments in screening for NCDs* particularly hypertension, diabetes, and some cancers. Screening in turn depends on its uptake and investments will be needed to *increase the demand* for screening as well as for treatment by the population.

Strengthen research on effective NCD / risk factor prevention

8.24 There is very little information specific to Brazil on the effectiveness of primary and secondary prevention interventions. Most of the information on NCD and risk factor prevention comes from developed countries with very different cultural contexts. Many of the interventions require changes in lifestyle and behaviors or are applied in settings like schools, communities and workplaces where cultural context is important. Research is urgently needed that provides evidence for the effectiveness and costs of interventions for the primary and secondary prevention of NCDs in Brazil.

8.25 *Increase capacity to carry out prevention effectiveness research.* Behavioral research uses methodologies that are very different from those used for interventions implemented during the 20th century such as vaccines and drug treatments. Investments are required for both training research scientists in these areas as well as developing research institutions that can support prevention effectiveness studies.

8.26 *Assess the effectiveness of prevention interventions among the poor.* The poor carry a higher burden of NCDs, however, many interventions such as those using mass media, information requiring skills like reading or interpretation, demand for screening, and taxes among others, often do not reach the poor. Research identifying interventions that are effective among the poor and other sub-populations (ethnicity, race, region) are urgently needed to assess and assure the equality of prevention activities. This is true in developed countries as well as in Brazil.

Table 8.1. Recommendations on Key Strategies for the Short and Medium Term			
	Short Term (next three years)	Medium Term (four to seven years hence)	Expected Impact
Policy Formulation Capacity	<p>Develop a national action plan for NCD / risk factor prevention.</p> <p>National action plan to include measurable goals and targets.</p> <p>Create National Advocacy Body that is multisectoral, involving civil society, NGOs, academia.</p>	<p>Finalize and disseminate national plan. Create action plans at the state level.</p> <p>Implement action plan in partnership with stakeholders.</p>	Increased activities related to NCD and risk factor prevention with measurable decrease in prevalence of risk factors and NCDs.
Regulatory Capacity	<p>Inter-ministerial forum to assist in accelerated decision-making on regulatory aspects of NCD prevention</p> <p>Key regulatory recommendations made and legislation developed and passed (e.g. tobacco and alcohol taxes, food content and labeling, smoke-free environments)</p> <p>Improve risk factor surveillance.</p>	Regulatory and legislative work related to NCD prevention and control continues.	Decreased prevalence of smoking and exposure to smoke with decreasing lung cancer rates; decreased alcohol abuse; lower salt and unhealthy fat content of processed food with lower rates of hypertension and heart disease.
Monitoring Capacity	<p>Introduce indicators related to priority NCD / risk factor prevention and control programs in the bipartite and tripartite “pactos” for performance at the state and municipal levels</p> <p>Include indicators for health promotion in</p>	<p>NCD / risk factor surveys carried out periodically and continuous surveillance implemented in some states / municipalities.</p> <p>NCD / risk factor surveillance provides better information about population sub-groups including the poor</p> <p>States and municipalities are carrying out population-based health promotion activities.</p> <p>FHP is more actively engaged in health promotion.</p>	<p>Information on risk factor prevalence available to policy makers.</p> <p>Impact of interventions assessed, including impact among population sub-groups.</p> <p>NCD risk factor prevention recognized as a priority public health issue. Activities to reduce RF prevalence increase and are having an impact on population health.</p> <p>Individual health promotion activities are having an impact on RF and NCD prevalence in FHP catchment areas.</p>

	FHP performance monitoring. Improve monitoring related to capacity of FHP to control NCDs.	Performance monitoring related to FHP NCD control has improved.	More patients have adequate control of their chronic diseases.
Implementation Capacity	Training for primary prevention increased in multiple sectors. Training to improve screening and provide adequate care for people with chronic conditions.	Increased number of health personnel and other partners with skills to implement primary NCD / risk factor prevention activities. More affected people receiving more effective care for chronic conditions.	Increase in activities leading to lower risk factor prevalence and ultimately lower NCD prevalence. Multisectoral involvement in NCD / risk factor prevention. Improved care for AH and DM patients leading to less disability. Lower health care costs due to fewer hospitalizations.
Research Capacity	Training for prevention research increased. Centers specialized in prevention research established and financed.	Research on the effectiveness of interventions for primary and secondary prevention in different regions and among a variety of sub-populations including the poor.	Increased knowledge about the effectiveness of interventions in Brazil. More effective interventions being implemented. More efficient use of financing.
Reduction in Exposure to Risk Factors			
• Diet	Consider alternatives to reduce the use of partially hydrogenated fat by the food industry through either voluntary industry action or regulation. Continue to support and strengthen health school lunches, with fruits and vegetables. Promote healthy food choices through mass media, health providers, and community groups. Legislation to decrease the salt content of processed food.		Reductions in overweight, obesity, blood pressure, cholesterol. Reductions in coronary heart disease, hypertension, stroke, diabetes, and many cancers. Reductions in associated productivity losses.

<ul style="list-style-type: none"> Physical Activity 	<p>Scale up comprehensive community campaigns for physical activity promotion similar to other major metropolitan areas</p> <p>Ensure physical activity and exercise in school physical education programs</p> <p>Encourage workplace programs to encourage physical activity (for example, use of stairs instead of elevators)</p> <p>Evaluate impact of currently ongoing municipal and state physical activity programs</p>	<p>Further scaling up of comprehensive community-based physical activity programs.</p> <p>Integrate messages about physical activity, healthy diet in school curriculum.</p> <p>Incorporate measures to encourage walking and bicycling in city planning—well-lit sidewalks, separate bicycle paths, car-free areas in cities, cross-walks, and speed bumps and other measures to reduce automobile speed. Create “walkable” communities.</p>	<p>For all measures: Increased physical activity, reductions in overweight and obesity. Reductions in coronary heart disease, stroke, diabetes, and many cancers. Reductions in associated productivity losses.</p> <p>Cost savings being realized. Comprehensive community campaigns are cost saving (programs like <i>Agita São Paulo</i> cost well below savings in treatment). Analysis in this report calculates that expanding such programs to cover 25% of the population would save 135,800 DALYs and have a cost-effectiveness of \$247 per DALY.</p>
<ul style="list-style-type: none"> Smoking 	<p>Ratify Framework Convention for Tobacco Control.</p> <p>Increase tobacco taxes further at least resulting in 10% price increase.</p> <p>Ban smoking in all public places.</p> <p>Control tobacco sales to minors</p> <p>Strengthen measures to control smuggling, given that 30-35% of consumption from smuggled cigarettes.</p> <p>Strengthen support for smoking cessation programs, including nicotine replacement therapy.</p>	<p>Further increases in tobacco taxes.</p> <p>Improved enforcement of smoking laws.</p>	<p>All measures will contribute to further reducing smoking prevalence, especially of youth. This will reduce over the long run cardiovascular disease, lung cancer, and chronic obstructive lung disease. Reductions in associated productivity losses. The tobacco tax increase will increase government revenue. Tobacco measures are cost saving (program costs are a fraction of saved treatment costs). Analysis in this report calculates that a tobacco price resulting in a 10% increase in the price of cigarettes would save 63,700 DALYs and have a cost-effectiveness of \$1 per DALY.</p>
<p>Secondary prevention</p>	<p>Increase demand for screening and treatment of hypertension and diabetes.</p>	<p>Increase in number of people with diabetes and hypertension being treated.</p> <p>Increase in detection of cervical cancer in early stages.</p>	<p>NCDs particularly diabetes, hypertension and cervical cancer being diagnosed earlier leading to fewer premature deaths, less disability, and lower hospital costs. Reductions in associated productivity losses.</p>

				Analysis in this report calculates that 25% coverage of hypertensives with front line drug treatment would save 645,900 DALYs and have a cost-effectiveness of \$1498 per DALY.
	AH and DM Care Reform Plan is fully implemented. Improve capacity of FHP teams to resolve problems of patients with NCDs including issues related to long-term treatment and patient self-management through training and supply of adequate resources.	Increase number of people with diabetes and hypertension under control. More effective care of people with NCDs.	Fewer complications from diabetes and hypertension leading to fewer premature deaths, less disability, and lower hospital costs. Reductions in associated productivity losses.	

9. ANNEX 1

Table A1. Life expectancy at birth in LAC countries, 2001

Country	2001
Cuba	76.9
Chile	76.3
Costa Rica	76.1
Uruguay	75.0
Panama	74.9
Barbados	74.4
Mexico	74.2
Argentina	73.9
Dominica	73.8
Venezuela, Bolivarian Republic of	73.6
Jamaica	72.7
Bahamas	71.9
Saint Lucia	71.3
Antigua and Barbuda	71.0
Saint Kitts and Nevis	70.9
Colombia	70.7
Paraguay	70.6
Ecuador	70.3
Saint Vincent and the Grenadines	70.0
Belize	70.0
Trinidad and Tobago	69.9
Nicaragua	69.5
El Salvador	69.5
Brazil	68.7
Peru	68.5
Suriname	67.4
Honduras	67.3
Grenada	67.2
Dominican Republic	67.0
Guatemala	66.2
Guyana	64.0
Bolivia	62.7
Haiti	50.0
All LAC	70.7

Source: WHR 2002. Annex table 1.

Table A2. Prevalence of selected risk factors in American countries by mortality stratum year 2000*

Risk factor**	Prevalence criteria	Mortality stratum					
		AMR A	AMR B	AMR D	Mean A	Mean B	Mean D
Alcohol	Proportion consuming alcohol	67%	66%	62%	85%	37%	19%
Blood pressure	Mean systolic pressure (mmHg)	127	128	128	134	131	130
Childhood sexual abuse	Proportion of adults with history of abuse	15%	9%	15%	12%	17%	26%
Cholesterol	Mean cholesterol (mmol/l)***	5.3	5.1	5.1	5.6	4.8	5.0
Indoor smoke from solid fuels	Proportion using biofuel	1%	25%	53%	0%	32%	71%
Iron deficiency	Mean haemoglobin level (g/dl)	13.7	13.1	13.1	13.7	12.8	12.3
Low fruit and vegetable intake	Average intake per day (g)	290	190	340	430	320	317
Overweight	Body mass index (kg/m ²)	26.9	26.0	26.0	25.0	24.4	21.2
Physical inactivity	Proportion with no physical activity	20%	23%	23%	17%	17%	16%
Underweight	Proportion less than 2 SD weight for age	2%	5%	12%	3%	14%	34%
Unplanned pregnancies	Proportion not using modern contraception	33%	45%	68%	39%	62%	79%
Unsafe health care injections	Unsafe injection(s) exposing to Hepatitis B each year	0%	0%	0%	0%	3%	9%
Urban air pollution	Concentration of particles less 10 micron (µg/m ³)	13	15	20	13	24	25
Vitamin A deficiency	Proportion vitamin A deficient with night blindness	0%	9%	9%	0%	10%	17%
Zinc deficiency	Proportion not consuming US recommended intake	6%	26%	68%	4%	20%	54%

* Estimates are age standardized to the WHO reference population and the denominator is the population most relevant to the risk factor - Alcohol, childhood sexual abuse, physical inactivity are ages 15+; Blood pressure, cholesterol, overweight, and fruit and vegetables are ages 30+; iron, vit A, zinc, and underweight are for <5; and for unplanned pregnancies females 15-44

** Many risk factors were characterized at multiple levels -- here they are collapsed to show exposure or no exposure (or means).

***1 mmol/ = 38.7 mg/dL

Table A3. Attributable mortality by specific risk factor and mortality stratum, 2000

	AMR A	AMR B	AMR D
Childhood and maternal undernutrition	0.2%	2.4%	8.8%
Underweight	0.0%	1.0%	4.9%
Iron, Vit A or zinc deficiency	0.2%	1.4%	4.0%
Other diet-related risks and physical inactivity	47.4%	38.9%	23.1%
Blood pressure	13.3%	12.8%	7.8%
Cholesterol	12.6%	6.5%	3.7%
Overweight	9.8%	10.1%	6.5%
Low fruit and vegetable intake	6.2%	5.4%	2.7%
Physical inactivity	5.6%	4.1%	2.4%
Sexual and reproductive health risks	0.6%	2.1%	6.3%
Unsafe sex	0.6%	1.9%	5.5%
Lack of contraception	0.0%	0.2%	0.8%
Addictive substances	24.0%	18.5%	6.9%
Tobacco	23.3%	8.5%	1.2%
Alcohol	0.2%	9.5%	5.5%
Illicit drugs	0.6%	0.4%	0.2%
Environmental risks	1.2%	3.8%	8.0%
Unsafe water, sanitation and hygiene	0.0%	1.2%	4.5%
Urban air pollution	1.0%	1.2%	1.0%
Indoor smoke from solid fuels	0.0%	0.6%	2.0%
Lead exposure	0.1%	0.8%	0.6%
Occupational risks	1.0%	1.4%	0.4%
Risk factors for injury	0.1%	0.7%	0.4%
Carcinogens and airborne particulates	0.9%	0.6%	0.0%
Other selected risks to health (unsafe health injections and childhood sexual abuse)	0.1%	0.1%	0.4%
Total deaths (000)	2 778	2 587	510
Attributable % of deaths by all risk factors	74.5%	67.0%	53.9%

The combined effects of any group of risk factors in this table will often be less than the sum of their separate effects.

Table A4. Attributable DALYs by specific risk factor and mortality stratum, 2000

	AMR A	AMR B	AMR D
Childhood and maternal undernutrition	1.1%	3.0%	10.1%
Underweight	0.1%	1.3%	5.5%
Iron, Vit A, and zinc deficiency	1.0%	1.6%	4.6%
Other diet-related risks and physical inactivity	24.7%	14.1%	7.6%
Blood pressure	6.1%	4.1%	2.3%
Cholesterol	5.4%	2.4%	1.2%
Overweight	7.6%	4.3%	2.5%
Low fruit and vegetable intake	3.0%	1.9%	0.8%
Physical inactivity	2.8%	1.5%	0.8%
Sexual and reproductive health risks	1.1%	2.2%	4.9%
Unsafe sex	1.1%	2.2%	4.9%
Lack of contraception	0.0%	0.5%	1.2%
Addictive substances	23.9%	16.8%	7.7%
Tobacco	13.4%	3.8%	0.4%
Alcohol	7.9%	11.7%	5.7%
Illicit drugs	2.6%	1.4%	1.6%
Environmental risks	0.8%	4.8%	8.5%
Unsafe water, sanitation and hygiene	0.1%	1.6%	4.5%
Urban air pollution	0.4%	0.4%	0.3%
Indoor smoke from solid fuels	0.0%	0.6%	2.0%
Lead exposure	0.3%	2.1%	1.6%
Occupational risks	1.2%	1.6%	0.8%
Risk factors for injury	0.3%	1.0%	0.6%
Carcinogens, particulates, noise, ergonomic stressors	0.9%	0.6%	0.1%
Other selected risks to health	0.9%	0.4%	0.6%
Childhood sexual abuse	0.9%	0.3%	0.4%
Unsafe health care injections	0.0%	0.0%	0.2%
Total attributable DALYs (000)	24 725	34 399	6 961
Total DALYs (000)	45 991	79 562	16 803
Attributable RF % of DALYs	53.8%	43.2%	41.4%

The combined effects of any group of risk factors in this table will often be less than the sum of their separate effects.

10. ANNEX 2

METHODS AND DATA FOR ECONOMIC ANALYSIS

The impact of three major risk factors is considered: smoking, physical inactivity, and arterial hypertension. In defining an appropriate methodological approach, certain issues have to be taken into account. The **first** is the lack of data on present parameters of NCDs in Brazil. Numerous studies have been carried out on the prevalence of risk factors, however many have important limitations. Some studies have a very narrow context which is difficult to extrapolate to the population at large. Others do not adequately define risk factor thresholds as measured by surveys, for example the exact measure of physical activity below which an individual is labeled as being inactive. The measurement of the risk factor is sometimes inaccurate; in the case of the most dynamic of these, arterial blood pressure, inadequate environments for measurement can make subjects anxious and lead to overestimates of the prevalence of hypertension. Despite these types of flaws and limitations, sufficient data exists on risk factors to be able to make reasonable estimates of population prevalence.

A more difficult parameter to establish is the quantitative relation between risk factors and specific diseases they cause. There is almost no data on this from Brazil, and studies with estimates from other countries have to be used. In doing so, it is assumed that these quantitative relations are relatively robust and do not vary greatly across different geographic and socio-cultural settings.

Similarly, there is little Brazilian data on the effectiveness of preventive interventions in reducing the prevalence of risk factors and diseases they cause. Systematically collected data on costs are almost non-existent. It is difficult to use evidence from other countries in Latin America and the Caribbean because this extreme lack of evidence for NCD interventions extends throughout the whole region.³⁴ Therefore, evidence is usually used from countries in other regions. For effectiveness, study results from other countries are taken as proxies; these can obviously vary significantly but they still provide a useful general estimate of intervention results. Similarly, quality data on costs is also uncommon to find. For studies from other countries and from WHO databases, costs are adjusted using International Dollars (Purchasing Power Parity); for Brazilian studies, unit costs are assumed to be the same across the country.

The **second** issue is how to best measure the true impact of NCDs. It is evident that diseases causing death at a younger age have a greater impact and this has to be adequately captured by the methodology utilized. Perhaps of greater importance is capturing and quantifying the impact of disability (non-fatal health outcomes). This is harder to measure than absolute events such as mortality; furthermore, disability can have a devastating effect on the exacerbation and propagation of poverty. Whereas mortality inflicts a one-time loss on a family, ongoing disability may hamper the individual's productivity while causing a chronic drain of resources for health care. Therefore, the

methodology to be adopted also needs to adequately reflect the impact of different degrees and durations of disability.

While calculation of productivity loss shows the effects of age at death and disability to some extent, it is a relatively crude measure and is not sufficient. In fact, economic measures of ill health are an important part of any analysis, but the overriding criteria should be impact on health. This is in part due to the intrinsic value of health to policymakers and the population.

The **third** issue concerns the relative burden of risk factors and diseases in the poor. If poverty is associated with an increased impact of NCDs, then targeting these diseases may be an effective way of targeting the poor. This could also have important implications on comparative cost-effectiveness of prevention among different economic classes, an important consideration in project design.

In considering all these issues, simplifying assumptions were necessary. Although many results in this document are approximate, they are still useful policy tools. In most parts of the world, the scale and sophistication of NCD control and prevention are still at a basic stage. Therefore, the most pressing need is not to spend time and resources arriving at exact estimates, but to send out an urgent call for action with whatever evidence is on hand. This is what the document sets out to achieve.

Methodological Approach – The conceptual approach is based on the existence of risk factors, each of which leads to an increased occurrence of specific secondary diseases, in turn bringing about negative health impact and financial and economic losses. For each risk factor, the initial parameter is its prevalence in the population. Results of different studies are considered in a broad context to define the appropriate overall value for the population. Characteristics such as the time period, geographic location, and characteristics of the study population are considered in arriving at this definition. Definitions and methods of measuring the risk factors are also compared as it is difficult to compare studies with important measurement incompatibilities. Risk factor definitions most easily related to consequence disease incidence are usually given preference.

Each risk factor increases the probability of certain secondary diseases. The quantitative relation between risk factors and diseases is derived from the literature, using the World Health Report 2002 as a broad base (WHO 2002). The baseline is the incidence^v of the secondary diseases in the population not exposed to the risk factor. Subsequently, two basic approaches can be used according to data availability: 1. the use of an absolute disease incidence in populations exposed and unexposed to the risk factor; 2. the use of the absolute disease incidence/prevalence in unexposed individuals along with a measure of increased risk in exposed individuals. The calculations using these two approaches would be thus:

^v Or prevalence as may be the case. All mentions of incidence assume the possible alternative use of prevalence according to the nature of the disease in question.

1. $I_{A\text{-riskfactor}} = I_{A\text{-exp}} - I_{A\text{-unexp}}$
2. $I_{A\text{-riskfactor}} = I_{A\text{-unexp}} * (RR_{A\text{-exp}} - 1)$

$I_{A\text{-riskfactor}}$ = Incremental Incidence of Disease A per 100,000 individuals secondary to risk factor exposure

$I_{A\text{-exp}}$ = Incidence of Disease A per 100,000 individuals exposed to risk factor

$I_{A\text{-unexp}}$ = Incidence of Disease A per 100,000 individuals unexposed to risk factor

$RR_{A\text{-exp}}$ = Relative Risk of Incidence of Disease A in individuals exposed to risk factor compared to unexposed individuals

In a situation where only the incidence of a secondary disease in the general population is known, together with the relative risk of exposure to the risk factor, and the prevalence of the risk factor in the general population, the incidence of the disease attributable to the risk factor can be calculated in the following manner:

$I_{A\text{-riskfactor}} =$

$$I_{A\text{-general}} * \{P_{\text{riskfactor-general}} * (RR_{A\text{-exp}} - 1)\} / \{[P_{\text{riskfactor-general}} * (RR_{A\text{-exp}} - 1)] + 1\}$$

$I_{A\text{-riskfactor}}$ = Incremental Incidence of Disease A per 100,000 individuals secondary to risk factor exposure

$I_{A\text{-general}}$ = Incidence of Disease A per 100,000 individuals in the general population

$P_{\text{riskfactor-general}}$ = % Prevalence of the risk factor in the general population

$RR_{A\text{-exp}}$ = Relative Risk of Incidence of Disease A in individuals exposed to risk factor compared to unexposed individuals

The incidence of secondary diseases are calculated drawing on data and estimates from the Brazilian as well as the Global Burden of Diseases Studies,^{10,79} as well as individual studies. In those cases where prevalence data and/or specific information on relative risk are not adequate from individual studies, heavy use is made of the calculations and estimates made in the World Health Report 2002 of the burden of disease attributed to specific risk factors.

Since different diseases have different impacts, it is necessary to translate health impact into comparable units. This is done utilizing the Global Burden of Disease methodology. This approach allows the addition of impact from years of life lost due to premature mortality with impact from years of life lived with disabilities of diverse degree. For both, impact is translated into a single indicator so the relative effect of mortality and disability can be compared or combined. It also makes it possible to compare, add, or subtract the impact of different diseases. The basic equation for this methodology is:

$$DALY_j = YLL_j + YLD_j$$

$DALY_j$ = Disability-Adjusted Life Years due to Disease j

YLL_j = Years of Life Lost due to premature mortality (based on life expectancy at age of death), due to Disease j

YLD_j = Years Lived with Disability (based on duration of disability and Disability Weight), due to Disease j

As mentioned above, disability is quantified by assigning a Disability Weight (DW) to capture the severity of the incapacity caused by the disease. The higher the DW, the more severe is the incapacity. This number ranges from 0 (no disability) to 1 (total disability). For example, vitiligo on the face has a DW of 0.020, Angina 0.223, blindness 0.624, and quadriplegia 0.895. Death has a DW of 1 as it is by definition a total loss of the year. Therefore, a year lived with a disability is treated as a partial loss of a year and a year lost to mortality is treated as a total loss of a year.

The methodology also factors in a future discount rate, usually set at an annual 3%, and an age-weighting factor which gives differing values to years lived at different ages. For reference, the formulae for calculating the two components of DALYs for one individual are:

$YLLs =$

$$KCe^{ra}/(r+\beta)^2 [e^{-(r+\beta)(L+a)} [-(r+\beta)(L+a)-1] - e^{-(r+\beta)a} [-(r+\beta)a-1]] + (1-K)/r (1-e^{-rL})$$

$YLDs =$

$$D \{ KCe^{ra}/(r+\beta)^2 [e^{-(r+\beta)(L+a)} [-(r+\beta)(L+a)-1] - e^{-(r+\beta)a} [-(r+\beta)a-1]] + (1-K)/r (1-e^{-rL}) \}$$

β = Parameter for age-weighting function (usually 0.04)

K = Age-weighting modulation factor (usually 1)

C = Constant (usually 0.1658)

a = Age at death

L = Standard expectation of life at age a

e = Natural logarithm

r = Discount rate (usually 0.03)

D = Disability weight

Therefore, once the discount rate, age-weighting factor, and Disability Weights are defined,^{vi} the total impact from a given disease as a result of a given risk factor is a function of the following parameters:^{vii}

$Impact_{riskfactor} = f$ (total incidence due to risk factor, age at incidence, degree of disability, duration of disability, total mortality due to risk factor, age at mortality, life expectancy by age)

^{vi} In this analysis, the values used in the Global Burden of Disease Study are adopted.

^{vii} For all parameters of the function except total incidence and total mortality, the distribution of values in the population or the weighted average in the population may be used.

Once impact is calculated in DALYs, the overall health impact caused by a risk factor is simply the sum of the impact caused by the incremental incidence of all its secondary diseases (Figure C):

$$\text{Impact}_{\text{total-riskfactor}} = \sum_{j=1}^n \text{Impact}_{j\text{-riskfactor}}$$

$\text{Impact}_{\text{total-riskfactor}}$ = Total impact caused by the risk factor

$\text{Impact}_{j\text{-riskfactor}}$ = Impact caused by risk factor through increased incidence of Disease j

n = Total number of secondary diseases caused by the risk factor

For subsequent calculations, the risk factors and the secondary diseases selected are as follows:

1. Arterial Hypertension

- Ischemic Heart Disease
- Cerebrovascular Disease

2. Physical Inactivity^{viii}

- Ischemic Heart Disease
- Cerebrovascular Disease
- Diabetes Mellitus

3. Tobacco Use

- Lung Cancer
- Chronic Obstructive Pulmonary Disease
- Ischemic Heart Disease

The same basic concept for impact applies to the financial and economic losses caused by a risk factor and its secondary diseases; the formulae are similar and will not be repeated here. The two main components of losses considered in the study are economic losses (lost productivity (the human capital approach) due to disability or death), and financial losses (health care costs). Productivity loss is calculated as GDP/capita applied to the time lost due to disability or death. Disability is calculated from the non-fatal complications considering those that are severe enough to prevent effective participation in the work force. The incidence and duration of these complications are taken from the Global Burden of Disease Study. For periods of productivity lost to both death and disability, a 3% annual future discount is applied. The value of a continuous period with discounting is calculated using the discrete formula for a continuous stream of life:

^{viii} The major part of impact due to Physical Inactivity is captured by the three selected diseases; however the full range of impact would ideally include certain neoplastic diseases and psychiatric conditions.

$$n_{\text{present value}} = (1 + r)^{-5} * 1/r * [1 - (1 / (1 + r))]$$

$n_{\text{present value}}$ = Present value of a stream of life of n years duration
 r = Future discount rate

For each disease, health care costs are calculated beginning with the reimbursement amounts in the public sector. Next, other health care costs from the public sector are taken into account, including both ambulatory costs and resources transferred through other mechanisms, notably the PAB (*Piso de Atenção Básica*) which is the main source of resources for primary health care. Care is taken to separate expenditures on prevention and promotion from true curative health care. To this is added the private sector expenditure on health care. Very few details are available on how the private sector plans spend their resources; similarly, little data is available on how public resources are spent in ambulatory and primary health care in general. Therefore, for each disease, the general assumption is made that the proportion of overall resources used in public sector hospitalization for the disease can be extrapolated to the other categories of expenditures. The sequence and approach of calculations is shown in great detail in the spreadsheet developed for this report.

It is important to mention at this point that the discounting of health impact (DALYs) and of productivity loss is carried out in two stages. The first stage involves the discounting of the period of time lost or affected by the disease back to the year of incidence of the disease. In the second stage, the net value at the year of incidence is then discounted back to the year of reference (2004). It is also possible to separately discount each individual year of impact or productivity loss back to the year of reference; however, this procedure is more difficult and would unnecessarily complicate the calculations. The approach for health care costs is somewhat different. These are considered one year at a time and discounted to 2004 in one stage only.

Once the health, financial, and economic impact of risk factors are quantified, a few sample interventions are selected as illustrations. Their effectiveness in modifying the risk factors (be they primarily behavioral or physiological) is translated into DALYs averted and financial and economic losses (health care costs and productivity loss) prevented. Their cost is contrasted to their effectiveness and benefits to derive their cost-effectiveness (in Brazilian Reals of expenditure per DALY averted), and cost-benefit (measured in losses prevented per Brazilian Real of expenditures).

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