HNP DISCUSSION PAPER

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Health, Nutrition and Population (HNP) Discussion Paper

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Health, Nutrition and Population (HNP) Discussion Paper

The Economic Implications of Non-Communicable Diseases for India

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Abstract: In 2004, 4.8 million (59.4 percent) of the estimated 8.1 million Indian deaths were due to NCDs. With India's population aging over time and a higher incidence of NCDs in older age groups, and with evidence emerging that the India's poor are at heightened risk of acquiring NCDs owing to high rates of smoking and tobacco use, occupational risks, and residential living conditions, a better understanding the economic impact of NCDs becomes urgent.

In 2004, Indians spent nearly INR 846 billion out of pocket on health care expenses, amounting to 3.3 percent of India's GDP for that year. The share of NCDs in out of pocket health expenses incurred by households increased over time, from 31.6 percent in 1995-96 to 47.3 percent in 2004. More than one-half of the out-of-pocket expenses on health care were incurred on purchases of medicines, diagnostic tests and medical appliances.

The odds of incurring catastrophic hospitalization expenditures are nearly 160 percent higher with cancer than the odds of incurring catastrophic spending when hospitalization is due to a communicable condition. By comparison, the odds of incurring catastrophic hospital spending due to CVD or injuries are about 30 percent greater compared to communicable conditions that result in hospital stays.

In 2004, assuming that all care-givers and sick individuals above the age of 15 years were productive yielded an annual income loss from NCDs of one trillion rupees. More than one-third of all income losses were due to CVD and hypertension.

If NCDs were completely eliminated, the estimated GDP in a year such as 2004, using two different assumptions, would have been 4-10 percent higher. Per capita GDP would also be higher. The primary driver of these results on GDP is the change in life expectancy at birth.

Our analysis suggests that NCDs constitute a significant economic burden on India.

Keywords: economic burden, non-communicable diseases, household catastrophic spending, poverty induction, out-of pocket spending or health

Disclaimer: The findings, interpretations and conclusions expressed in the paper are entirely those of the authors, and do not represent the views of the World Bank, its Executive Directors, or the countries they represent.

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Acronyms

ADA	American Diabetes Association
AIDS	Acquired Autoimmune Deficiency Syndrome
BCS	Bloom, Canning, and Sevilla
CDC	Centers for Disease Control and Prevention
CGE	Computable General Equilibrium
COPD	Chronic Obstructive Pulmonary Disease
CRS	Civil Registration System
CSO	Central Statistical Organization
CVD	Cardiovascular Disease
DALY	Disability Adjusted Life Years
DFLE	Disability Free Life Expectancy
DM	Duraisamy, Mahal
EIU	Economist Intelligence Unit
GDP	Gross Domestic Product
HH	Household
HIV	Human Immunodeficiency Virus
HNP	Health Nutrition Population
ICD	International Classification of Disease
ICMR	Indian Council of Medical Research
IIPS	International Institute of Population Sciences
INR	Indian Rupee
LASI	Longitudinal Aging Study of India
MCCD	Medical Certification of Causes of Death
NCAER	National Council for Applied Research
NCD	Non-Communicable Disease
NCRB	National Crime Records Bureau
NFHS	National Family Health Survey
NHA	National Health Accounts
NIH	National Institutes of Health
NSS	National Sample Survey
NSSO	National Sample Survey Organization
OLS	Ordinary Least Square
PODIS	Prevalence of Diabetes in India Study
RSBY	Rashtriya Swasthya Bima Yojana
SCD	Survey of Causes of Death
SRS	Sample Registration System
WHO	World Health Organization
WHS	World Health Survey
VSLY	Value of a Statistical Life Year

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Executive Summary

This report contributes to the literature on the economic implications of NCDs in developing countries by focusing on the case of India. First, we examine available evidence on the economic impact of NCDs in India. Second, we present new estimates of impact of NCDs, both on household economic well being as well as on aggregate economic outcomes in India. India is a worthwhile case to study for many reasons, beginning with the large numbers involved. In the year 2004, an estimated 8.1 million Indians died from all causes. Based on WHO data on the distribution of deaths by cause, estimated deaths from non-communicable conditions[1] (including injuries) amounted roughly to 4.8 million, or about 59.4 percent of all deaths in the year. Moreover, about 24 percent of these deaths from non-communicable conditions occurred in the 35-64 age-group as per data from medically certified deaths from hospitals located in urban areas of India. Available data also indicate that 34 percent of all injury-related deaths occurred among individuals in the 35-64 year age group. India's population is also ageing over time, an issue of concern given the higher incidence of NCDs in older age groups. All of these developments are occurring in a setting where health expenditures are growing rapidly led by an unregulated private sector and where health insurance and pension coverage are still limited. These financial concerns are further exacerbated by the emerging evidence that the India's poor are at heightened risk of acquiring NCDs owing to high rates of smoking and tobacco use, occupational risks, and residential living conditions.

For the purpose of defining NCDs, we followed closely the NCD classification adopted in the WHO burden of disease analysis, albeit with two modifications. We included injuries in our definition of non-communicable diseases because these account for nearly 10 percent of all deaths in India; or 16 percent of all deaths not classified under communicable and/or maternal and child health conditions. To address the concern that injuries are not included in some standard definitions of NCDs, we present our results on the economic impacts of NCDs for two cases: one where injuries were included in the definition of NCDs, another where NCDs were so defined as to exclude injuries. We *excluded* congenital anomalies since the datasets we used provided very limited information on such conditions. This category, along with "unclassified conditions" and communicable, maternal & child health conditions will henceforth be referred to as "non-NCDs" for our purposes.

[1]In WHO burden of disease analysis, non-communicable diseases include CVD, cancers, diabetes, chronic obstructive pulmonary disease (COPD), asthma, neuro-psychiatric conditions (e.g., mental disorders, epilepsy, Alzheimer's), congenital conditions, skin and musculoskeletal conditions (e.g., arthritis), eye conditions, skin diseases, diseases of the digestive systems (e.g., peptic ulcer) and genitourinary conditions (prostate disorders, nephritis). Accidents and injuries are considered as a category separate from NCDs (World Health Organization (WHO) 2004).

Existing Evidence on the Economic Impact of NCDs in India and its Limitations

Existing studies on the economic impact of NCDs in India have focused primarily on health conditions with a significant morbidity and/or mortality impact – CVD, diabetes, respiratory conditions (COPD, asthma) and injuries. Although limited in number, these studies highlight the potentially large economic burden associated with NCDs in India.

The gaps in the existing literature on economic impacts of NCDs in India are the following. Firstly, not all of the major NCDs are covered. Conditions such as cancer are inadequately addressed, as also neurological and psychiatric disorders. Secondly, existing analyses on India tend to downplay the role of co-morbidity and of competing risks in assessing the economic impacts of NCDs. The presence of co-morbidities – the existence of one condition is associated with the increased likelihood of acquiring another - implies that economic impacts allocated to a specific disease ought to involve some sort of *netting out* exercise (or alternately, consolidation), depending on the health condition involved. Similarly, mortality risks from two competing (say on account of some common cause) conditions imply that standard methods used to allocate costs allocated to a disease (based on the identified cause of death or illness) ought to be corrected because of their implicit assumption of statistical independence of the risk of acquiring the two conditions. Thirdly, existing analyses for India exclude consideration of subsidies on health services, whether provided by the public sector or private enterprises. Most tend to focus on out of pocket spending by households. It might appear first sight that, if our interest is in the identification of economic impacts on individuals and households, the exclusion of such subsidies is not only correct but is, in fact, a necessity. However, information on public subsidies is required if we wish to go beyond simply estimating household economic impacts to understanding the factors that drive them. Moreover, information on public subsidies is an essential input if we wish to estimate the aggregate economic outcomes of NCDs. To see this, observe that if health expenditures result in lower savings and investment (whether by private entities or the government) they will adversely impact aggregate economic outcomes. Fourthly, with few exceptions no effort is made in the Indian literature to use existing theoretical and/or empirical models of economic growth to assess aggregate outcomes. This omission typically leads to exaggerated claims of income losses with a myriad of diseases, usually when the authors follow a cost-of-illness methodology to infer aggregate economic outcomes. Fifthly, with only one or two exceptions, existing analyses of the economic impacts of NCD on households in India do not inquire into the impact of morbidity and mortality on the household allocation of labor within domestic work, on children's schooling, on supply of labor, on the likelihood of falling into poverty, and so forth.

Finally, existing work for India does not permit an easy "adding up" of estimates of the economic impacts of different categories of NCDs. This stems partly from the different methods employed in each study. Some studies neglected the effects of mortality on economic outcomes but others did not. Others downplayed economic effects working through morbidity, focusing instead on deaths. However, an important element of the story is the differences in the type of data used for individual studies. Some

analyses used information from a variety of small sample surveys to arrive at an acceptable prevalence rate for a disease. Others relied on a single small sample to arrive at estimates of aggregate prevalence. Other studies relied on data from large household surveys. The net result is a series of numbers on morbidity and mortality for different health conditions that lack consistency and hamper efforts to arrive at an aggregated estimate of the impact of NCDs in India.

Methodology Issues

One way of assessing the economic impacts of NCDs is to estimate the associated *costs of health care* – the so-called 'direct costs' of ill health. It is important to appreciate, however, that 'direct costs' of NCDs do not necessarily indicate the economic burden that NCDs impose on households. This is firstly due to the fact that households are not the only party that pays for the costs of health care. Governments, insurance agencies and firms typically account for a significant portion of this amount. Secondly, households with sick members may incur lost wages either because the sick members are unable to work, or that care-givers have to give up productive labor time, neither of which is included in the calculation of direct costs. Future incomes may also be foregone if children are pulled out of school and these are typically also not included in direct cost calculations.

It is also not obvious that health expenditures are a "bad" that needs to be *deducted* from some household (or social) measure of economic well being. Indeed, the level of health spending (and its growth) can be directly related to improved health outcomes, in and of itself, a good thing. Moreover, consider a *competing risks* formulation, where there are a large number of competing sources of morbidity (and mortality). Here, the emergence of effective prevention efforts for one disease may lead to increased household spending on other sources of morbidity that now acquire greater priority for the society or household in question. That permits the possibility that observed health spending may not change by much (and may even increase) with improvements in health outcomes. Related to this point, increased investments in technological innovations in newly prioritized health conditions can also explain higher health expenditures. This argument would be even stronger if there is a positive feedback loop from good health to income

The preceding discussion suggests that in assessing the 'economic burden' of health spending, we should also consider any relevant health gains (or lack thereof) that might have been achieved by such spending. At the very least, we ought also to include a measure of income loss/gain to make the analyses comparable across households who may make different choices about health care (and spending) when confronted with an episode of ill health.

There are important exceptions to the arguments made above. The first is the issue of *efficiency*. If, for instance, desired levels of health can be attained by purely preventive behavior at zero cost, one could say that all of the health expenditure is excessive and

could have been used for other purposes. The same argument would hold if the treatments that health expenditures support are ineffective in improving health outcomes.

Concern with the cost of treating a disease from the point of view of households/society may arise from at least two other considerations. If the members of a society are highly averse to financial risk, then the risk of incurring high out of pocket expenses in the event of illness can potentially impose very large welfare costs on such individuals, for which providing for some form of insurance may be desirable. Also, if there are substantial socioeconomic inequalities in society, then high levels of out of pocket expenses on illness can be considered "unfair" even for individuals who are "neutral" to risk if these costs fall disproportionately upon backward social groups. These concerns (along with income losses linked to ill health) form the bases for analyses that look at 'consumption smoothing' by households in response to illness, the impacts of ill-health on poverty, and catastrophic levels of health spending by households.

Health spending on NCDs and Public Subsidies

In Chapter 3 we assess firstly the *direct costs* of NCDs in India. We use information on direct costs to infer the economic burden of NCDs on Indian households by describing how these costs are financed and how the economic burden on households varies by income class. Because formal insurance is limited and firms pay for only a small portion of total health spending in India, we focused primarily on the distribution of health care costs between the public sector and household out of pocket spending as a way to infer the burden of NCDs on households. We also inquired into the methods by which Indian households financed their out of pocket spending for NCDs. Analyses of the impact of NCDs on households' likelihood of incurring catastrophic spending and of falling into poverty were also undertaken.

According to National Sample Survey Organization (NSSO) there were nearly 2.5 billion outpatient visits and 30.6 million hospital stays in India in the year 2004. These numbers are considerably greater than similar categories for 1995-96. NCDs accounted for nearly 40 percent of all hospital stays and 35 percent of all outpatient visits in 2004; in 1995-96 the corresponding proportions were 32 percent and 22 percent, respectively. The average length of a hospital stay for NCDs was higher than for other health conditions suggesting a greater intensity of care received by patients admitted under the former category. Heart disease and accidents and injuries were the two most important reasons for hospital stays, along with kidney/urinary conditions, respiratory problems and cancers. Hospital stays and outpatient visits due to diabetes, respiratory conditions and injuries increased rapidly during the period from 1995-96 to 2004.

The private sector accounted for about 59 percent of all hospital stays in 2004, slightly higher than in 1995-96; and for 82 percent of all outpatient visits, similar to 1995-96. Overall, these data confirm the important role that the private sector plays in the provision of health services in India. The proportion of inpatient stays in the public (or private) sector did not vary much by the broad categories of NCD and non-NCD; but the share of the public sector in outpatient visits was higher for NCDs than for the non-NCD

conditions. Within NCDs, the share of the public sector hospital stays was highest for cancers, accidents and injuries, respiratory conditions and psychiatric care.

Indians spent nearly INR 846 billion out of pocket on health care expenses in the year 2004, amounting to 3.3 percent of India's GDP for that year. This marked a substantial increase (in current Indian Rupees) from INR 315 billion spent out of pocket on health care in the year 1995-96 (about 2.9 percent of India's GDP in 1995-96). The data also show that the share of NCDs in out of pocket health expenses incurred by households increased over time, from 31.6 percent in 1995-96 to 47.3 percent in 2004. That would indicate growing importance of NCDs in India in terms of their financial impact on households (and the underlying disease burden).

Out of pocket expenses on care obtained at public facilities per unit of health care utilization (a single hospital stay, a single hospital day, or an outpatient visit) were lower than expenses incurred on comparable units of utilization at private facilities. All else the same, that would point towards public facilities providing Indian households some degree of financial risk protection from ill health, whether from NCDs or non-NCDs. NCDs impose a greater burden on out of pocket expenditures than other health conditions. Our data for 1995-96 and 2004 show that the out of pocket expense for a single hospital stay for an NCD was nearly double that of other health conditions; and expenses incurred per hospital day were between 30 percent and 50 percent higher in a private than in a public health facility. The differences in out of pocket expenses incurred on NCD and non-NCD conditions are less marked for outpatient visits but nonetheless exist, with visits for NCD being 15 to 50 percent more expensive than non-NCD visits. Within NCDs, out of pocket expenses per unit of utilization are particularly high for cancer, heart disease, accidents and injuries and kidney/urinary conditions.

More than one-half of the out-of-pocket expenses on health care were incurred on purchases of medicines, diagnostic tests and medical appliances. The proportions are more or less the same across broad groups of NCDs and other health conditions. A major chunk of overall out of pocket health spending (in excess of 45 percent) is on medicines and this proportion is as high as 64 and 58 percent for cases of hypertension and diabetes, respectively. The data on the components of out of pocket health spending highlight the importance of drug expenditures as a major source of household economic difficulty. With even users of public health facilities being forced to rely on their own resources for purchasing drugs in recent years, the issue of financial affordability of drugs will acquire increasing significance in India in the future.

In the year 2003-4, governments in India at the central and state levels spent a total of nearly INR 220 billion on health. Our estimates of public subsidies to different health conditions show that accidents, cancers, kidney/urinary conditions and injuries account for the highest level of subsidies per unit of care (as well as the total amounts of subsidies allocated). Taken as a proportion of total out of pocket spending, however, government subsidies are rather small, irrespective of the health condition considered. This leaves the average Indian household vulnerable to considerable risk from the financial implications of illness.

Financing and Vulnerability to NCD Risk among Indian Households

Own savings and income turned out to be the most important source of financing for many health conditions (typically between 40-60 percent of all spending). In 2004 about 10-15 percent of financial resources were provided by friends & family, a form of community insurance. The share of reimbursements from insurance or employers amounted to only about 5-6 percent of all NCD-related out of pocket health spending for hospitalization. However, a large number of households rely upon "borrowing," presumably with (or without) a collateral and potentially carrying interest payments. Some of the more expensive to treat health conditions (CVD, cancers, accidents and injuries, and neurological disorders) also involve larger shares of financing from the "other" category in 2004, primarily via the sale of assets. Overall, the evidence supports significant household financial vulnerability arising from poor health in India, be it NCDs or other health conditions.

Households' financial vulnerability to NCDs can also be assessed by comparing the costs of hospitalization for health conditions that comprise NCDs to income (or total consumption spending). In the year 2004, India's income per capita was INR 25,320. It is worth noting that a single hospital stay for cancer (or heart disease) would have accounted for anywhere between 80 percent and 90 percent of this income if health care were to be obtained from private providers. Even if health care was sought at a public facility, the expenses out of pocket would still have amounted to between 40 percent and 50 percent of per capita income. Yip and Mahal (2008) have further shown that the bite out of income per capita taken out by a single hospitalization event increased sharply between 1995-96 and 2004 for the poorest individuals.

Total out of pocket health spending, taken as a proportion of per capita household expenditure, does not vary much across expenditure quintiles, whether we look at the sample population as a whole, or break down it down into rural and urban populations. Urban populations tend to allocate a greater share of their (out of pocket) health expenses on NCDs, compared to their rural counterparts. Moreover, the share of NCD expenditures as a proportion of total household expenditure is rising from poorest to the richest groups. This is in contrast to the situation of expenditures on other (non-NCD) health conditions, whose share in household total expenditures either remains unchanged across expenditure quintiles (rural), or declines with economic well being (urban).

At first sight, our findings would appear to go against the idea that NCDs are creating a financial burden on the poor. However, because individuals belonging to the lowest expenditure quintile live much closer to the survival threshold, allocating even smaller proportions of income is likely to increase their likelihood to falling below the poverty line. Living so close to the survival threshold also means that in many cases they forgo needed care. Thus, while communicable disease mortality and morbidity mostly explain the high share of non-NCD out of pocket health spending among the less well off, another part of the explanation (low proportion of spending on NCD in the bottom quintiles) may lie in the expense of seeking treatment for NCD. This suggests looking at

other monetary indicators of the financial burden suffered by households on NCDs, such as income losses or premature mortality.

Catastrophic Expenditures and Medical Impoverishment on Account of NCDs

We inquired about the degree to which different categories of NCDs influence household risk of catastrophic spending and impoverishment. Our results indicate that the odds of incurring catastrophic hospitalization expenditures are nearly 160 percent higher with cancer than the odds of incurring catastrophic spending when hospitalization is due to a communicable condition. By comparison, the odds of incurring catastrophic hospital spending due to CVD or injuries are about 30 percent greater compared to communicable conditions that result in hospital stays. The odds of incurring catastrophic spending with cancers are nearly double compared to accidents and CVD. Our results are essentially unchanged when the focus is on the risks of impoverishment associated with health spending, with cancers greatly increasing the likelihood of falling into poverty.

Household Income Losses from NCDs

In Chapter 4 we estimate a second key component of the cost of illness associated with NCDs: namely *income losses* to households associated with morbidity/disability and premature mortality from NCDs. Usually, the calculation of income losses relies on the *human capital* methodology, whereby the lost income for each dead/disabled/sick individual is calculated as the present value of their expected future stream of income, appropriately discounted, while allowing for growth in real wages over time, and the likelihood of unemployment and survival. Calculated in this way, these income losses (or 'indirect costs') could be considered a lower bound of the *combined* present and future income losses likely suffered by households that have members with NCDs (because we exclude, for instance, human capital losses due to reduced schooling for children in affected households).

The measure of income losses we report is slightly different from the strict human capital measure of indirect costs described in the previous paragraph. Specifically, we estimated income losses associated with morbidity and/or death associated with NCDs for one year. This measure is attractive because health care expenditures for chronic conditions (characteristic of many NCDs) are likely to be incurred in future years for the same individual. In this scenario, adding up health expenditures incurred in any one given year (direct costs) to the combined (discounted) income losses that occur over multiple periods due to premature deaths appears inconsistent. Constructing the annual estimate also helps us better address data limitations in India with regard to information on the likelihood of survival of sick patients with NCD, their future medical expenditures and hospital stays in estimating their cost of illness.

We first estimated *annual* income losses using a standard cost-of-illness approach. Three different methods were used to assess the size of the population with an NCD in India, and to distribute this population into individuals who died during the preceding year and those that did not.

Assuming that all care-givers and sick individuals above the age of 15 years were productive yielded an annual income loss from NCDs of one trillion rupees in 2004. Much of this was in the form of income losses arising from days spent ill and in care-giving effort. The loss on account of premature death was lower, reflecting the chronic nature of NCDs, so that care and treatment amount cumulatively to much larger amounts than incomes foregone by households owing to the premature death of their members from NCDs. More than one-third of all income losses were due to CVD and hypertension. Another 15 percent were accounted for by diabetes, so that nearly half of all income losses from NCDs occur on account of a fairly narrow range of conditions and their co-morbidities. Another significant chunk (roughly in the region of 20 percent) of all income losses were related to asthma and other respiratory conditions. Accidents and injuries made up for about 6-7 percent of all annual income losses.

Annual incomes based on an imputed wage for all individuals above the age of 15 years will not be an accurate reflection of household declines in income due to NCDs if not everybody works, or if safety nets exist that protect individuals from loss of income during ill health or if there is survivor pension that provides support to the family of a deceased income earner. The latter is not a major concern in India given that only 10 percent of the work force is employed in the formal sector where such protections exist. However, the issue of work force participation most certainly is. Our sample survey data reveal that overall work force participation rate (proportion of people aged 15 years and above with NCDs who actually worked) was only about 47 percent (inclusive of injury cases). If we consider only those who are working, we end up with much lower estimates of the annual income losses to households associated with NCDs – roughly INR 280 billion. Our findings with regard to the relative importance of different types of health conditions remained essentially unchanged when we adjust for worker participation rates.

Impact of NCDs on India's National Income and Aggregate Well-Being

In chapter 5 we constructed estimates of two different versions of aggregate impacts: one on the gross domestic product (GDP) or national income, and the other on the value of statistical lives lost. For estimating impacts of NCDs on GDP and GDP per capita we used Solow-type production functions with two sets of empirically estimated parameters. Under the first of these scenarios we estimated parameter values on the set of baseline explanatory variables used in Bloom, Canning and Sevilla (2004). A second set of parameter estimates were obtained from cross-provincial study for India undertaken Duraisamy and Mahal (2005). Our analysis suggests that were NCDs to be completely eliminated, the estimated GDP in a year such as 2004 would have been 5 to 10 percent higher under the Bloom, Canning and Sevilla estimates, and 4 to 9 percent higher under the Duraisamy and Mahal estimates. Per capita GDP would also be higher. The primary driver of these results on GDP is the change in life expectancy at birth. In this, our findings differ from those of Abegunde et al. (2007) whose focus is on a Solow-type production function downplays the influence of the quality of labor (life expectancy) on national output.

If our interest is in the welfare implications of eliminating NCDs, the size of the GDP (or GDP per capita) is probably not the right metric as it captures only one dimension of the potential gains that result. Indeed, the more significant gain is likely to be the increase in the number of years lived. For this reason, we focused on the value of statistical lives that could be saved by eliminating NCDs. We used two sets of estimates for annual income in India – the average imputed wage for people with NCDs in our sample survey; and GDP per adult worker. This information was combined with information on the value of a statistical life of US$4.35 million for a sample of workers in the United States, and an income elasticity of the value of a statistical life of 0.55 (US$1=INR 45 in 2004), to obtain the value of a statistical life for India. This was roughly INR 90.9 million if we used the GDP per worker as an estimate of income and INR 89.7 million if we used the imputed wage method (or about US$2 million in both cases).

Using a discount rate of 5 percent and a life expectancy for a worker aged 25 of 47.5 years (based on life tables for India) we obtained the value of a statistical life year as INR 473 thousand (using the GDP per worker method) and INR 467 thousand (using the imputed wage method). These estimates were used to assess the potential gains to newborns in the year 2004 in terms of the value of additional life years lived. Because the gains in 7.4 additional life years (on average) due to the elimination of NCDs occurring far in the future, the present discounted monetary value of this gain was in the range of INR 133 thousand and INR135 thousand. With roughly 25.9 million births in 2004, the potential gains from eliminating NCDs to the cohort born in 2004 could be anywhere between INR 3,445 billion and INR 3,497 billion. These (potential) welfare gains amount to between 13 percent and 14 percent of GDP – slightly higher than our estimates of the impact of NCDs on GDP.

The Impact of NCDs on Economic Outcomes in India: Taking Account of Competing Risks

Standard methods for assessing the cost of illness and/or economic impacts typically assume that the risks of morbidity/mortality from NCDs and other (non-NCD) conditions are statistically independent. While this generally makes it easier to undertake the desired analyses, this assumption is inappropriate owing to the existence of statistically dependent competing risks. In chapter 6 we illustrate, using cross-sectional household survey data for India, the use of a propensity score matching approach to address the bias resulting from not taking account of *interdependent* competing risks when attributing direct health care expenses, and other economic impacts to NCD.

For each individual with NCD (in this chapter we use CVD, cancers and injuries for illustrative purposes), we find a control possessing similar observed pre-determined characteristics. We can then assess the economic impact of acquiring NCD by comparing the outcome for each person with his, or her, matched control. We show below that our matched control group is quite different from our random sample of people, both in terms of their observed characteristics such as education level, age, location of residence, and in terms of their health and economic outcomes. Matching to the control group therefore

makes a significant difference to our estimates of the economic impact of CVD, cancers and injuries.

Our analysis suggests that estimates of the impact of NCDs ought to adjust for competing risks in assessing the economic impacts of disease. Our results point to a 5 percent to 20 percent reduction in estimates of household economic impacts that do not use matched controls. The significance of our findings is tempered by our relatively small-sized treatment group, and the fact that we had only a limited set of pre-determined variables to match. Ideally, one would have liked information on smoking history, alcohol consumption, family history of heart disease/cancer and obesity. Unfortunately, the National Sample Surveys do not include this type of historical information in the survey instrument. Indeed, the lack of a longitudinal dataset to examine these questions (which really underpins the preceding sentence) is serious issue of concern. If unobservable characteristics influenced the risk for acquiring an NCD, or health care utilization – such as high rates of discounting the future, or if health facilities were in close proximity in the past (enabling early treatment and medical advice), matching on currently observable characteristics will not yield reliable estimates of the economic impact of NCDs in India. This remains an area of potential importance for future research in NCDs.

Research Implications

Along with other recent efforts in the field, this paper constitutes a first step in the overall research goal of assessing the economic impacts of NCDs in India and other similarly placed developing countries. As noted at several points in the following text, there are several methodological weaknesses in the study, ranging from its use of household survey data that may underestimate the prevalence of disease, not taking full account of disabilities associated with NCDs, the inadequate treatment of competing disease risks in assessing economic impacts, and perhaps in its inability to adequately consider (and bring together) scenarios that take a more careful account of disease prevalence estimates from elsewhere in the literature, such as those of the Shah et al. (2004), the World Health Survey data, and so forth. We believe that all of these are valid concerns and ought properly, to belong to any reasonable agenda for future work on the economic impacts of NCDs in India. Here we consolidate some of more important research ideas emerging from earlier chapters, add some new ones, and highlight what we think are likely to be some of the more productive avenues for further work.

Perhaps the biggest single gap that exists in India relates to information on disease-specific morbidity and mortality on a scale appropriate for India and an appropriate linkage of this information to economic variables, ranging from health spending to socioeconomic status of households. We also believe that longitudinal studies that focus on the economic angle of health are needed to better take account of the poverty impacts of NCDs (and other health conditions). There are none that we are currently aware of on a suitably large scale although one that is currently in the pipeline is the NIH funded Longitudinal Ageing Study of India (LASI) led by David Bloom and colleagues at Harvard and Rand, the first wave of which is expected to take place in

2010-11. It may be a while before these studies can bear fruition. Thus, it might be more useful, at least in the short-run, to exploit what appear to be excellent sources of longitudinal information on health and financing – namely the Indian railways and the armed forces.

Missing also in the existing work is good information on care-giving and support within the family, as well as within communities, related to the financial and disease burdens associated with NCDs. The NSS health care utilization and expenditure data offer a useful data source for this purpose, given that they document some information on the support systems for Indians aged 60 years and above. But this information is very limited, and is generally expressed in qualitative terms. Moreover, we know little about how families respond to crises in the presence of NCDs (or NCD-related deaths) among prime income earners, who appear to be at increased risk of NCDs in India.

Policy Implications

Irrespective of what these more refined analyses may or may not conclude at some point in the future, it is unlikely that they will overturn the major conclusions reported here - that NCDs constitute a significant economic burden on India. This study specifically points to the high levels of out of pocket spending incurred by households that have members with NCDs, the limited levels of insurance coverage (including subsidized public services) and the income losses that befall affected households. Moreover, these findings strengthen conclusions by other recent studies on the economic implications of ill health for India that emphasize the associated risks of catastrophic spending and impoverishment. The study also points to the adverse aggregate economic implications of NCDs.

How to address these economic challenges in a cost effective and equitable manner while ensuring financial risk protection for affected households is an obviously important policy goal. Governments at the national and state levels in India are beginning to wake up to this challenge. The Indian state of Andhra Pradesh, for instance, launched the Arogyasri health insurance scheme in 2007 on a pilot basis and is now in the final stages of extending it throughout the state. The scheme provides for a tax funded insurance plan that (fully) covers all poor people in the state for care sought for a wide range of high-end treatments at public and private health care providers. Moreover, the state government has used the financial clout resulting from the large financial base of the scheme to negotiate quite reasonable rates for a range of different interventions in tertiary facilities. On a national level, the government of India also recently introduced the Rashtriya Swasthya Bima Yojana (RSBY) that provides financial coverage for health care for up to INR 30 thousand to poor households. These schemes run on a “cashless” basis in that any health care expenses covered under the schemes are paid directly by the insurer to the health care provider, greater reducing inconvenience to households who might otherwise have to run after insurance agencies to get their out of pocket expenses reimbursed.

Clearly these schemes mark a fairly radical departure from the situation until the first half of this decade where a long period of decline (following the 1991 fiscal crisis) in public financing of health led households to increasingly rely on the private sector and out of pocket spending to meet their health care requirements. Whether these new schemes provides adequate financial risk protection to people who need such protection the most, and their ability to do so in an efficient manner is, however, still open to question. There are questions about how well they target poor households and there are serious questions about their ability to contain health care costs. The Arogyasri scheme, although ostensibly directed towards the poor, has ended up covering nearly 80 percent of the population of Andhra Pradesh (about 64 million people) owing to the way it has defined a 'poor' household as one holding a ration card. Moreover, the scheme does not emphasize preventive aspects of health, so that it is likely to lead to pressures for more advanced treatment methods and promote either health care cost inflation, or alternatively, financial breakdown. Similarly, the RSBY scheme appears not to have any built-in mechanisms to promote preventive care, and is geared primarily to curative treatment. It is also unclear what the implications of these schemes would be for the public health care sector, that has often served as a provider of the last resort and as a competitor to the private sector, albeit inefficiently, for the less well off. Moreover, there are concerns about the quality of care provided to the insurees given the limited regulatory capacity over health care provision in India. As further steps are taken towards scaling up, our analysis points to the need to evaluate these schemes from a variety of different perspectives.

Treatment, however, ought to be only part of the picture. Long term sustainability of financing mechanisms, requires the diffusion of more effective prevention methods, so that early onset of NCDs can be prevented and their effects on long term disability limited. This calls firstly for curtailing tobacco consumption and smoking that have been linked to cardiovascular disease and different types of cancers. To be sure, the Indian government has recently initiated steps such as the banning of smoking in public places. However, there is a long way to go in terms of implementation, particularly in the use of 'bidis' that are popular among lower socioeconomic groups. Other interventions, such as the promotion of physical exercise, may not be as urgent for rural populations; although the same is not true for urban populations in India. Sedentary lifestyles, common among Indian middle classes probably reflect some combination of prevailing social norms, and importantly a lack of opportunity for undertaking physical exercise, particularly in the larger cities. Existing constraints include limited spaces for walking or bicycling and call for a fundamental rethinking about urban planning in India. Dietary habits of Indian households could also be targeted, whether by means of changing agricultural pricing policies, taxes (subsidies) on less (more) nutritionally desirable foods and public health messages; and the significant costs of respiratory conditions points to addressing indoor air pollution and workplace conditions, particularly in the informal sector that tends to stay under the policy radar. Prevention ought also to be a major focus of concern in education in Indian medical schools, where the predominant focus has been on high-end clinical interventions at the cost of expertise in community medicine and public health.

By highlighting the large economic consequences of injuries and deaths, a significant portion of which are traffic-related in India, our study points to the need for effective measures to promote traffic safety, including better training of drivers, the use of seat belts and helmets, improved vehicle designs and roads, separate lanes for different classes of traffic (when possible), developing trauma centers and so forth. The existing literature points to a number of lacunae in this regard, including the extensive use of bribes in the grant of drivers' licenses and lack of helmet use, particularly in the smaller towns and cities of India. The well known problems of private sector providers turning away traffic injury 'police' cases needs increased policy attention, as also a focus on trauma centers that are urgently needed. The increasing use of 108 ambulance services on a call-center platform to speedily recover and help direct patients to needed emergency care in many parts of India is an important innovation in this direction. Further work on assessing the net economic benefits from 108 services is obviously desirable.

Traffic injuries are only one component of the category of accidents and injuries. Particularly important are suicides and burn injuries, underpinned in India by significant violence against women, often in the context of dowry demands. As is usually the case in India, there already exist a range of laws and regulatory mechanisms to this end, so the issue is often one of implementation and information provision. The emergence of women's groups in different settings in India – among sex workers, self-help groups in villages and elsewhere – has helped in some cases to empower women and to help protect them against this violence. Policies to further strengthen these groups including providing economic opportunities via expanded microfinance mechanisms may be a useful direction to pursue.

Finally, we wish to make an important closing observation. Many of the issues highlighted here are not specific to NCDs. An efficient and equitable health care system becomes a key tool for NCD control as it is for control of other health conditions. However, with the NCDs becoming more common, improving efficiency, quality, and access to a sound health care system is good strategy for NCD control. Likewise, efforts to improve health care delivery and access for NCDs will improve the infrastructure for the broader health care system. The ultimate challenge is to strategically focus on policies that will yield the best returns.

CHAPTER 1. BACKGROUND: REVIEW OF THE LITERATURE ON THE ECONOMIC IMPACT OF NCDS IN INDIA

1.1. Introduction

The role of ill health in influencing the economic well being of nations and households has long been appreciated. In the early economic literature on the subject, researchers primarily estimated direct medical care costs and productivity losses on account of illness using the so-called "cost of illness" method to arrive at an aggregate measure of the economic costs of disease (Rice 1966). Recent literature has utilized somewhat different methodological tools to emphasize the same point. For instance, Gallup and Sachs (2001) used cross-country data in a regression model to demonstrate that countries with high levels of malaria had much lower levels of per capita income. Cuddington (1993) using mathematical modeling, and MacDonald and Roberts (2006) using cross-country panel data regressions, found that the AIDS epidemic was associated with lower rates of growth in per capita income. Instead of focusing on specific diseases, some studies have sought to assess the implications of "health" in the form of broad health measures such as life expectancy at birth. Bloom *et al.* (2004)**,** in a review of this literature, concluded that a 5-year increase in life expectancy at birth translates into increases in the annual average rates of growth of gross domestic product (GDP) per capita that range (depending on the study) from 0.06 to 0.58 percent.

The large national level economic impacts are underpinned by adverse economic outcomes for households affected by disease. Russell (2004) reviewed the literature on the economic impact of malaria, tuberculosis and HIV on households in a number of developing countries and concluded that medical care expenditures and lost labor earnings associated with these conditions were large relative to household incomes. He found that poorer groups were less able to cope effectively with the adverse economic implications of ill health, whether in terms of being able to finance health expenditures without incurring significant borrowing cost or reallocating labor supply within the household; and they tended to be at greater risk for forgoing treatment for their health conditions. Another study, that used panel data for Indonesia assessed that rural households were unable to fully insure themselves against the financial risk of serious illness, particularly income losses associated with disease as shown by their sample of households experiencing sharp declines in consumption following episodes of ill health (Gertler and Gruber, 2002).

Households' inability to cope with the economic impacts of ill health is also reflected in data that show a large proportion of individuals falling into poverty on account on ill health. In a major review of field studies summarizing household dynamics of poverty in developing countries in Africa, Asia and Latin America, Krishna (2007) identified health-related causes as accounting for between 60 percent and 90 percent of all households that fell into poverty. Using household survey data from 11 low- and middle-income Asian countries, Doorslaer et al. (2006) concluded that measured poverty was 2.7 percent greater than the base-line estimate once health care expenditures were excluded from household consumption estimates. Another study, focused on the United

States, found that nearly half of all individuals filing for bankruptcy in the United States did so for medical reasons (Himmelstein et al. 2006). Finally, Xu et al. (2003) demonstrated using survey data that health expenditures in several developing countries were at a "catastrophic" level for between 2 percent and 10 percent of the households.

The concerns about aggregate economic impacts are particularly acute in developing countries in South Asia and sub-Saharan Africa which account for about 40 percent of deaths and nearly half of the Disability Adjusted Life Years (DALYs) lost worldwide (World Health Organization 2004). Collectively, these countries account for only about 3.5 percent of the world's income; and an average income per person that amounts to only 2 percent of the average income per person in the high-income nations in the world (World Bank 2007). For these countries, high rates of morbidity will not only lead to a significant diversion of an already low income to health care, but also lowered opportunities for economic advancement. Non-communicable health conditions account for major portion of this disease burden making up about 44.4 percent of all deaths in low income countries of South Asia and sub-Saharan Africa and 40.4 percent of all disability adjusted life years lost according to the World Health Organization. Moreover, it has been noted that deaths from key cardiovascular diseases, cancers, diabetes and injuries appear to be occurring at increasingly younger ages in many developing nations. In a recent study of four developing countries with large populations, Leeder et al. (2004) noted that a significant proportion of all cardiovascular deaths occurred in the 35-64 years age-group, very much considered a part of the work force, under any definition. Injuries and injury-related deaths are common among younger populations in developing countries (Nantulya and Reich 2002; Kopits and Cropper 2003).

Stemming perhaps from concerns about the world-wide HIV/AIDS epidemic, there is a voluminous literature examining the impacts of HIV on individual and national economic outcomes in developing countries (Over 1992; MacDonald and Roberts 2006; Mahal 2004; Young 2005). There is also a large literature on the economic impacts of tuberculosis and malaria, two other major killers in developing countries (Bloom et al. 1996; Gallup and Sachs 2001; Russell 2004). In contrast to the prominence accorded to existing work on the impact of infectious disease morbidity and mortality on economic outcomes, the literature on the economic impact of non-communicable conditions in developing countries is less visible. This is partly a consequence of the fact that in many developing countries, including India, there is a dearth of research on the economic impact of ill health, be it related to HIV/AIDS or any other. Indeed, a recent review of the Indian literature on the economic implications of disease found only a few analyses, related to HIV/AIDS and tuberculosis that could be construed as rigorous (Mahal 2005). However, this lack of attention to non-communicable conditions is also likely a consequence of the perception, and one not necessarily valid for developing countries, that such conditions relate to mainly older age groups that are typically less economically productive (Leeder et al. 2004).

It is not obvious that non-communicable conditions, even if confined to older ages, would have negligible effects on economic outcomes. This is clearly not the case for households, an issue that we revisit in Chapter 2. In fact, one can make a strong case

that aggregate economic outcomes and non-communicable health conditions, even if confined to older age groups, are closely linked. For instance, there are the economic implications of time spent as care-givers by young adults. Also, aggregate economic outcomes associated with disease are not simply a function of the (lower) number of younger labor units available. Older individuals likely enjoy a greater stock of firm-specific capital and have longer years in the work force that raise their productivity. Moreover, the higher expenditures typically required for treating non-communicable conditions would have implications for savings habits and human capital accumulation at younger ages, depending on the nature of insurance/social safety nets available. In the absence of social protection mechanisms (whether social insurance or subsidized public provision), individuals might have to save more for financing NCD treatment in older ages, or alternatively invest more in children (by raising fertility for instance), who could care for them in their old age and finance their treatment. In these circumstances, both physical capital and human capital could potentially increase. Of course, the reverse would hold if the governments funded social insurance and/or subsidized public health services in pay-as-you-go systems.

This report contributes to the literature on the economic implications of NCDs in developing countries by focusing on the case of India. First, we examine available evidence on the economic impact of NCDs. Second, we present new estimates of impact of NCDs, both on household economic well being as well as on aggregate economic outcomes. India is a worthwhile case to study for many reasons, beginning with the large numbers involved. In 2004, an estimated 8.1 million Indians died from all causes. Based on WHO data on the distribution of deaths by cause, estimated deaths from non-communicable conditions (including injuries) amounted roughly to 4.8 million, or about 59.4 percent of all-cause deaths in the year. Moreover, about 24 percent of these deaths from non-communicable conditions occurred in the 35-64 age-group as per data on medically certified deaths from hospitals located in urban areas of India (Registrar General of India 2007). Available data also indicate that 34 percent of all injury-related deaths occurred among individuals in the 35-64 year age group (Registrar General of India 2007). India's population is also ageing over time, an issue of concern given the higher incidence of NCDs in older age groups (Bloom et al. 2007). All of these developments are occurring in a setting where health expenditures are growing rapidly, led by an unregulated private sector, and health insurance and pensions are limited. These financial concerns are further exacerbated by the emerging evidence that the India's poor are at heightened risk of acquiring NCDs owing to high rates of smoking and tobacco use, occupational risks and residential living conditions (e.g., indoor pollution).

In the remainder of this chapter we review existing work on the economic impact of NCDs in India. The review is used to highlight the major gaps in coverage, data and methodology that exist in the Indian literature on the economics of NCDs and lay out the case for generating new estimates for the economic impact of NCDs in India that we construct in this report.

1.2. Economic Implications of Non-Communicable Diseases in India: The Evidence

We begin with a working definition of "non-communicable" health conditions. As used in the burden of disease statistics presented by the World Health Organization, non-communicable diseases include conditions such as CVD, cancers, diabetes, chronic obstructive pulmonary disease (COPD), asthma, neuro-psychiatric conditions (e.g., mental disorders, epilepsy, Alzheimer's), skin and musculoskeletal conditions (e.g., arthritis), congenital anomalies, oral conditions, eye conditions, skin diseases, diseases of the digestive systems (e.g., peptic ulcer) and genitourinary conditions (prostate disorders, nephritis). Accidents and injuries are considered as a category separate from NCDs (World Health Organization (WHO) 2004). These "burden of disease" categories are fairly easily matched to the formal ICD-10 classification of heath conditions (WHO 2007), and to the medical certification system of causes of deaths in India, given its basis in the ICD-10 system (Registrar General of India 2007).

A recent report of the WHO, however, refers to non-communicable conditions as "…major chronic diseases and their behavioral risk factors" (Yach and Hawkes, 2004, p 5). This definition excluded, among other health conditions, mental illness. While such a definition is "practical" in the sense that it helps focus attention on the most important sources of mortality and morbidity in NCDs and their underlying drivers, it is at once a narrower and broader definition than we are interested in. Narrower, because it omits mental illness which is a major health challenge, and broader because of its focus on behavioral risk factors – presumably including smoking, alcohol intake, obesity and so forth, which are not usually included in standard disease classifications.

We followed closely the NCD classification adopted in the burden of disease analysis, albeit with two modifications. We included injuries in our definition of non-communicable diseases because these account for nearly 10 percent of all deaths in India; or 16 percent of all deaths not classified under communicable and/or maternal and child health conditions (WHO 2004). To address the concern that injuries are not included in any standard definition of NCDs, we present our results on the economic impacts of NCDs for two cases: one where injuries were included in the definition of NCDs, another where NCDs were so defined as to exclude injuries. We *excluded* congenital anomalies since the datasets we used provided very limited information on such conditions. This category, along with "unclassified conditions" and communicable, maternal & child health conditions will henceforth be referred to as "non-NCDs" for our purposes.

Evidence on the Economic Impact of NCDs in India

Cardiovascular Disease (CVD)

We begin with analyses of the economic impact of CVD. Gupta et al. (2006) estimated the economic burden of CVD in the Indian state of Kerala, indicating that this could amount to as much as 20 percent of its state domestic product. The study used estimates of CVD prevalence in the Kerala population to estimate the total number of

CVD cases in the state. It assumed that 25 percent of all deaths in the 25-70 year age-group to be due to CVD (Gupta et al. 2006, p.38). For estimating (direct) health care spending per CVD case, Gupta et al. relied on insurance claims data in a single firm, plus drug spending incurred by that firm (and its employees). They multiplied these costs by estimates of the absolute number of CVD cases (dead or not) to get at the direct costs. Indirect costs were estimated by multiplying the total number of cases by an estimate of the days lost per case (based again on data from a single firm), and an estimate of state per capita income (converted to its equivalent daily income). Indirect costs of dead individuals were estimated by assuming that on average, a CVD death result in a loss of 10 years of work and using the state per capita income, appropriately discounted, and allowing for unemployment.

The Gupta et al. (2006) analysis was original in its use of insurance claims data to estimate CVD costs in the Indian context, and in its careful assessment of available local evidence on CVD prevalence. Similar approaches could presumably be used for analyses for employees of large enterprises such as the Indian Railways, members of the armed forces and elsewhere. At the same time, there are a number of areas where the methodology used in the paper could be improved upon. Specifically, their findings on the direct costs of CVD for the entire state of Kerala were based on the sample of employees of a single firm, which appears problematic. Moreover, the authors allocated to each individual with CVD the average income for the state, which may not be a valid assumption, if there is an economic gradient associated with the risks of acquiring CVD. Finally, they assumed that each individual who died of CVD lost the same number of years (10) of productive work – assumed to die at 50 years and retiring at 60 years. Again this may not be entirely appropriate, both because retirement ages are not fixed, especially in the unorganized sector (the bulk of the employed work force in India), and also because a more careful analysis would proceed with age-specific death rates from CVD.

Another analysis of the economic impacts of CVD on India was undertaken by Leeder et al. (2004) in the context of a multi-country study of the impacts of CVD in Brazil, India, China, Russia and South Africa. This study used information on death rates from CVD from WHO mortality statistics. The authors combined population projections (by age and sex) with disease-specific death rates to predict CVD deaths (by age) over several decades into the future; and estimated "productive life years lost" from CVD-related mortality as the difference between 65 years (their assumed age of retirement) and the mid-point of the age category where a CVD death occurred. Similar to the approach of Gupta et al. (2006) the study assumed *forgone* annual income per CVD death as equivalent to the average industrial wage for urban residents and half the wage for rural residents, for each person dying of CVD. For individuals aged between 35-64 years the authors estimated the total "payroll" losses to be in the region of US$200 million. In an effort to assess the impact of disability (and not just death) they used the WHO burden of disease data on DALYs lost on account of CVD, in conjunction with an estimate of US$1,000 per DALY lost to arrive at CVD-related losses of US$30 billion per year (Leeder et al. 2004, p.48). This study has many of the same weaknesses as in the Gupta et al. (2006) analysis, although it seeks to address the issue of differential incomes across

individuals by distinguishing between rural and urban CVD deaths and adjusting for differences in labor force participation rates of men and women in India. Another problem with these estimates (as also those of the Gupta et al. study) is the underlying assumption that the workers affected by CVD cannot be replaced (no unemployment), which likely biases the estimates of payroll losses due to CVD upwards. The study did not directly estimate medical care costs associated with treating CVD.

A third set of analyses on CVD in India is by Popkin et al. (2001), who estimated the combined costs of healthcare as well as lost incomes from ill-health for cancers, diabetes and CVD using a mix of data from the 1995-96 health care utilization and expenditure survey of the National Sample Survey Organization (NSSO) and estimates of the cost of public health care services from Mahal et al. (2002). The study points to the substantial healthcare costs and lost productivity associated with these health conditions. For instance, healthcare costs (both out-of-pocket and government spending) associated with just these three conditions amounted to US$13.9 billion in 1995-96, or about 0.4 percent of GDP. Using a standard human capital methodology (and a lost work time of 10 years on account of death) and per capita expenditure/income estimates from sample surveys, they estimated lost incomes in 1995-96 to be roughly US$2.25 billion (Popkin et al. 2001, Table 2). Apart from its results being somewhat out of date now, this study adopted a rather simplistic view of the problem of measuring aggregate income (or production) losses associated with CVD (see, for instance, Abegunde 2007). It also underplayed the significance of lost output due to morbidity associated with CVD.

Recently, Abegunde et al. (2007) estimated the combined impact of major chronic conditions (CVD, diabetes, cancers and respiratory conditions) on current and future national output. Their analysis improved upon earlier work on the aggregate economic impacts of chronic disease by focusing directly on impacts on GDP, via the device of an aggregate production function (Cuddington 1993). They compared GDP levels under business-as-usual scenarios with GDP levels that could be achieved if deaths from chronic disease were to be eliminated completely. Their analysis for India relied on mortality (by cause) statistics for rural and urban areas from the Registrar General of India and projections made by Mathers and Loncar (2006). They find the loss in GDP due to chronic conditions to be of the order of US$1.35 billion in 2006 and amounting cumulatively to a total of US$17 billion by the year 2015.

Although certainly a major improvement over existing work, the economic analyses in Abegunde et al. (2007) are somewhat rudimentary compared to the state-of-the-art modeling techniques now available. Unlike much of modern empirical work, their analysis does not consider the *quality* of labor lost on account of deaths – be in terms of education, experience or health. Secondly, their analysis excludes any consideration for days lost on account of illness and disability for individuals who did not die from these health conditions, which could potentially be quite substantial. They also did not clarify how they obtained information on health expenditures of chronic diseases in India. In a previous paper that appears to be the source of the results reported in Abegunde et al., there is a reference to national health accounts as one of the sources of this information (Abegunde and Stanciole 2006). However, a careful examination of the national health

accounts for India reveals no such information, at least in their published form (Mahal et al. 2005).

We understand that some recent studies on the economic impact of CVD have also been undertaken by the Public Health Foundation of India. We were unable to access these studies which appear not to be in the public domain as of now.

Diabetes

Apart from the analyses by Abegunde et al. (2007) and Popkin et al. (2001), which did not provide separate estimates for different chronic conditions, there is only one other major study that we are aware of that estimated the economic impact of diabetes on aggregate economic outcomes in India. The Economist Intelligence Unit (EIU 2007) specifically estimated the economic costs of the diabetes epidemic in 4 countries, including India. It did so by assessing direct medical care costs, lost productivity as a result of mortality, morbidity and disability associated with diabetes. Their estimates of the costs for India are about 2.1 percent of GDP, about 1.2 percent of GDP in the USA, and 0.4 percent and 0.6 percent of the GDP in UK and Denmark, respectively.

The approach adopted by the EIU team was essentially a version of the cost-of-illness methodology. For direct healthcare costs, they proceeded as follows. Firstly, the number of diabetes patients was estimated, using population and diabetes prevalence data for India. Data on prevalence (by age) was obtained from 3rd edition of the International Diabetes Federation (2007) which, in turn, is based on a number of community level surveys in India. This was multiplied by an estimate of the medical care costs per diabetes patient (the sum of the cost of hospitalization, outpatient care and drug costs). Estimates of per patient costs were based on the work of Rayappa et al. (1999). For assessing lost income on account of diabetes-related mortality, they used the "human capital" method, while allowing for growth in real wages over-time, and labor force participation rates. Estimates of real wages per worker were based on EIU's own models that the study did not describe fully. The EIU study also used life tables to assess survival in the event that the diabetic individuals in question did not die, assuming that the mortality risks from other conditions were statistically independent of dying from diabetes-related conditions. These were used to estimate income losses due to diabetes-related morbidity. Unfortunately the approach followed by the authors seemed rather ad hoc. The authors used data from the American Diabetes Association for American patients to guess at the extra number of days lost by survivors in the countries studied – hospital days, leave (about 11 days for men, and 9 days for women) in their set of 4 countries – which seems unrealistic The number of lost days were multiplied by estimated per-worker wages to get at the income losses due to morbidity.

In addition to the above, there are a number of small-scale studies of the costs of treating diabetes in India, which can serve can useful indicators of household economic impacts. Shobhana et al. (2000) estimated the out-of-pocket spending by a sample of about 600 diabetic in-patients in Chennai (Tamil Nadu) hospitals. They estimate the

average expenditure during hospitalization to be about INR 5,300. Diabetic patients with a longer history of diabetes (5 years or more) spent 70 percent more during their hospitalization than those with a recent history of diabetes. Shobhana et al. (2002) focused on out of pocket expenditures incurred on 209 diabetes Type 1 cases in South India. They found expenses ranging from INR 2,050 to INR 87,150, with a median of INR 14,000. Not surprisingly, they found that poor families were spending much greater proportions of their income, some as much as 60 percent of their household income, on the care of their diabetic household members. Finally Grover, et al., (2005) assessed the costs of treatment in a sample of 50 diabetes patients in a North Indian hospital as roughly INR 10,000, and another INR 4000 as losses on account of morbidity. Although the sample sizes are small, with a per capita annual income of INR 41,000 in 2004, these analyses point to significant financial implications of diabetes in India.

Respiratory Conditions

Two recent studies (Murthy and Sastry 2005a, b), along with Abegunde et al. (2007) provide the only available economic analyses of the impact of chronic obstructive pulmonary disease (chronic bronchitis and emphysema), and asthma in India. As part of their work for the Indian National Commission on Macroeconomics and Health, Murthy and Sastry (2005a) estimated the direct and indirect costs of treatment of COPD. Focusing on individuals over the age of 30 years, and based on a number of small community-level studies in India, they first estimated the total number of *chronic* COPD cases. The numbers were estimated separately for men and women, and for rural and urban areas. They used data from a study in Greece to divide up the chronic COPD cases in India into mild, moderate and severe categories. All severe cases were assumed to be hospitalized once (per year) and all three categories were assumed to follow the same medication regimen, excluding the hospitalization phase. They used a large scale community study from Hyderabad district (Andhra Pradesh) to estimate the spending on hospitalization, outpatient services and medication. According to their estimates, treatment costs for a patient with severe COPD was nearly INR 33,000 in 2001.

Assuming no change in prevalence rates over time, and no change in urbanization patterns (urban areas had double the COPD prevalence rates than rural areas) they projected future populations with COPD. These projections were combined with simple forecasts of the future costs of treating various cases (mild, moderate, and severe) of COPD to arrive at the aggregate national health care costs of COPD in Murthy and Sastry (2005a) – of INR 169 billion in 2001, and INR 483 billion in 2016.

Separately, Murthy and Sastry (2005b) used out of pocket expenditures incurred by asthma patients to get a set of "cost" estimates for asthma from their Hyderabad study. Unlike their work on COPD where estimates of prevalence were constructed from a meta-analysis of a large number of small sample studies, in the case of asthma they obtained information on population prevalence from the 2nd National Family and Health Survey of 1998-99 for India. Asthma cases were then classified into acute and chronic cases based on their study for Hyderabad. Based also on the Hyderabad study they estimated it would cost about INR 16,200 for moderate to severe cases of asthma, and

INR 436 for mild asthma; and an additional INR 4,379 for a single hospitalization stay. Using an essentially similar analysis to that for the COPD, they concluded that aggregate healthcare costs of asthma would have been in the order of INR 49.8 billion in 2001, and projected these costs to rise to INR135.3 billion in 2016.

These two studies are remarkable in the careful attention that was paid to prevalence data on COPD and asthma in India. However, because the data for Hyderabad district (which surrounds the provincial capital) is likely to overstate treatment and expenditure rates, the studies likely overestimated the healthcare costs of COPD and asthma for India. No estimates of public subsidies in the provision of care, or lost labor income of households' are available in these analyses. The only other study relevant to assessing the impact of COPD and asthma on aggregate economic outcomes in India is by Abegunde et al. (2007) who estimate the impact of mortality arising for a set of chronic conditions (including COPD and asthma) on GDP. This work has already been referred to above and does not provide separate estimates for COPD and/or asthma.

Cancers

There does not appear to be much information available on the economic impact of cancers in India with the exception of two studies that have been noted previously. Abegunde et al (2007) included cancer-related deaths in their work assessing the aggregate economic impact of mortality from chronic diseases on GDP. Popkin et al. (2001) included cancers in their assessment of the impact of diet-related health conditions in terms of health spending and on income losses experienced by households. These apart, we are unaware of economic impact of cancers on individuals, households and the economy as a whole.

A reading of the popular press does, however, reflect concerns about economic impacts and some information of the magnitudes involved. For instance, in an article in a leading Indian newspaper (*The Hindu*), Hiddleston (2008) points to the significant economic impacts of cancer on poor households. She cites estimates by the head of major government-run specialty hospital in Tamil Nadu indicating that the hospital spent INR12-16,000 on each of its inpatients for which it had provided treatment free of cost owing to their low-income status. In the same news article, representatives of a charity hospital estimated spending substantially higher amounts, in the range of INR 200,000 on some patients, or more. Also in the *Hindu,* Charan (2007) cites experts that private corporate hospitals could charge as much as INR 50,000 for a cancer-related surgery, with chemotherapy also costing as much per cycle. One oncologist also stated that individuals often discontinued treatment owing to cost. The consequence in this latter case could be higher income losses compared to the alternative of effective treatment having been obtained, particularly if the cancer patient were someone who was employed.

Injuries

The final set of health conditions for which we have some evidence on the economic impacts is available for India is injuries. We were able to access results from three types of analyses – one that estimated costs of injury treatment (and associated impacts) on households using a nationally representative survey, and two additional analyses of household impacts of *traffic* injuries. Gururaj (2005) cites yet another study, by Mohan (2004) that estimated large aggregate economic effects of road traffic injuries, amounting to some 3 percent of India's GDP. We were unable, however, to access the paper or the methodology used to derive these conclusions.

Gumber (1995) used data from the National Sample Survey round of 1986-87 to estimate the cost of treating injuries in public and private hospitals in India in five Indian states – Gujarat, Maharashtra, Tamil Nadu, Uttar Pradesh and West Bengal. He found the average out of pocket payment for hospitalization for injuries to range from INR 621 in West Bengal and INR 6,034 in Gujarat. Public hospitals were somewhat cheaper with spending on injury-related medical care ranging from INR 324 to INR 1,740 in the two states. Among households with an injured member, expenditures averaged around 80 percent of the household monthly income. Gumber also noted that many (minor) injuries go unreported, so one might conclude that these estimates correspond to the more severe injury cases and comprise a lower bound of the actual economic impact.

Thomas et al. (2004) report the results of a large household survey in Bangalore in the Indian state of Karnataka that focused on injuries. They found that households that had members who sustained injuries reported an average of INR 18,000 in health spending, declines in earnings, increase incidence in debt, and limited access to financial support from other entities. Another analysis of the economic impact of traffic injuries on households was recently conducted by Mohanan (2008). He notes that the likely two-way relationship between ill health and incomes makes assessments of the causal implications running from health to household economic outcomes difficult. Using data from traffic injuries in Karnataka (which he argued constituted *exogenous* health shocks, conditional on matching across key pre-determined variables) he compared the economic outcomes for households with injured members with comparable households that did not have any injured members. He found that households were unable to smooth consumption fully, and experienced declines in educational spending. Households with members who sustained injuries relied to a much greater extent on debt financing than their counterparts without injuries.

1.3. Key Gaps and Lessons from the International Literature

Clearly, there exists some research relating to the economic impacts of NCDs in India relating to CVD, diabetes, injuries and respiratory conditions. However, it should also be apparent that there are several areas where existing analyses could be improved upon and gaps that could be filled.

Firstly, not all NCDs are covered by the existing Indian literature on the economic impacts of disease and some major conditions, such as cancer, appear to be inadequately addressed, as also are neurological and psychiatric disorders. Together these two conditions accounted for nearly 11 percent of the worldwide disease burden. Depression alone resulted in 3.4 percent of the worldwide burden of disease (Hyman *et al.* 2006). As studies elsewhere have shown, depression can result in quite significant losses in productivity and health care costs under the cost of illness method (Simon *et al*. 2002). The potential economic impact estimates for cancer available in the international literature also points to a substantial gap in this area for India. Estimates in a National Institutes of Health (NIH) report indicate that cancer cost the US nearly US$210 billion in 2005 – US$74 billion in direct healthcare costs and US$135.9 billion in productivity losses. Estimates of productivity losses were based on the human capital approach (discounted lifetime earning) – based on age-specific mortality and morbidity and earnings for each group, and expected productivity increases, and discount rate of 3 percent (NIH 2005). Health Canada (2002) estimated the costs of cancer in 1998 using a standard cost of illness approach – direct health care costs; value of activity days lost due to disability (morbidity costs) and value of life lost due to mortality – human capital approach. Total costs were C$14.3 billion, of which C$2.5 billion were direct costs and C$11.8 billion were indirect costs. Of the indirect costs, C$1.3 billion were due to disability.

Secondly, existing analyses on India tend to downplay the role of co-morbidity and of competing risks in assessing the economic impacts of NCDs. For instance, one would expect persons with diabetes to be more likely to experience CVD, all else the same. Narayan et al. (2006) note that mortality risk is substantially higher for those with diabetes than for those without; and that a majority of deaths among persons with diabetes, at least in rich countries, are due to CVD. Similarly, depression can go hand in hand with diabetes and CVD (Moussavi et al. 2007), and smoking has been associated with an increase in both respiratory deaths and CVD deaths (Gajalakshmi et al. 2003). Many of the underlying factors that increase the risk of heart disease also increase the risk of developing cancers (Honore and Lleras-Muney, Forthcoming). The presence of co-morbidities – the existence of one condition is associated with the increased likelihood of acquiring another - implies that economic impacts allocated to a specific disease ought to involve some sort of *netting out* exercise (or alternately, consolidation), depending on the health condition involved. Similarly, mortality risks from two competing (say on account of some common cause) conditions imply that standard methods used to allocate costs allocated to a disease (based on the identified cause of death or illness) ought to be corrected because of their implicit assumption of statistical independence. As one example, a decline in communicable conditions increases the likelihood of acquiring a non-communicable condition. The obvious implication is that we need either to think of diseases falling under NCD as one consolidated sum, or account for this fact in our calculation of economic impacts of specific diseases. Most of the existing analyses carried out for India ignore allocative issues associated with co-morbidity and competing risks.

By including cancers, CVD and diabetes under one all encompassing category, Abegunde et al. (2007) got around the problem of problem of addressing co-morbidities and competing risks somewhat, but other potentially more attractive ways of addressing these methodological challenges exist. The international literature has some good examples of how one might go about estimating economic impacts in the light of such concerns. For instance, the American Diabetes Association's (ADA) (2007) calculation of the health care costs of diabetes takes careful account of co-morbidities associated with diabetes, by assigning to diabetes, "extra" costs associated with other health conditions (i.e., costs that would not have been incurred had the person been without diabetes). The ADA also sought to address the question of competing risks by controlling for age- and sex- prior to comparing the costs of people with and without diabetes. Kessler et al. (2008, see also Insel 2008) estimated the economic costs of mental illness in the United States. Their analysis was based on a cross-sectional survey of 5,000 individuals (probability weighted) that included information on mental disorders, earnings in the preceding 12 months (excluding unearned income) , age, gender, education, marital status, occupation, and so forth. Similar to the ADA approach, Kessler et al. estimated a relationship between earnings and a collection of socio-demographic characteristics, plus indicators of mental health. Their estimation led to two sets of "fitted" estimates: one for earnings given the socioeconomic and demographic characteristics; and one if no one had mental ill health. The difference (averaged across all individuals with mental health problems) was taken as the average difference in earnings due to mental ill health. Given population prevalence of mental ill health, this was used to assess the difference in earnings for the population as whole due to mental disease. They estimated the societal-level effect to be US$193.2 billion. The share of women's costs was US$62 billion, which they attributed to their not valuing the opportunity cost of women's work. Kessler et al. showed that earnings were lower by nearly 40 percent for men with serious mental illness (in the previous 12 months) compared to their mental illness free counterparts.

Thirdly, existing analyses for India exclude consideration of subsidies on health services, whether provided by the public sector or private enterprises (with the possible exception of Abegunde et al. 2007). Most tend to focus on out of pocket spending by households. It might appear first sight that, if our interest is in the identification of economic impacts on individuals and households the exclusion of such subsidies is not only correct but is, in fact, a necessity. That is a valid assertion, but only up to a point. Information on public subsidies is necessary if we wish to go beyond simply estimating household economic impacts to understanding the factors that drive them. Moreover, information on public subsidies is an essential input if we wish to estimate the aggregate economic outcomes of NCDs. To see this, observe that if health expenditures result in lower savings and investment (whether by private entities or the government) they will adversely impact aggregate economic outcomes (e.g., Cuddington 1993).

Fourthly, with the exception of Abegunde et al. (2007) no effort is made in the existing economics literature to use existing theoretical and/or empirical models of economic growth. This omission typically leads to exaggerated claims of income losses with a myriad of diseases, usually when the authors follow a cost-of-illness methodology

to infer aggregate economic outcomes. Even when a cost of illness approach is used to estimate aggregate income losses, the typical analysis for India relies on assumptions that are unrealistic. These assumptions include taking labor market conditions (see Chapter 4 for more on this) as unchanged from the type a person falls sick/dies to their actual retirement/death in the absence of the disease in question. Related to this point, most of the cost-of-illness literature for India does not attempt to identify the actual incomes of individual affected workers/households, resorting instead to hand-waving assumptions that worker incomes equal the average for the country as a whole.

Fifthly, with the exception of Mohanan (2008) who studied the impact of traffic accident injuries on households, existing analyses of the economic impacts of NCD on households in India do not go much beyond estimating out of pocket health care expenses. Much of the existing research does not inquire, for example, into the impact of morbidity and mortality on the household allocation of labor within domestic work, on children's schooling, on supply of labor, on the likelihood of falling into poverty, and so forth (for examples from the international literature, (Basu et al. 1997; Doorslaer et al. 2006; Gertler and Gruber 2002; Yamane and Jayne 2004).

Finally, existing work for India does not permit an easy "adding up" of estimates of the economic impacts of different categories of NCDs. This stems partly from the different methods employed in each study, ranging from cost-of-illness analyses of varying rigor to standard growth models. Some studies neglected the effects of mortality (e.g., Murthy and Sastry) on economic outcomes but others did not (Leeder et al. 2004; Gupta et al. 2006, Abegunde et al. 2007). Others downplayed economic effects working through morbidity, focusing instead on deaths as in the estimates of Abegunde et al. (2007). However, an important element of the story is the differences in the type of data used for individual studies. Some analyses, such as those of Murthy and Sastry (2005a, b) and Gupta et al. (2006) used information from a variety of small sample surveys to arrive at an acceptable prevalence rate for a disease. Others relied on a single small sample to arrive at estimates of aggregate prevalence. Other studies relied on data from household surveys. The net result is a series of numbers on morbidity and mortality from different health conditions that lack consistency and hamper efforts to arrive at a combined estimate of the impact of NCDs in India.

1.4. Goals for the Report

In the remainder of this report we have *two* main goals. The first is to generate a set of estimates for the economic impact of NCDs that build on the existing work and are closer to the 'state of the art' than the literature that currently exists on this subject in India. The economic impact estimates that we are interested are intended to highlight not just the aggregate (economy-wide) impact of NCDs – such as GDP per capita – but also in terms of impacts on households, whether in terms of poverty, catastrophic expenses or the burden placed on members of different income groups. We will also seek to inquire about the extent to which government provision and financing of health care in India is likely to have influenced these outcomes. The second goal of this report is to generate

insights about the appropriate policies to follow with regard to NCDs in India and other developing countries that find themselves in a similar situation.

To this end, the report devotes the next chapter (Chapter 2) to a formal definition of the economic impacts that we are concerned about and the methodology we intend to follow to estimate these impacts. We assess existing data on NCDs in light of the data requirements necessitated by the methods we intend to use, and describe the data that we do intend to use. Chapters 3 to 6 provide our estimates of the economic impacts of NCDs at the household and national levels. Chapter 7, the concluding section, presents the research and policy implications of these results.

CHAPTER 2. THE ECONOMIC IMPACT OF NCDS IN INDIA: METHODOLOGY AND DATA SOURCES

2.1. Methodology

In estimating the economic impacts of NCDs, we will be concerned with impacts at the level of the household as well as at the level of the economy. The general approach that we will adopt in assessing these impacts is described in the sub-sections that follow. This chapter can be skipped by individuals who wish to proceed to the results and conclusions in Chapters 3 to 7.

2.1.1. The "burden" of Health Spending

One way of assessing the economic impacts of NCDs is to estimate the associated *costs of health care* – the so-called 'direct costs' of ill health. As we shall see in Chapter 3, our results point to a significant economic "burden" of the direct costs from providing medical care to treat NCDs in India, whether considered in absolute Rupee terms, or as a proportion of GDP. This finding is also supported by several of the studies that we cited in Chapter 1.

It is important to appreciate, however, that 'direct costs' of NCDs do not necessarily indicate the economic burden that NCDs impose on households. This is firstly due to the fact that households are not the only party that pays for the costs of health care. Governments, insurance agencies and firms typically account for a significant portion of this amount. Secondly, households with sick members may incur lost wages either because the sick members are unable to work, or that care-givers have to give up productive labor time, neither of which is included in the calculation of direct costs. Future incomes may also be foregone if children are pulled out of school and these are typically also not included in direct cost calculations. Some of these elements of the economic burden are captured in cost of illness studies by the estimation of the 'indirect costs' of illness, although typically these studies do not consider factors such as social security, or unemployment/disability insurance that could reduce these costs. Nor do such studies consider the impact of an adult member's health on child schooling/health.

It is also not obvious that health expenditures are necessarily a "bad" that needs to be *deducted* from some household (or social) measure of economic well being. Indeed, the level of health spending (and its growth) can be directly related to improved health outcomes, in and of itself, a good thing (Doyle 2007, Jones 2002). To see this, consider Figure 2.1 which describes on the X axis, a single consumption good (which can also be used for purchasing health care) available to a society (or to a household). The Y-axis describes the average health attainment of this society. Let the total amount of the consumption goods available to this society be denoted by C^*. The curve AB describes how health attainment improves with the consumption of health services. To understand how this works, if the amount of health spending is zero (i.e., if all spending is diverted to

non-healthcare activities) the society attains a non-health consumption level of B (call this the GDP, or household income). On the other hand, if all income is devoted to health care, the society ends up at health level A. Presumably, something intermediate is chosen, so that h* is health attainment, and C* the consumption (of non-health goods) in this society. The expenditure on health care then is the segment C^*B.

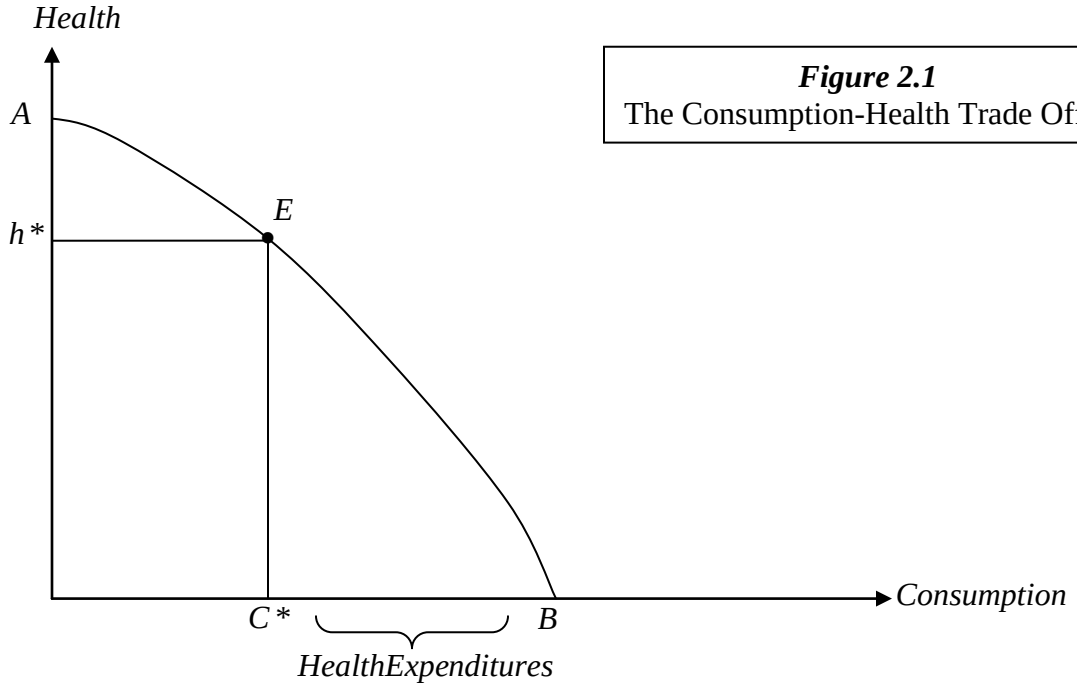

Figure 2.1
The Consumption-Health Trade Off

There is nothing in the above set-up that would imply that health spending is bad, *per se*. Moreover, consider a *competing risks* formulation, where there are a large number of competing sources of morbidity (and mortality). Here, the emergence of effective prevention efforts for one disease may lead to increased household spending on other sources of morbidity that now acquire greater priority (e.g., Dow, Philipson and Sala-i-Martin 1999) for the society or household in question. That permits the possibility that observed health spending may not change by much (and may even increase) with improvements in health outcomes. Related to this point, increased investments in technological innovations in newly prioritized health conditions can also explain higher health expenditures (Jones 2002). In Figure 2.2 we illustrate this as a movement of health technology from AB to BC, and a new point chosen by society at $\overline{E}$, where health spending is even greater than at E. This argument would be even stronger if there is a positive feedback loop from good health to income, which could now increase beyond B. Empirical research in support of the causality running in the direction from health improvements to national income can be found in Bloom et al. (2004), and the evidence at the individual and household levels is even more easy to find (Strauss and Thomas 1998).

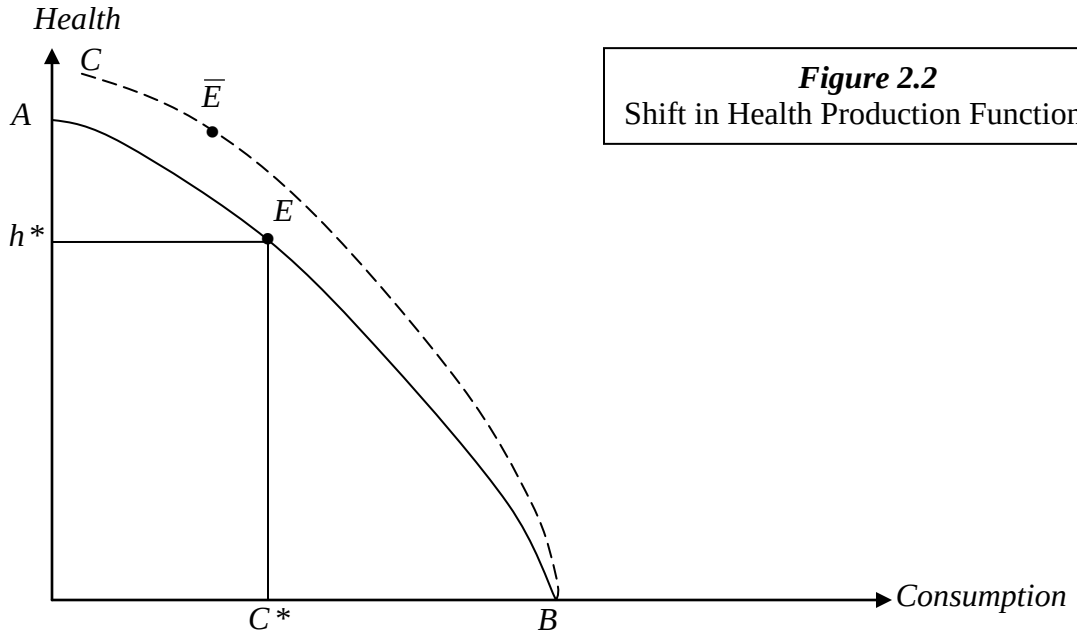

Figure 2.2
Shift in Health Production Function

The preceding analysis suggests that in assessing the 'economic burden' of health spending, we should also consider any relevant health gains (or lack thereof) that might have been achieved by such spending. At the very least, we ought also to include a measure of income loss/gain to make the analyses comparable across households who may make different choices about health care (and spending) when confronted with an episode of ill health. Interviews that one of the authors carried out with slum dwellers in Ahmedabad (India) underline this point. Several of the respondents pointed out that the major reason they incurred large amounts of health spending on seemingly trivial health problems was to avoid missing work and losing jobs in an informal sector characterized by a lack of unemployment insurance and paid medical leave.

There are important exceptions to the arguments made above. The first is the issue of *efficiency*. Going back to Figure 2.1, if it so turns out that health spending by society at a level of health attainment given by h*, exceeds C^*B, then we do have an economically inefficient outcome. Indeed, if we assume in the extreme that h* can be attained by purely preventive behavior at zero cost, one could say that all of the health expenditure C^*B is excessive and could have been used for other purposes, including more consumption of services and goods other than health care related. The same argument would hold if the treatments that health expenditures support are ineffective in improving health outcomes. In this sense, health expenditures constitute a negative economic impact on social outcomes.

Concern with the cost of treating a disease from the point of view of households/society may arise from at least two other considerations. If the members of a society are highly averse to financial risk, then the risk of incurring high out of pocket expenses in the event of illness can potentially impose very large welfare costs on such individuals, for which providing for some form of insurance may be desirable. Also, if

there are substantial socioeconomic inequalities in society, then high levels of out of pocket expenses on illness can be considered "unfair" even for individuals who are "neutral" to risk if these costs fall disproportionately upon backward social groups. These concerns (along with income losses linked to ill health) form the bases for analyses that look at 'consumption smoothing' by households in response to illness, the impacts of ill-health on poverty and catastrophic levels of health spending by households (Doorslaer et al. 2006; Gertler and Gruber 2002; Krishna 2007; Xu et al. 2003).

In Chapter 3 we assess firstly the *direct costs* of NCDs in India. We use information on direct costs to infer the economic burden of NCDs on Indian households by describing how these costs are financed and how the economic burden on households varies by income class. Because formal insurance is limited and firms pay for only a small portion of total health spending in India (Mahal et al. 2005), we focus primarily on the distribution of health care costs between the public sector and household out of pocket spending as a way to infer the burden of NCDs on households. We also inquire into the methods by which Indian households finance their out of pocket spending for NCDs. Analyses of the impact of NCDs on households' likelihood of incurring catastrophic spending and of falling into poverty were also undertaken along the lines of Doorslaer et al. (2006) and Xu et al (2003).

In Chapter 4 we estimate the second key component of the cost of illness associated with NCDs: namely the *income losses* to households associated with morbidity/disability and premature mortality from NCDs. Usually, the calculation of income losses relies on the *human capital* methodology, whereby the lost income for each dead/disabled/sick individual is calculated as the present value of their expected future stream of income, appropriately discounted, while allowing for growth in real wages over time, and the likelihood of unemployment and survival. Calculated in this way, these income losses (or 'indirect costs') could be considered a lower bound of the *combined* present and future income losses likely suffered by households that have members with NCDs (because we exclude, for instance, human capital losses due to reduced schooling for children in affected households).

The measure of income losses we use in this report is slightly different from the strict human capital measure of indirect costs described in the previous paragraph. Specifically, we estimated income losses associated with morbidity and/or death associated with NCDs for one year. In the framework of Figure 2.1, the *annualized* version of income loss can be thought of as an inward shift of the curve AB in any given year, because the point of maximum income (B) moves to the left. This measure is attractive because health care expenditures for chronic conditions (characteristic of many NCDs) are likely to be incurred in future years for the same individual. In this scenario, adding up health expenditures incurred in any one given year (direct costs) to the combined (discounted) income losses that occur over multiple periods due to premature deaths appears inconsistent. Constructing the annual estimate also helps us better address data limitations in India with regard to information on the likelihood of survival of sick patients with NCD, their future medical expenditures and hospital stays in estimating their cost of illness.

2.1.2. Aggregate Economic Impacts of NCDs

We shall estimate two types of aggregate impacts. First, we shall estimate output losses associated with NCDs to the economy as a whole. The human capital measure of indirect costs has been used in the literature to arrive at a measure of output losses to the economy as a whole (e.g., Rice 1966; Yang 1992). This method of estimating aggregate output losses is open to a number of important criticisms, however. For instance, it is difficult to justify the sum (across individuals) of the present discounted value of future income as lost national income. If the elasticity of labor supply is large at the existing wage rate, there may be no income loss at all because any losses in workers owing to disease would be quickly replaced. Even if one were to assume that any recent deaths from the work force are not readily replaceable by other workers (a highly doubtful assumption in a country such as India with large numbers of underemployed working age individuals) and hence results in net income loss in the short run, it is difficult to envisage that this loss continues into the future, up until the time the individual would have lived had they not contracted the fatal disease in question. Indeed, one would imagine that labor markets respond fairly rapidly to address such shortfalls, particularly for low skilled jobs. For skilled jobs, the period of adjustment might take a little longer, but probably not enough to justify using each individual's human capital measure as an indicator of loss to the national economy.

The economy may also respond in other ways, such as via reorganization of production processes that ameliorate the impact of any shortfalls in labor supply, including by changes in labor intensity of production processes. Moreover, health spending itself can impact current and future national incomes and its distribution. Rising health expenditures can, via a multiplier effect, contribute to rising national incomes, just as military spending does. One might also argue that this multiplier effect will be quite large given that healthcare is a highly labor intensive activity, particularly if owners of labor have higher propensities to consume than owners of other types of resources, such as land and capital. As against this, one could argue that rising health spending due to NCD (or communicable conditions) reflects a diversion of consumption spending to uses that do not add to the economy's productive capacity. Clearly, a more direct formulation that models the GDP loss (gain) associated with disease directly is desirable, if our interest is in aggregate losses to the economy.

In Chapter 5, we provide estimates of annual GDP losses associated with NCDs using results on the determinants of national income from the existing empirical literature that relies on standard models of economic growth. Here it is worth noting that estimates based on the use of theoretical models of economic growth (and their empirical counterparts) to simulate the adverse economic impacts of disease may be limited by an inadequate accounting of all of the channels (pathways) through which ill health may influence GDP (Bloom and Mahal 1997).

A second monetary measure of aggregate impacts that we shall be concerned with is the 'value of lives lost' on account of NCDs. Indeed, another interpretation of the

human capital measure of indirect costs of premature deaths is that it gives us a monetary measure of the value of life *lost* on account of NCDs. A more attractive measure in this regard, however, is the *"value of statistical lives"* lost on account of illness. This usually relies on empirical methods that help to identify the additional compensation that an individual needs to avoid small mortality risks (Viscusi and Aldy 2003). If V is the additional monetary compensation needed to face a "small" added risk of death of p, the value of a statistical life is $\frac{V}{p}$. Some authors also use the human capital method to assess the value of an individual's life, relying on economic theory that suggests estimates based on the human capital method constitute a lower bound to the monetary value of a statistical life. Both approaches lead to very large monetary estimates of "indirect costs", but experts using one or the other of these methods differ markedly in their emphasis on the interpretations of their respective findings. For instance, authors using the "value of a statistical life" approach tend to emphasize the losses to the aggregate of individual well being from the disease (Viscusi and Aldy 2003). Proponents of the human capital approach tend to emphasize income losses.

The value of life (or the willingness to pay) approach to assessing indirect costs due to disease is not without its problems. It has been argued by Broome (1985) that the money metric may not be an appropriate measure of the value of lives lost. Specifically, the monetary value of any life lost should be infinitely large since the value to any given person of their life is infinite. Broome objects to the measure of the value of statistical life as defined by $\frac{V}{p}$, since that is dependent on the person not *knowing for sure* whether they would die, even if it is known that they face some (small) risk of death. However, his point is that while this may be true of any single individual facing a small mortality risk, the society (or the planner) as a whole (enjoying the benefit of "large numbers") knows that some individuals would *surely* die. If Broome's argument is taken as valid and monetary measures are unsatisfactory, direct measures of the "quality of life years" lived (or lost) can be used. Prominent examples include Disability-Adjusted Life Years (DALY), Disability Free Life Expectancy (DFLE), numbers of deaths, and so forth.

In Chapter 5 we also estimate the value of statistical lives lost in India on account of NCDs using information from Viscusi and Aldy (2003) and data on incomes for India. We focus solely on mortality and not on the value of DALYs lost. Apart from the difficulty of getting systematic information on disabilities linked to disease in India, we would also face the challenge of linking NCD-associated disabilities with socio-economic and demographic characteristics. This would constitute a whole new project best addressed in a separate report.

2.1.3. Implications of Co-morbidity and Competing Risks for Assessing the Economic Burden of NCDs

There are well known weaknesses associated with the methods described above when it comes to estimating economic impacts, whether at the level of households, or national economies. Here we highlight one key problem – related to the existence of co-

morbidities and competing risks - which is addressed in estimates of economic impacts in Chapter 6 of this report. Specifically, if some health conditions (e.g., diabetes) are a risk factor for other health conditions (e.g., CVD), namely we have *co-morbidity*, economic impacts attributed to CVD are likely to be upwardly biased estimates of the impact of CVD, unless the added effects associated with diabetes are netted out. Similarly, and this is a point we referred to in Chapter 1, health care costs (or, for that matter, income losses) assigned to specific diseases are problematic if there are *competing risks* from other (non-NCD) health conditions. Specifically, in the presence of *statistically dependent* competing disease risks,[2] to attribute the income loss from any death/disability *fully* to the NCD identified as its immediate cause will result in biased estimates of the added cost, additional out of pocket expenses associated with a specific disease. This bias is likely to be magnified as we disaggregate economic/health care utilization impacts further by disease, since one would expect competing risks of death (from causes *other* than the disease in question) to increase in magnitude.

The methods adopted in Chapter 6 to estimate the economic impacts of selected NCDs and injuries attempt to address this problem. In the context of cross-sectional household survey data for India, we use a (propensity score) matching approach to address the potential bias that might result from not taking account of potentially *interdependent* competing risks when attributing direct health care expenses, and other economic impacts to NCD. For each individual with a specific NCD (in this chapter we use CVD, cancers and injuries), we find a control possessing similar observed pre-determined characteristics. Because individuals with NCD are likely to be a self-selected sample, competing risks for such individuals are likely to systematically differ from randomly selected survey participants. The propensity score matching approach that we use also addresses this selection effect by creating a control group of individuals from our random sample. We then assess the economic impacts – such as consumption spending and out of pocket spending on health - of acquiring NCD by comparing the outcome for each person with his, or her, matched control.

Our analysis goes beyond simply looking at utilization of health services, consumption expenditures and out of pocket spending. We also use the matching framework to assess impacts of NCDs on households' risk of falling into poverty and of incurring catastrophic spending.

2.2. Data

Data requirements for estimating the economic impacts of NCDs are described in the first sub-section. The later sub-sections focus on the quality of data available in India for this purpose.

[2]In circumstances where competing risks can be described by multinomial logit models or the Cox latent survivor model where the hazards are statistically independent, traditional methods of estimating direct and indirect costs suffice. However, this is not likely to be as common as its counterpart with dependent competing risks (Honore and Lleras-Muney 2006)

2.2.1. An Assessment of the Needs

The discussion in Chapter 1 as well as of the methodology that we propose to use to estimate of economic impacts of NCDs points to a number of key data requirements for carrying out effective analysis of the economic impacts of NCDs in India. These include firstly, the requirement that information on the prevalence of NCD-specific morbidity and mortality be available, preferably by age- and sex- and by rural and urban populations. This information is relevant both because the NCD prevalence is likely to vary by demographic categories (e.g., some ages are more at risk from asthma, COPD and cancers) and it is known that urban populations are currently more at risk from NCDs that India's rural populations (e.g., Leeder et al. 2004). Moreover, for the data to be useful in making inferences about economic impacts, be it at the national and regional levels, or for the future, it ought to be representative of the population of concern.

Secondly, available data on morbidity and mortality should be able to be matched at the level of each sampled individual, by type of health condition, to out of pocket spending, health-care utilization (both inpatient and outpatient, and by public and private services) and types of health spending, such as on drugs, on consultations, and on diagnostics. This will enable calculations of health care expenditures associated with specific-NCD conditions. If information on multiple health conditions is available for the same individual, it could enable the separating out of effects of co-morbidity, and competing risks.

Thirdly, when our interest is in household economic outcomes, the data on NCDs at the individual level ought to be *matched* to additional individual socioeconomic and demographic characteristics, such as caste, region of residence, educational status, indicators of income and assets, work status, earnings, household size and consumption expenditures. Ideally, the data should be longitudinal so as to help net out any unobserved individual-level and household-level effects that could confound results on the economic impact of NCDs. Additional crucial information at the household (or individual level) includes the way health expenditures are financed and on the availability of social safety nets (unemployment and disability allowances, sick leave, life and health insurance, food and housing aid, community support, etc.) to which the household members have access.

The fourth set of data that are likely to be useful relate to translating individual and household-level findings on the economic impacts of NCD to the regional and national levels. One could, of course, "add up" the economic impact results at the household unit-level (for instance) from say, sample surveys, but they cannot tell us anything about how an individual's (or a set of individuals') departure from the labor market would affect output in his (their) former jobs. To be sure, if the number of people sick or dying from NCDs were relatively small compared to the total labor force and if there were no unemployment, the estimated sum of individual level income losses would very likely equal national income losses. But, if the numbers are large relative to the work force, and if NCDs are concentrated among the more experienced and educated members of the work force, or if there is substantial unemployment, this is no longer the case. Moreover, as we noted earlier, health spending can influence the national economy

through its impact on capital formation. These effects cannot be captured simply by relying on household-level information. Data that are likely to be relevant in this context include information on private and public investments in physical/infrastructural capital, labor market conditions (unemployment rates, labor supply elasticities) and measures of national output (Gross Domestic Product). Population data (by age and sex) are obviously necessary to understand the labor market context as well. All-cause death rates by age and sex- could be useful for developing human capital indicators when assessing aggregate economic impacts. Data that can help in the construction of trends in all of these aggregate demographic and economic variables will help in projecting aggregate economic impacts if needed.

2.2.2. Socioeconomic, Demographic and National Income Data

In general, data on aggregate demographic and economic variables are readily available in India. Thus, long-term time series on various indicators of national income, private sector investment, government expenditures on capital account (a proxy for public sector investment) are readily available from the Central Statistical Organization (CSO) and the Reserve Bank of India. Demographic data – such as the distribution of total population by age-groups, age-specific all-cause death rates and population projections (by age group) are readily available for India and its constituent states. The CSO also provides information on growth in wages of industrial workers, a measure (along with GDP per adult worker) that can be used to develop long term wage-growth projections.

Information on aggregate unemployment rates (constructed from labor-force sample surveys) is readily available from publications of the Ministry of Labor. Such estimates are usually constructed from the "employment-unemployment" sample surveys undertaken regularly by India's National Sample Survey Organization. These surveys also collect individual- and household-level information on a range of socioeconomic and demographic characteristics of individuals, their employment status, occupation, earnings as well as unearned income. The data, however, are not matched to individual health status, utilization or health spending.

2.2.3. Information of Health: Community Level Surveys

There are several sources of information on NCD-related morbidity and mortality status of Indians. Firstly, a *large number of small community-level or facility-level cross-sectional sample surveys* have been undertaken to estimate the prevalence of various types of health conditions. In their analysis of COPD, Murthy and Sastry (2005a) reviewed 11 studies from different regions of India, both rural and urban, concluding that COPD prevalence rates in India were about 5 percent in males over 30 years of age, and 2.7 percent among females over 30 years of age. The 11 studies, mostly small scale, ranged over a period from 1964 and 1995. Murthy and Sastry (2005b, p.252) reviewed a few such studies for estimating asthma prevalence, concluding that while the sample sizes were much too small to be useful in making inferences about current prevalence, the combined evidence from these surveys indicated that asthma prevalence was increasing over time in India.

As another example, Gupta et al. (2006) summarized the results of 21 studies on CVD with household sample sizes ranging from about 200 to 25,000. These studies varied by type of primary health condition studied (hypertension, coronary heart disease, diabetes, stroke, rheumatic heart disease) and region (rural and urban, and different parts of India). The studies cited in Table 2 of Gupta et al. (2006) suggest heart disease prevalence ranging from 4.6 to 13.9 percent, higher in north India than in South India, and higher in urban areas compared to rural areas. Recently Joshi et al. (2006) used verbal autopsy methods to identify the cause of roughly 1350 deaths that occurred in a sample of 45 villages in the Indian state of Andhra Pradesh during 2003-4. The crude death rate of 7.5 per 1000 estimated for the population in these villages was about the average for India as a whole. 14 percent of all deaths were due to ischemic heart disease, 13 percent to strokes and 13 percent to injuries and external causes. No cause of death could be identified for 18 percent of the cases.

The Indian Council of Medical Research (ICMR) undertook a series of "meta-analyses" for a range of NCDs in 2004 that sought to consolidate the information from these small region- and disease-specific studies (Shah et al. 2004). Using six studies for urban areas, and four for rural studies, they concluded that diabetes prevalence rates were 12 percent among urban adults and 4 percent among rural adults. Again, using eight studies for urban areas and three for rural areas, they concluded a hypertension prevalence rate of roughly 16 percent in both sets of (adult) populations. They also estimated the prevalence of Ischemic heart disease among adults to be 6.4 percent in urban areas and 2.7 percent in rural areas (using 9 studies); and stroke prevalence at about 0.2 percent.

An illustrative example of the use of such studies in the context of mental illness can be found in Gururaj et al. (2005) who summarizes a number of small Indian studies and two sets of meta-analyses. He concludes that the prevalence of major mental disorders in India is of the order of 6.5 percent, including common mental disorders (about 2 percent), and mood disorders (e.g., depression) ranging from 2 to 4 percent. Gururaj (2005) also contrasted the incidence rate of injuries from small regional studies with official injury statistics put forth by the National Crime Records Bureau of India, concluding that officially recorded injuries are no more than 8 percent of all injuries, presumably reflecting serious versus non-serious injuries.

The consensus among Indian experts seems to be that firstly that disease prevalence estimates from the large number of small cross-sectional population surveys, while they have certain advantages, also suffer from a number of obvious problems. On the plus side, several of these studies were led by experienced researchers and thus likely to have resulted in lower measurement errors of the health condition. In a large country such as India, cost considerations might also be used to justify such studies. However, apart from the small sample sizes (and associated large standard errors), the studies have been conducted at different times, and at different places, making it difficult to make inter-temporal or interregional comparisons. Gururaj et al. (2005) point out that the majority of psychiatric epidemiology studies in India have focused on small sized samples, often using "convenience" samples. As a consequence prevalence rates

estimated from these studies ranged from 10/1000 to 370/1000. In any event, most of these studies are unsuited to assessing economic impacts of households. With the exception of the Hyderabad study cited by Murthy and Sastry (2005a, b) and the analysis by Thomas et al. (2004), the data collected from these surveys lack corresponding information on earnings, health care utilization, health expenditures, and so forth. Murthy and Sastry (2005b) also note that variation in definitions – such as those of asthma – used in survey instruments may further hinder cross-study comparisons of prevalence estimates.

2.2.4. Information on Health: Official Records

Information on NCDs in India can also be obtained from records compiled by agencies such as the Registrar General of India and the National Crime Records Bureau in the Ministry of Home Affairs. The Registrar General of India collects information on deaths under three different mechanisms: the Civil Registration System (CRS), Medical Certification of Causes of Death (MCCD) and the Sample Registration System (SRS). The MCCD and the SRS systems (and the latter's predecessor – the survey of causes of death (SCD), rural) are evaluated in Mahapatra and Rao (2001). Comments on the former are available in Roy (2003).

The CRS collects information on a very large number of deaths - roughly of the order of 5 million annually. The reporting of births and deaths is, under Indian law compulsory, but with an estimated 8 millions annually, the coverage amounts to about 60 percent of all deaths, so it is not complete. More importantly for our purposes, while the registration form for CRS-recorded deaths does provide space for reporting the "cause" of death, in practice the cause goes unreported. A large proportion of deaths are recorded in the CRS as having either non-specific causes, or none at all, since they often rely on self-reports of the person filling out the form. The CRS in its current form, therefore, is not particularly useful for the purpose of figuring out the distribution of deaths by cause.

The Medical Certification of Causes of Death (MCCD) database typically contains information on about 0.5 million deaths that are certified by medical doctors and include information on the cause of death. Typically, doctors prepare a report specifying the cause of death, using the ICD-10 classification and then forward it to municipal authorities, who then provide this information to the Registrar General's (vital statistics) office. Obviously certification by the doctor is preferable to verbal reports, and that is an advantage of the MCCD data. However, note that only about 6 to 7 percent of all estimated deaths in India were covered by the MCCD in the most recent year for which data are available. Also, Mahapatra and Rao (2001) note that the performance of MCCD has been uneven across states, with some states recording a very large number of deaths, whereas other states (some with very high populations, e.g., Bihar) tend not to report a large number of MCCD deaths. They attribute this occurrence partly to a mix of uneven application of the MCCD guidelines across states, across public and private hospitals, and rural and urban health facilities. Moreover, they found uneven levels of awareness among hospital and municipal staff of the need to transmit medical certification to data to the vital statistics department. It is also possible that some categories of deaths are more

likely to be certified than others. Traffic injuries are an obvious example, given the involvement of the police. Because most of the MCCD data is based on reporting by hospitals in urban areas, there is also the potential of disproportionate recording of deaths among urban residents.

Until 1998, rural deaths were recorded under the survey of causes of death (SCD)-rural, by the Registrar General of India. The technique was to survey deaths in rural areas under the jurisdiction of a sample of primary health centers. A structured questionnaire (that also specified symptoms) was used to elicit responses on the cause of death from individuals who knew the dead person. The SCD-R was discontinued in 1999 owing to its relatively small coverage of deaths in rural areas – about 40 thousand in its most recent year (1998). SCD-R had a large proportion of non-specific causes of death (20 to 28 percent of deaths in the database, a proportion that was double that for MCCD recorded deaths) (see also Gajalakshmi 2003). Beginning 1999, the SCD-R was replaced by record keeping of rural deaths under the SRS (Sample Registration System) that spans both rural and urban deaths. Again deaths were recorded under a verbal autopsy method, using the ICD-10 classification of diseases. Roughly 50 thousand deaths are recorded each year by the SRS. Published data under the SRS are available under extremely broad disease categories making them less than useful for understanding disease-specific causes of death. In recent years, the Registrar General of India has begun an large collaborative enterprise with the Center for Global Health Research at the University of Toronto (Jha et al. 2008) to improve the coverage and validity of cause of death information recorded under the SRS. The data are not publicly accessible and could not, therefore, be used in this study.

A final source of official information that is sometimes useful, particularly for collection of data on traffic deaths, other injuries and suicides are the annual reports of the National Crime Records Bureau (NCRB). Some Indian researchers believe that NCRB data on traffic deaths are very reliable (given the involvement of the law enforcement agencies) (communication with professor Dinesh Mohan, Indian Institute of Technology, New Delhi). Estimates from the NCRB suggested that more than 80 thousand deaths occurred due to road traffic injuries in India in 2002. These, however, are considerably smaller than the estimates of traffic deaths for India reported in Kopits and Cropper (2003) whose estimates are from the Global Burden of Disease study. It has to be said that the rationale for the Kopits-Cropper estimates is not obvious, at least when one considers the available data on injuries in India. Some support for NCRB road traffic death estimates comes from the work of Thomas et al (2004) in Bangalore. Less reliable are NCRB estimates on suicides and injuries, particularly among women given the widespread concern about dowry-related murders masquerading as suicides. Moreover Thomas et al. (2004) show from their Bangalore study that injury/death ratio from traffic accidents is much higher than reported in NCRB.

All of the administrative data on NCDs suffer from the problem that they cannot be matched to economically relevant information at the individual level, or to information on health care utilization and spending. Thus these numbers are unlikely to be very valuable for undertaking economic impact assessments at the individual and household

levels. They may sometimes be useful for carrying aggregate economic impact exercises of the kind reported in Leeder et al. (2004) and Abegunde et al. (2007).

2.2.5. Large Scale Sample Surveys

A third major source of information on morbidity and mortality by cause is large-scale sample surveys undertaken by various organizations. The National Sample Survey Organization (NSSO) periodically conducts nationally representative health care utilization and expenditure surveys with coverage often exceeding 100 thousand households. These surveys include information on self-reported ailments and treatments in the 15 days preceding the survey, and hospitalizations in the one year preceding the survey. Because the 15-day reference period covers both newly-acquired conditions as well as ongoing health problems, in principle it ought to be able to capture not just acute conditions, but health problems of a "chronic" nature. Three such surveys have been conducted by NSSO over the last two decades, in 1986-87, 1995-96 and 2004.

Another set of large surveys are the National Family Health Surveys (NFHS I-III), undertaken in 1992-93, 1998-99 and 2005-6. These surveys are undertaken by the International Institute of Population Sciences (IIPS) in Mumbai, in collaboration with Macro-International. Because the focus of the NFHS on reproductive health, these surveys contain few questions on NCDs, mainly confined to self-reported diabetes and asthma. The surveys also not include any questions on health expenditures, limiting their usefulness (relative to the NSSO surveys) in assessing economic impacts on households. Financing information is also limited. Other surveys, usually undertaken for a limited purpose, and typically with smaller sample sizes are undertaken by the National Council for Applied Economic Research (NCAER), based in New Delhi. Specifically NCAER has undertaken two recent surveys on human development, only one the older version of which (undertaken in 1994) the authors were able to access. These surveys sometimes contain information on ailments and expenditures, but because of their focus on "human development" more generally, a limited set of questions are asked on the nature of ailments, health spending and associated financing of health care expenses by households.

Another sample survey dataset of relevance for our purposes is the World Health Survey (WHS) undertaken by the IIPS, with assistance from the World Health Organization. The survey covered 6 states (Assam, Karnataka, Maharashtra, Rajasthan, Uttar Pradesh and West Bengal), about 11 thousand households, or about 60 thousand individuals (Arokiaswamy et al. 2006). The health portion of the questionnaire was administered to about 10 thousand individuals aged 18 years and above. This survey, while much smaller in size, and confined to only 6 of the 14 major provinces, covers many of the same questions as the NSS health care utilization and expenditure surveys, some in greater detail. A comparative analysis of WHS surveys is obviously desirable, although not pursued in this report.

Sample surveys where the health condition is self-reported, whether small or large, raise obvious concerns. The self-reported nature of ailments is likely to result in the

underestimation of the prevalence of different types of health conditions, and there may be a misclassification of diseases as well. Moreover, people may be more likely to report an ailment if they are aware of it and seek treatment. Individuals may also be unaware of a disease that they may have acquired. Murthy and Sastry (2005b) cite a study for Mumbai that showed that the ratio of treated to untreated cases of asthma was about 1:7. EIU (2007) also cites evidence from Chennai that suggests that in rural areas, diabetes cases are likely to go undetected and rural populations do not seek care for diabetes until quite late. Cultural taboos may lead to some women revealing their diabetic status in case it reduces their chances of finding a spouse. A comparison of Tables 2.1-2.3 which report prevalence data for a 15-day reference period in NSSO data with previously reported estimates of disease prevalence in the 35 year+ age group reflects these points, particularly when one notes that treatment rates in the NSSO sample are in excess of 70 percent.

The above concerns are particularly relevant in the case of psychiatric disorders. Gururaj et al. (2005) make the point that mental health has gained recognition in India only in recent years as a serious public health problem. With stigma attached to mental ill health, a shortage of mental health professionals, and facing a broad set of conditions – from mild anxiety states to severe behavioral abnormalities – sample surveys are more likely than not to under-record such conditions. Wang et al. (2007) used data from World Mental Health Surveys to conclude that very small proportions of people with mental disorders sought treatment, particularly in developing countries. Nair et al. (2005) echo these concerns, noting that the diagnostic infrastructure for cancer is limited in India, so that there will be lots of cases of undiagnosed cancers, especially in rural areas, with only advanced cases being diagnosed.

On the plus side, large sampling surveys such as those undertaken by the NSSO, and the National Family and Health Surveys have the advantage of linking individual socioeconomic and demographic characteristics to health conditions, health care utilization, expenditures and health financing. Moreover, in the case of NSSO, it is relatively easy to undertake a matching exercise that extrapolates earnings, experience and schooling regression results from labor force surveys (also undertaken by the NSSO) to the health surveys. The nationally representative nature of the NSSO surveys also makes them more attractive (relative to the WHS) when seeking to draw implications for India-level outcomes. If we believe that individuals accurately report all of their health spending, then our results would capture the financial implications of specific health conditions at the household level, even if the overall prevalence levels are downwardly biased. In this, sampling surveys have an advantage of simplistic exercises that multiply estimated number of cases (using prevalence data) with an indicator of "average" treatment costs.

One example of a large survey (of 18,000 individuals) that avoided self reporting was conducted by Sadikot et al. (2004) as part of the Prevalence of Diabetes in India Study (PODIS). According to this survey, the prevalence rate for diabetes mellitus was 4.3 percent for India as a whole, with the rate for urban areas (5.9 percent) more than double that for rural areas (2.7 percent). Because the survey did not include enough

corresponding socioeconomic information, the resulting data are unlikely to be particularly useful for conducting the type of economic impact analyses that we are interested in (assuming we could access the data!). However, carefully conducted surveys by clinicians such as this can shed light on the value of information produced by the surveys such as those of the National Sample Survey Organization. Thus, NSS data from its health care utilization and survey for 2004 assess self-reported diabetes prevalence to be 2.1 percent in urban areas and 0.7 percent in rural areas (see Tables 2.1-2.2) for the 15-day reference period. Although self-reported prevalence rates are much lower than those produced by PODIS, it is noteworthy that the estimated *ratio* of rural to urban diabetes prevalence is about the same. Because of the censoring of disease reporting common in surveys such as that conducted by the NSSO (usually the major "acute" problem is likely to be reported) and low levels of testing for glucose impairment, it is not surprising to find self-reported diabetes prevalence lower.

2.2.6. Other Data Sources

There are a number of other data sources that could potentially be used for an economic impact analysis, with varying degrees of accessibility for researchers. For instance, the Indian railways and the armed forces maintain detailed information of the health status, health care use, days absent from work and socioeconomic and demographic characteristics of their service members and their dependents. The highly subsidized care provided to employees and their dependents also means that the bulk of medical care sought by these employees (and their dependents) is obtained at health facilities operated by their respective employers. Data from these organizations has the potential to address all of the concerns raised above for various data sources available in the Indian context. The size of the study population, likely in excess of 1 million in each of the two cases is obviously a plus. Private sector organizations such as the Tata Company which operates its own facilities to care for its tea estate employees might be another possible source of information. None of these datasets are likely to be easily accessible. Claims information from insurance companies is another possibility, although in its current form, this will yield information mainly for the better off groups. However, as insurance coverage expands in the country, claims data will become an increasingly attractive source of health expenditure information, just as in the case of Medicare in the United States.

Other datasets that are accessible include information from the cancer registries in different parts of India. There are two main problems with Indian cancer registry data. Firstly, as Nair et al. (2005) point out, a large number of cancer cases present themselves in advanced stages of the disease. They highlight the need for establishing cancer registries, both in rural and in urban areas, if undercounting is to be avoided (and better treatment results achieved). Secondly, we continue to face the problem of being able to match cancer cases to health expenses, their financing and socioeconomic characteristics of individuals with cancer.

Finally, we can rely on estimates published by the WHO for India on its burden of disease website. The advantage of using this data is that the mortality estimates are based

on the "best possible use" of death statistics available in India and are available by disease. The disadvantages possibly are that the data and methods used for arriving at disability measures are less transparent, and cannot be readily associated with economic outcomes.

In the absence of India-specific data, one option is to rely on information from neighboring countries. Of course, this would mean that we would no longer be able to connect individual economic information with that of their disease status. Examples would be a recent study reported in the Lancet (Mannino and Buist 2007) that provides estimates of COPD prevalence in China. Similarly, Ghaffar et al. (2004) present, in addition to India, estimates of diabetes in neighboring countries (Bangladesh, Sri Lanka, Pakistan), which can serve as an approach to address the paucity of data for some categories of NCDs.

2.3. Data Used for the Estimates in this Report

Given the relative strengths and weaknesses of the different types of data available in India, we decided to use a combination of datasets for producing the estimates of the economic impacts of NCDs in India in this report. Thus, we relied on data from the National Sample Survey health rounds of 1995-96 and 2004, in combination with information from the MCCD and the WHO mortality statistics, labor force survey data from the NSSO from the 1999-2000 rounds, data on macroeconomic variables (government and private investment spending, GDP), and demographic data from the Registrar General of India (age-specific death rates, population age distribution) to estimate the economic impact of NCDs on India. Further details on these datasets will be provided in later chapters.

Table 2.1: Prevalence (per 100) of Selected NCD Ailments, in the Rural Indian Population 35 years and over (15-day reference period), 2004

Income Quintile	CVD	Respiratory Conditions (incl. asthma)	Diabetes	Accidents & Injuries	Cancer	All NCDs	Non-NCDs
Bottom 20%	0.44	1.04	0.17	0.34	0.08	3.52	7.91
II	0.78	1.43	0.29	0.26	0.04	4.75	7.94
Middle 20%	1.00	1.55	0.32	0.43	0.11	5.74	9.42
IV	1.54	2.27	0.69	0.35	0.12	7.38	9.43
Richest 20%	3.71	2.43	1.84	0.53	0.22	12.70	11.37
All Groups	**1.49**	**1.73**	**0.66**	**0.39**	**0.11**	**6.79**	**9.22**

Source: Authors' estimates, using NSS health care utilization and expenditure data from the 60th round, conducted in 2004.

Table 2.2: Prevalence (per 100) of Selected NCD Ailments, in the Urban Population 35 years and over (15-day reference period), 2004

Income Quintile	CVD	Respiratory Conditions (incl. asthma)	Diabetes	Accidents & Injuries	Cancer	All NCDs	Non-NCDs
Bottom 20%	1.96	1.48	0.89	0.54	0.15	7.05	8.13
II	2.64	1.97	1.18	0.44	0.18	9.23	7.69
Middle 20%	3.89	1.30	1.89	0.34	0.10	10.72	6.98
IV	6.61	1.95	3.05	0.39	0.12	15.04	7.50
Richest 20%	7.35	1.71	4.14	0.29	0.25	17.18	7.76
All Groups	**4.32**	**1.67**	**2.05**	**0.40**	**0.16**	**11.58**	**7.61**

Source: Authors' estimates, using NSS health care utilization and expenditure data from the 60th round, conducted in 2004.

Table 2.3: Prevalence (per 100) of Selected NCD Ailments, in the Indian Population 35 years and over (15-day reference period), 2004

Income Quintile	CVD	Respiratory Conditions (incl. asthma)	Diabetes	Accidents & Injuries	Cancer	All NCDs	Non-NCDs
Bottom 20%	0.85	1.16	0.36	0.40	0.10	4.46	7.97
II	1.33	1.59	0.55	0.32	0.08	6.07	7.87
Middle 20%	1.80	1.48	0.75	0.41	0.10	7.11	8.74
IV	2.70	2.19	1.23	0.36	0.12	9.13	8.99
Richest 20%	4.70	2.24	2.46	0.46	0.23	13.91	10.39
All Groups	**2.25**	**1.71**	**1.06**	**0.39**	**0.13**	**8.08**	**8.78**

Source: Authors' estimates, using NSS health care utilization and expenditure data from the 60th round, conducted in 2004.

CHAPTER 3. HEALTH SPENDING ON NCDS, FINANCING AND HOUSEHOLD IMPACTS

3.1. Introduction

This chapter has 3 main objectives. First, we seek to estimate the annual medical care expenses incurred in the treatment of NCDs in India. As we shall see, the results in the chapter point to a significant annual economic "burden" resulting from medical care of NCDs in India, whether evaluated in absolute Rupee terms, or taken as a proportion of GDP. Moreover, these expenditure estimates are broadly in line with estimates produced for India, China, and other developing countries in Asia that have been used by scholars to argue for increased efforts to prevent NCDs. Second, we inquire how these expenses are financed, including out of pocket spending by affected households, support from family and friends, the government and insurance. Limited insurance coverage and lack of social safety nets leads households in India to undertake high levels of out of pocket spending that are not reimbursed from other sources. Third, we explore the implications of the current patterns of financing health spending for NCDs. Specifically, high levels of out of pocket expenditures exposes households to increased risks of catastrophic levels of spending, which we measure using the methods of Xu et al. (2003). We conclude by undertaking an exercise similar to that of Doorslaer et al. (2006) who estimated poverty rates using consumption expenditures, both gross and net of health spending. This difference has been interpreted by some authors as the 'impact' of health spending on poverty.

3.2. Data and Methods

The calculations reported in this chapter are based on data from several sources. Firstly, information on health care utilization and out of pocket health spending by disease category was derived from the 52nd and the 60th rounds of health care utilization and expenditure surveys of the National Sample Survey Organization (NSSO) conducted in 1995-96 and 2004, respectively. In addition to information on patterns of health care utilization and expenditures incurred on treatment, the surveys also collected household-level information on the way health expenses were financed, whether from borrowing, own resources, community support, or asset sales; and whether any of these expenses were reimbursed by employers or insurance companies. The 1995-96 survey covered nearly 120 thousand households, or 600 thousand individuals. The 2004 survey covered nearly 80 thousand households and some 380 thousand individuals. The 1995-96 survey was carried out, on a rolling basis, throughout India over a period of 12 months, to help address seasonal shifts in ailments and health care use. In contrast, the 2004 survey was undertaken over a six-month period, from January to June. To the extent that seasonal variations are important, results from the two surveys are not readily comparable.[3]

[3]Because these are stratified random sample surveys, all our estimates are derived by applying sampling weights supplied by the NSSO (National Sample Survey Organization). Even after applying these weights,

The NSSO survey data on health care utilization and financing were supplemented by information on financing from a recently undertaken National Health Accounts (NHA) analysis for India (Mahal et al. 2005), and from public spending data in the health sector from the 'demand for grants' in the central and state government budgets of India for the corresponding years.

Methods

We used the household health surveys of 1995-96 and 2004 to first assess healthcare utilization patterns by type of NCD. For each category of NCD for which information was available in the survey data, we inquired about public and private health care use, days spent as an inpatient in health facilities, and the number of outpatient visits. Data on hospitalizations (and associated conditions) were available for a one-year reference period to capture the relative rarity of hospitalization events. In addition, data on reported illnesses (and associated treatments) was collected using a 15-day reference period preceding the survey. Utilization over the 15-day reference period was multiplied by 24.33 to obtain an annualized counterpart to hospitalizations (after netting out any hospitalizations reported in the 15-day reference period).

In trying to match diseases (under the NCD category) with health care utilization, we found that the list of health conditions provided for in the household health care utilization and expenditure surveys was smaller (and aggregated) than say, disease categories available in the ICD-9, or ICD-10 classification of health conditions. The survey data, being self-reported, are also likely subject to classification error, recall problems and so forth as noted in Chapter 2. Specifically, given the rather broad scope of the health conditions classified in the survey, there is a risk of classification bias in that some constituent diseases end up being reported as belonging to a specific health category, whereas they might properly belong elsewhere. It is also possible that specific NCD and non-NCD conditions end up being reported under other headings by respondents. To consider a specific example, consider the category, "respiratory conditions, including ear/nose/throat ailments" (disease code = 08) used in the 2004 survey. Because only two under respiratory conditions are separately identified: namely, asthma and tuberculosis, it is very possible that several childhood respiratory infections end up being included in the same category as say, COPD (chronic obstructive pulmonary disease), the latter being an NCD. Similarly, CVD included only two categories: "heart disease" and "hypertension". There appears to be no obvious slot for acute conditions such as "cerebral stroke," except perhaps in the category "neurological disorders." But there is no way to be sure, since we have no information on the health conditions covered under these categories. About 10 percent of the health conditions could not be identified by the respondents in the survey. These difficulties aside, we matched the disease categories in the sample survey to the ICD-9 classification of

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we found that total population estimates produced by the survey were an underestimate for India's population as a whole for the corresponding years. For this reason, our estimates in this study were constructed by adjusting (scaling up) sample weights using the interpolated census population data for 1995-96 and 2004.

diseases to distinguish between NCDs and other conditions. Table 3.1 describes the classification system (into NCDs and non-NCDs) we adopted vis-à-vis the 2004 health survey health condition categories. Because injuries are usually not considered part of NCDs, we present some our calculations for NCDs for two settings: a definition that includes NCDs and another that excludes injuries.

This exercise will, of course, exclude conditions not adequately described in the health care utilization and expenditure survey, or conditions that go unreported. In this circumstance, there are at least three cases that merit consideration. Firstly, a health condition may have been experienced by an individual and care is sought, but the individual fails to report it in the survey. Secondly, the health condition may exist and the person does not report it, but s/he *does not* seek health care for it. Finally, the condition may exist and the person reports it, but s/he does not seek treatment from some health care provider.

Allowing for the first of the three possibilities would imply that our survey-based estimate of utilization (when multiplied by estimates of health spending) cannot be used to arrive at national-level aggregates of NCD health spending. Rather, we will need to combine per-case expenditure by NCD with (upwardly adjusted) estimates of <u>overall</u> health care use from "other" sources. This, to us, sounds unrealistic, since there are *no other* nationally representative sources that link the reporting of health conditions to health care use. The alternatives are unreliable administrative data from government annual reports for public hospitals, or data from small-scale surveys conducted in specific states/regions of India, as seen in Chapter 2. Indeed a future project might aim to assess consistency between nationally representative surveys such as those of the NSSO and information available from more intensive local studies. There is also the worry that health expenditure estimates revised in this manner will no longer be consistent with separately assessed national health accounts estimates based on consumer expenditure surveys. In addition, underreporting of such cases may have resulted because treatment costs were small. 'Adjusting' for costs in the manner outlined above would then amount to overestimating the true costs of treatment.

If, on the other hand, a respondent underreports an ailment but does not seek care either, there is no effect on direct spending on health care. In this respect, this case is no different from the third scenario where the condition is actually reported but no treatment is sought. To be sure, we would have underestimates of specific health conditions in the population at large as noted in Chapter 2. That, in turn, may influence estimates of "indirect costs", income losses and so forth. But that is a separate problem which we partially address in Chapter 4 by obtaining additional disease-specific mortality information from other sources. For the remainder of this chapter, we will assume that if there is mismatch between what we call "NSS survey-based" estimates of health conditions and estimates obtained from independently obtained epidemiological data, the individual <u>did not seek care</u> for the conditions so omitted.

Out of pocket spending is not the only source of health financing in India. Considerable amounts are also spent by governments in India, at the central and state

levels, on public facilities that provide subsidized care. On a smaller scale, employers, both in the public and private sector, often reimburse employees for expenses incurred. Some large employers, such as the Indian Railways, the Indian armed forces, and the Tata Steel Company, also operate their own medical facilities that provide free care to their patients. That said, the bulk of the health sector spending in India is financed by out of pocket expenses and the government via its provision of subsidized public facilities (Mahal et al. 2005). Thus, we will focus primarily on only these two sources of financing health, referring to other funding sources when appropriate.

Estimating Public Subsidies by Health Condition

It is not straightforward to estimate the *public subsidy* component of health care spending on NCDs. Because public expenditures occur at both the central and state levels we will need to add the expenditures by both sets of entities to arrive at the overall magnitude of subsidies. Further break-down of subsidies by disease is complicated by the fact that there are no studies we are aware of that cost out health care provision for different diseases, and none in any case, that are nationally representative. At the very least, we need assumptions on the relative magnitude of public subsidies on inpatient days and outpatient visits across diseases. The assumptions are necessary because there is no reason to believe that the two types of health service utilization cost the same at a public facility; and also because the intensity of care varies by disease.

Our best source of information to help formulate realistic assumptions for estimating public subsidies came from out of pocket payments incurred on *private care*. Because health insurance in India is practically non-existent, household expenditures on inpatient days and outpatient visits could be used as indicators of the relative expense of the two components of health care use (inclusive of associated expenses for diagnostic tests, drugs, consultations and so forth). This ratio was 4.5 on average for out of pocket expenses incurred for non-NCD health conditions. Moreover, an examination of out of pocket expense data on outpatient visit and inpatient day expenses for NCDs at private facilities suggests that the median ratios across the different health conditions that comprise NCDs are about the same as for non-NCDs. Thus we took the public subsidy per inpatient day at a public facility to be about 4.5 times the public subsidy on an outpatient visit, *conditional on a specific disease.* However, the amount of public subsidy varies by health condition because of disease-specific variation in the average number of inpatient days and outpatient visits.

Financing of Health Services for NCDs

Public subsidies are an important way in which health care expenses for NCDs are financed in India. Specifically, in the case of NCD-related health services provided by public facilities, the primary source of funds is general taxation, and only a negligible share accounted for by user charges. However, households burden a considerable financial burden in the form of out of pocket expenses for treating NCDs both because public services themselves are limited, and because of the relative absence of other forms of insurance coverage.

In trying to describe the different ways in which households finance their out of pocket spending on health care for NCDs (or other health expenditures), we faced a difficulty in that health financing information by source in the 2004 NSSO survey was available only at the household, and not the individual, level. Thus, if members of a single household experienced several episodes of illness and associated expenditures for treatment, we would have no obvious way of knowing how they separately financed each treatment. If our concern is with how households finance their *overall* health expenditures, there is obviously no problem. However, given our interest in how households finance NCDs, we needed some way of relating the pattern of financing to a specific health condition (and treatment). For this purpose, we made the assumption that the description of the way households financed their health spending in the survey corresponds most closely to the treatment (and the associated health condition) that the households spent the most money on. In contrast, information on the sources of financing for out of pocket spending on health in the 1995-96 survey was collected at the individual level, by episode of illness, lending itself to more straightforward calculation.

We also analyzed how the burden of health financing in general (and specially expenditures on NCDs) differed across different socioeconomic groups. For this purpose, we divided the population into 5 groups (quintiles) ranked by per capita household expenditure (sample weights were used to construct quintiles) and assessed how health spending (per capita and as a proportion of mean expenditure) varied across quintiles, separately for rural and urban populations.

Catastrophic Spending and Impoverishment Among Households

Following Xu et al. (2003) and Doorslaer et al. (2006, 2007), we considered two measures of the impact of health spending on NCDs on the economic situation of households. The first is an indicator of the contribution of health spending on NCD-related hospitalization to "catastrophic" expenses incurred by households. Here "catastrophic" spending is defined as occurring when health expenditure on hospitalization for a given household exceeds a certain proportion of a suitably defined measure of *ability to pay*: household consumption spending *less* combined survival income for all household members. We used a threshold of 30 percent for our analysis, although other cut-offs are obviously possible. Survival income was defined as the poverty line level of expenditure *multiplied* by household size. Mathematically, for each household "j", we defined a variable D_j as

$$D_j = \frac{h_j}{E_j - n_j P}$$

Here, h_j is the combined health spending on all hospitalizations for household "j", E_j is total household consumption spending, n_j is the size of household "j", and P is the poverty line level of spending. Catastrophic spending is said to occur whenever D_j exceeds 0.3 in our framework. We assessed the contribution of NCDs to catastrophic spending of households by estimating the following equation in a logit model:

$$C_j = \alpha + \sum_{i=1}^{K} \beta_i NCD_{ij} + \theta_j X_j + \varepsilon_j$$

Here C_j is a dummy variable indicating whether the household incurred catastrophic spending, NCD_{ij} is a dummy variable indicating the presence of major NCDs of type "i" in household "j" and X_j refers to a collection of other characteristics of household "j".

Our second measure indicated whether health spending would be *impoverishing*, all else the same. Specifically, we considered (total) hospitalization spending as impoverishing if, after subtracting it from total household spending, a household would fall below the poverty line (more formally, per capita expenditure within the household falls below the poverty line). Thus, consider household "j" and a variable indicating total household spending E_j where $E^b{}_j = \frac{E_j}{n_j}$ indicates the household's per capita spending (gross of health spending). Let $E^a{}_j = \frac{E_j - h_j}{n_j}$ as per capita household spending after deducting total hospitalization spending.

If $E^b{}_j > P$ and if $E^a{}_j < P$, we say that the health expenses of this household are impoverishing. Of course, modeling the poverty impact in the manner of the previous paragraph requires the assumption that there are *no economies of scale* in the allocation of household spending. Incorporating such considerations, by using equivalence scales, such as in Xu et al. (2003), or as in Doorslaer et al. (2006, 2007), is straightforward. More tricky is the assertion (that the impoverishing impact suggests) that household expenditure would have remained unchanged in the counterfactual situation where no ill health occurred in the household. In general, this claim is difficult to defend and our findings relating to the impoverishing impact of NCDs are subject the appropriate caveats.

We assessed the contribution of NCDs to impoverishment among households by estimating the following equation in a logit model:

$$I_j = \alpha + \sum_{i=1}^{K} \beta_i NCD_{ij} + \theta_j X_j + \varepsilon_j$$

Here I_j is a dummy variable indicating whether health care resulted in household impoverishment, NCD_{ij} is a dummy variable indicating the presence of major NCDs of type "i" in household "j" and X_j refers to other household characteristics used as controls.

3.3. Findings and Discussion

We first assessed the utilization of health services in India. Table 3.1 reports estimates of the total number of hospital stays, days spent in hospitals, the average length of a hospital stay and the total number of outpatient visits in 2004 and 1995-96. We found that among individuals who reported visiting a health care provider in the reference period of 15 days, one visit was the norm. This does not, of course, imply that the during an illness episode an individual visits an outpatient provider just once. Episodes may have a length exceeding the 15-day period, in which case more than one outpatient visit may result. There was no way, however, of capturing this information in the survey, and in any event our interest lies in estimating the aggregate annual number of outpatient patients. This we did by multiplying the number of visits reported in the 15-day reference period by 24.33 (= 365/15).

From Table 3.1, we see that were nearly 2.5 billion outpatient visits and 30.6 million hospital stays in the year 2004. These numbers are considerably greater than similar categories for the 1995-96 survey, which indicates a rapid increase in health care service utilization. Another plausible scenario is that the differing utilization reflects differences in the survey methodologies used, although it is probably not sufficient to account for the entire difference over the two survey years. NCDs accounted for nearly 40 percent of all hospital stays and 35 percent of all outpatient visits in 2004; in 1995-96 the corresponding proportions were 32 percent and 22 percent, respectively. The average length of hospital stay for NCDs is higher than for other health conditions, suggesting a greater intensity of care received by patients admitted under the former category. Heart disease and accidents and injuries were the two most important reasons for hospital stays. Other noteworthy conditions in this respect were kidney/urinary conditions, respiratory problems and cancers. Hospital stays and outpatient visits due to diabetes, respiratory conditions and injuries increased rapidly between 1995-96 and 2004.

Table 3.2 reports results on the relative share of public and private sectors in health care utilization, by health condition, from the two household surveys. The private sector accounted for about 59 percent of all hospital stays in 2004, slightly higher than in 1995-96; and for 82 percent of all outpatient visits, slightly lower than in 1995-96. Overall, these data confirm the important role that the private sector plays in the provision of health services in India. The proportion on inpatient stays in the public (or private) sector did not vary much by the broad categories of NCD and non-NCD; but the share of the public sector in outpatient visits was higher for NCDs than for the non-NCD categories. Within NCDs, the share of the public sector hospital stays was highest for cancers, accidents and injuries, respiratory conditions and psychiatric care. This is easily rationalized for accidents and injuries given that private providers tend to avoid "police-cases" and emergencies associated with traffic injuries, suicides, female burn injuries, and the like. Most psychiatric wards in India are provided in the public sector, so that too is not a surprise. Moreover, the high cost of treating cancer may result in individuals treating public facilities as providers of the last resort. Average lengths of stay fell between 1995-96 and 2004, in both the public and private sectors, possibly reflecting higher costs of treatment, more efficient interventions, or some combination of the two.

In Tables 3.3 and 3.4 we present information on out of pocket expenditures incurred for treatment of health conditions by Indians in the years 1995-96 and 2004. Indians spent nearly INR 846 billion out of pocket on health care expenses in the year 2004, amounting to nearly 3.3 percent of India's GDP in that year. This marked a substantial increase (in current Indian Rupees) from INR 315 billion spent out of pocket on health care in the year 1995-96 (about 2.9 percent of India's GDP in 1995-96). The data in Tables 3.3 and 3.4 also show that the share of NCDs in out of pocket health expenses incurred by households increased over time, from 31.6 percent in 1995-96 to 47.3 percent in 2004. That would indicate growing importance of NCDs in India in terms of their financial impact on households (and the underlying disease burden).

Some other findings are noteworthy as well. Out of pocket expenses on care obtained at public facilities per unit of health care utilization (a single hospital stay, a single hospital day, or an outpatient visit), are less than expenses incurred on comparable units of utilization at private facilities. All else the same, that would point towards public facilities at least playing some role in providing Indian households financial risk protection from ill health, whether from health conditions of the NCD, or of the non-NCD, variety. Nonetheless NCDs do impose a greater burden on out of pocket expenditures than other health conditions. Our data for 1995-96 and 2004 show that the out of pocket expense for a single hospital stay for an NCD was nearly double that of other health conditions; and expenses incurred per hospital day were between 30 percent and 50 percent higher in a private than in a public health facility. The differences in out of pocket expenses incurred on NCD and non-NCD conditions are less marked for outpatient visits but nonetheless exist, with visits for NCD being 15 to 50 percent more expensive than non-NCD visits. The difference of per episode cost of treatment between public and private facilities is sharper if expenses on drugs and medicines are taken out of consideration, although we do not present those findings here. Within the category of NCDs, out of pocket expenses per unit of utilization are particularly high for cancer, heart disease, accidents and injuries and kidney/urinary conditions.

Components of Out-of-Pocket Expenses

In order to evaluate the relative importance of different items of out of pocket expenditure on health care, we present information on expenditure sub-categories from the 2004 sample survey of the NSSO. Analogous information is not available from the 1995-96 survey.

As can be observed from Table 3.5 more than one-half of the out-of-pocket expenses on health care are incurred on purchases of medicines, diagnostic tests and medical appliances. The proportions are more or less the same across broad groups of NCDs and other health conditions. A major chunk of overall out of pocket health spending (in excess of 45 percent) is on medicines and this proportion is as high as 64 percent and 58 percent for cases of hypertension and diabetes, respectively. In general, consultation fees account for between 5 to 12 percent of total out-of-pocket expenses, irrespective of whether the patients has an NCD, or not.

The data on the components of health spending highlight the key role of drug expenditures as a major source of household economic difficulty. With even users of public health facilities being forced to rely on their own resources for purchasing drugs in recent years (Garg and Karan 2008), the issue of access to drugs will acquire increasing significance in India in future years.

Public Subsidies on Health Care: NCDs and Other Health Conditions

Table 3.6 presents our estimates of public subsidies "allocated" to the treatment of different categories of NCDs as well as for other health conditions. These subsidies were calculated by estimating the cost to the government per day spent as an inpatient at a public hospital (by NCD type) and the cost per outpatient day at a public facility.

In the year 2003-4, governments in India at the central and state levels spent a total of nearly INR 220 billion. We excluded local governments who typically account for only up to 5 percent of all government spending, a situation that has persisted even after recent reforms towards decentralization (Mahal et al. 2005). Our estimates of public subsidies to different health conditions are reported in Table 3.6. Given that accidents, cancers, kidney/urinary conditions and injuries are easily the most expensive of the conditions treated in the private sector, it is not surprising that subsidies per unit of care as well as the total amounts of subsidies allocated to these conditions are also large. Note, however, that taken as a proportion of total out of pocket spending, government subsidies are rather small, irrespective of the health condition considered. This leaves the average Indian household vulnerable to considerable risk from the financial implications of illness.

Financing and Vulnerability to NCD Risk Among Indian Households

National Health Accounts analyses show that the overwhelming contribution to health financing in India comes from two sources: the government, through its provision of subsidized medical services (about 20 percent of all spending), and the households, via out of pocket expenses (about 72 percent of all spending). Contributions by private and social insurers are quite small thus far in India. Only about 4 percent to 5 percent of health financing comes from employers and insurers via reimbursements for expenditures already incurred (Mahal et al. 2005).

Information on how households financed their out of pocket spending on health is available from the NSSO survey data for 1995-96 and 2004. However, using this information required care and moreover, response categories in the two surveys were different, making inter-temporal comparisons difficult. For the 2004 survey, we explored responses to questions on how households financed their health expenditures with the options being: income/saving, borrowing, contribution from friends & family and other sources. The last category primarily covered the sale of assets such as jewelry, draught animals and other physical assets. Because the information on the way health expenditures were financed was available only for the *household* (and not at the individual level), matching the pattern of financing to a specific disease required an

additional adjustment to address the possibility that a household incurred expenditures on two or more (and different) health conditions in the reference period. Specifically, we assumed that the pattern of financing reflected the health condition on which the household incurred the most expenditure in the reference period. Information on expenditures that were reimbursed by employers and insurance companies was obtained from responses to another question in the survey. The 1995-96 survey did not include any information on the contributions by friends and family but instead included reimbursement as a separate response category alongside sales of assets, borrowing and financing from income/savings. For this reason, any comparisons across the two surveys related to the financing of health spending must be undertaken with caution.

Tables 3.7 and 3.8 present our results, by source of financing, for 2004, and for 1995-96, respectively for expenses incurred for inpatient care. In both years, own savings and income turned out to be the most important source of financing for many health conditions (typically between 40-60 percent of all spending). In 2004, about 10-15 percent of financial resources were provided by friends and family, a form of community insurance. The share of reimbursement in 1995-96 amounted to only about 5-6 percent of all NCD-related out of pocket health spending for hospitalization. Data (not presented here) from the 2004 NSSO survey also provide a similar estimate of reimbursements from employers and insurance companies – about 6 percent – for out of pocket spending on inpatient care. However, it can be seen that a large number of individuals rely upon "borrowing," presumably with (or without) a collateral, and potentially interest payments. Some of the more expensive to treat health conditions (CVD, cancers, accidents and injuries, and neurological disorders) also involve larger shares of financing from the "other" category in 2004, primarily via the sale of assets. Overall, the evidence supports significant household financial vulnerability arising from poor health in India, be it NCDs or other health conditions.

Another way to inquire about the extent to which households are financially vulnerable to NCDs is to assess how large the costs of hospitalization for health conditions that comprise NCD are, relative to income (or total consumption spending). In the year 2004, for instance, India's income per capita was INR 25,320. It is worth noting that a single hospital stay for cancer (or heart disease) would have accounted for anywhere between 80 percent and 90 percent of this income if health care were to be obtained from private providers. Even if health care was sought at a public facility, the expenses out of pocket would still have amounted to between 40 percent and 50 percent of per capita income. Yip and Mahal (2008) have further shown that the bite out of income per capita taken out by a single hospitalization event increased sharply between 1995-96 and 2004 for the poorest individuals.

In Tables 3.9-3.11 we present statistics on per capita health spending incurred on NCDs and other health conditions, ranked by household expenditure quintiles, our indicator of economic status. We use this information to inquire how out of pocket health spending varies by economic status. Note from Tables 3.9-3.11 that total out of pocket health spending, taken as a proportion of per capita household expenditure, does not vary much across the quintiles, whether we look at the sample population as a whole, or break

it down into rural and urban populations. Note also that urban populations tend to allocate a greater share of their (out of pocket) health expenses on NCDs, compared to their rural counterparts. Moreover, the share of NCD expenditures as a proportion of total household expenditure is rising from poorest to the richest groups. This is in contrast to the situation of expenditures on other (non-NCD) health conditions, whose share in household total expenditures either remains unchanged across expenditure quintiles (rural), or declines with economic well being (urban).

At first sight, our findings would appear to go against the idea that NCDs are creating a financial burden on the poor (for instance, Ghaffar et al. 2004). However, because individuals belonging to the lowest expenditure quintile live much closer to the survival threshold, allocating even smaller proportions of income is likely to increase their likelihood to falling below the poverty line. Living so close to the survival threshold also means that in many cases they forgo needed care. Thus, while communicable disease mortality and morbidity mostly explain the high share of non-NCD out of pocket health spending among the less well off, another part of the explanation (low proportion of spending on NCD in the bottom quintiles) may lie in the expense of seeking treatment for NCD. This suggests looking at other monetary indicators of the financial burden suffered by households on NCDs, such as income losses or premature mortality.

Catastrophic Expenditures and Medical Impoverishment on Account of NCDs

Previously we highlighted the potential financial risks that NCDs are likely to impose on households. Here we address this issue more formally by inquiring about the degree to which different categories of NCDs influence household risk of catastrophic spending and impoverishment. Table 3.12 presents the results of simple logit regressions of indicators of household catastrophic spending and medical impoverishment on disease categories that comprise NCDs and non-NCDs. The results indicate that the odds of incurring catastrophic hospitalization expenditures are nearly 160 percent higher with cancer than the odds of incurring catastrophic spending when hospitalization is due to a communicable condition. By comparison, the odds of incurring catastrophic hospital spending due to CVD or injuries are about 30 percent greater compared to communicable conditions that result in hospital stays. The odds of incurring catastrophic spending when the hospitalization is due to cancer are nearly double compared to accidents and CVD. Our results are essentially unchanged when the focus is on the risks of impoverishment associated with health spending with cancer greatly increasing the likelihood of falling into poverty.

Concluding Remarks

This chapter has focused on health spending associated with NCDs in India, the way such spending is financed in India, and the potential implications for the financial risks to which Indians are exposed. We find that out of pocket expenses for treating health conditions categorized as NCD have risen sharply over the period from 1995-96 to 2004. Non-communicable diseases generally cost more than non-NCD to treat and so imply a higher financial risk burden on affected individuals and households, all else the

same in the absence of insurance. Unfortunately, social and private insurance, as well as de facto risk coverage provided by Indian governments at the central and state levels in the form of subsidized public health facilities is limited. Nearly three-quarters of health expenditures on NCD are likely to be borne by households. The survey data suggest that about 40 percent of these expenditures are financed by household borrowing and sales of assets which appears to indicate significant levels of financial vulnerability to NCD (or non-NCD health conditions). Cancers appear to be a major factor in households incurring catastrophic levels of health spending and falling into poverty.

Figure 3.1 Classifying the 2004 Household Survey Response Categories into Communicable, Non-Communicable and Other Categories

I. **Communicable Conditions/Childhood Diseases**

- Diarrhea/Dysentery, Gastritis/peptic ulcer, worm infestation, Amoeboisis, Hepatitis/Jaundice
- Malaria, Mumps, Diphtheria, Whooping Cough, Fever of Unknown Origin
- Tetanus
- Filariasis
- Diseases of the skin,
- Gynecological disorders
- Under-nutrition, anemia
- Sexually transmitted diseases
- Respiratory (including ear/nose/throat) ailments for ages < 15 years
- Tuberculosis

II. Non-Communicable Conditions

- Heart disease, hypertension
- Bronchial asthma
- Respiratory (including ear/nose/throat) ailments for ages > 15 years
- Disorders of joints and bones
- Diseases of the kidney/Urinary system
- Neurological disorders
- Psychiatric disorders
- Diabetes
- Cancers and other tumors
- Accidents/injuries/burns/fractures/poisoning

III. Other Conditions/Disabilities

- Goiter
- Eye ailments (cataract, glaucoma, conjunctivitis)
- Diseases of the mouth, teeth and gum
- *Disabilities*: locomotor, visual, speech hearing
- Other undiagnosed ailments

Note: We classified the age-category for respiratory ailments to get around the problem of confusing childhood conditions with conditions such as COPD.

Table 3.1: Hospital Stays and Outpatient Visits in India, 1995-96 and 2004, By Disease

Disease	1995-96				2004			
	Hospital Stays (millions)	Average Stay (days)	Hospital Days (millions)	OP Visits (millions)	Hospital Stays (millions)	Average Stay (days)	Hospital Days (millions)	OP Visits (millions)
Heart Disease	0.734	11.8	8.683	18.846	1.664	9.9	16.443	67.602
Hypertension	0.304	12.4	3.757	26.188	0.689	6.8	4.685	129.846
Other Respiratory	0.303	9.5	2.885	17.900	1.015	6.9	6.970	177.117
Asthma	0.381	8.1	3.095	84.311	1.009	8.4	8.512	90.640
Joints & Pain	0.423	20.4	8.621	51.622	0.765	12.7	9.669	163.802
Kidney/Urinary	0.507	14.7	7.468	10.013	1.365	9.7	13.211	27.636
Neurological	0.267	17.6	4.701	12.102	0.986	12.3	11.876	50.714
Psychiatric	0.154	36.5	5.637	7.604	0.267	15.3	4.077	16.903
Diabetes	0.158	15.1	2.381	18.204	0.598	9.9	5.931	88.831
Accidents/Injury	1.085	13.9	15.052	26.656	2.962	12.6	37.398	67.215
Cancer	0.442	26.4	11.661	6.066	0.898	15.0	13.432	13.372
NCD	4.757	15.5	73.940	279.513	12.200	10.8	132.204	893.677
NCD (no injuries)	3.672	16.0	58.888	252.857	9.238	10.3	94.806	826.462
Non-NCD	10.454	10.4	109.133	1,014.538	18.382	8.1	148.479	1,636.053
Total	15.211	2.1	183.885	1,294.230	30.582	9.2	280.684	2,529.730

Table 3.2: Health Care Utilization in the Public and Private Sectors in India, 1995-96 and 2004, By Disease

Disease	1995-96				2004			
	Public Sector (%) Share Hospital Stays	Public Sector (%) Share OP Visits	Average Hosp Stay (Public Sector)	Average Hosp Stay (Private Sector)	Public Sector (%) Share Hospital Stays	Public Sector (%) Share OP Visits	Average Hosp Stay (Public Sector)	Average Hosp Stay (Private Sector)
Heart Disease	37.8	17.9	11.2	12.2	39.2	26.0	11.6	8.8
Hypertension	35.7	12.8	10.6	13.3	29.5	19.5	7.8	6.4
Other Respiratory	45.2	9.2	10.6	8.6	37.9	15.9	8.6	5.8
Asthma	40.7	13.4	9.5	7.2	45.0	21.9	9.7	7.4
Joints & Pain	40.9	11.5	25.5	16.9	33.6	17.4	17.6	10.1
Kidney/Urinary	39.0	16.0	15.6	14.2	34.0	18.6	11.1	8.9
Neurological	38.1	11.6	29.0	10.5	38.4	24.9	12.6	12.1
Psychiatric	54.4	13.1	49.6	20.9	42.7	17.9	18.3	13.0
Diabetes	38.5	18.4	20.5	11.7	32.0	18.2	11.4	9.2
Accidents/Injury	52.1	17.6	14.5	13.2	44.3	23.5	14.5	11.1
Cancer	52.7	24.2	31.7	20.6	48.7	31.6	17.4	12.6
NCD	44.0	14.0	18.5	13.3	39.7	19.7	12.8	9.5
NCD (No Injuries)	41.6	13.6	20.0	13.3	38.2	19.4	12.2	9.0
Non-NCD	44.0	14.7	11.7	9.5	41.4	17.1	9.7	6.9
Total	44.0	14.5	13.8	10.7	40.7	18.0	10.9	8.0

Table 3.3: Out of Pocket Health Expenses on Health Care in India, 2004, By Disease

Disease	Inpatient Care				Outpatient Care		All Out of Pocket Expenses (INR, billions)
	Expenses per Stay (Public) INR	Expenses per Stay (Private) INR	Expenses per day (Public) INR	Expenses per Day (Private) INR	Expenses per Visit (Public) INR	Expenses per Visit (Private) INR	
Heart Disease	8,342	22,203	722	2,522	341	485	58.18
Hypertension	2,392	7,026	305	1,105	198	336	44.00
Other Respiratory	1,969	5,682	228	980	176	143	30.64
Asthma	2,079	5,840	215	785	230	322	31.54
Joints & Pain	4,872	11,703	276	1,157	165	222	41.94
Kidney/Urinary	5,134	14,359	462	1,606	445	1,073	41.75
Neurological	5,749	15,484	456	1,284	291	366	28.97
Psychiatric	4,238	8,353	231	641	369	288	6.87
Diabetes	4,052	8,280	355	897	246	390	36.43
Accidents/Injury	5,556	12,585	383	1,132	350	390	53.62
Cancer	11,659	23,868	670	1,888	1,128	603	26.38
NCD	5,585	13,213	435	1,388	264	320	400.31
NCD (No Injuries)	5,596	13,398	460	1,484	256	207	346.69
Non-NCD	2,770	6,716	286	967	228	213	445.87
Total	3,865	9,352	354	1,170	242	250	846.18

Table 3.4: Out of Pocket Health Expenses on Health Care in India, 1995-96, By Disease

Disease	Inpatient Care				Outpatient Care		All Out of Pocket Expenses (INR billions)
	Expenses per Stay (Public) INR	Expenses per Stay (Private) INR	Expenses per day (Public) INR	Expenses per Day (Private) INR	Expenses per Visit (Public) INR	Expenses per Visit (Private) INR	
Heart Disease	4,193	15,117	374	1,239	243	608	18.30
Hypertension	2,167	3,906	204	293	124	218	6.39
Other Respiratory	1,685	2,861	159	331	411	272	5.79
Asthma	1,009	1,854	106	259	112	128	11.20
Joints & Pain	4,106	4,990	161	295	196	251	14.59
Kidney/Urinary	3,421	9,599	219	678	610	448	8.39
Neurological	2,522	5,441	87	516	160	357	5.20
Psychiatric	5,913	5,877	119	281	160	280	2.92
Diabetes	2,903	4,549	142	389	110	264	4.90
Accidents/Injury	3,505	6,451	241	489	307	340	14.24
Cancer	5,047	10,732	159	522	419	794	7.68
NCD	3,467	7,554	188	570	208	267	99.61
NCD (No Injuries)	3,453	7,821	173	587	195	260	85.37
Non-NCD	1,727	3,522	148	373	165	188	215.39
Total	2,271	4,784	164	445	174	205	315.00

Table 3.5: Percentage Distribution of Out of Pocket Health Expenses on Health Care by Components, 2004, By Disease

	Doctor fees	Medicines	Diagnostic & medical appliances	Other medical expenses*	Total medical expenses	Other expenses
Heart disease	6.76	38.61	5.95	42.73	94.05	5.88
Hypertension	7.59	64.20	3.95	17.79	93.52	6.60
Respiratory	11.93	54.46	4.01	21.51	91.91	8.38
Bronchial asthma	7.43	56.12	10.19	19.88	93.63	6.56
Disorders of joints & pain	9.73	54.39	4.14	22.74	91.00	9.02
Disease of kidney/urinary system	5.32	21.65	4.46	61.80	93.22	6.88
Prostate disorders	10.49	36.63	5.18	40.87	93.17	6.85
Neurological disorder	6.87	40.93	5.82	36.75	90.37	9.82
Psychiatric disorder	7.94	54.04	3.69	22.68	88.34	12.13
Diabetes mellitus	8.94	58.05	7.93	18.94	93.85	6.23
Accidents and Injuries	9.52	32.10	4.28	46.25	92.16	7.74
Cancer and other tumors	6.47	27.64	7.18	48.97	90.27	9.71
Other Unknown NCD	2.07	10.33	1.25	80.40	94.04	5.96
NCD	8.06	44.56	5.56	34.32	92.51	7.56
Non-NCD	8.74	47.02	4.57	31.01	91.34	8.74
NCD (No Injuries)	7.92	46.03	6.14	32.45	92.53	7.47
Total	8.42	45.86	5.04	32.58	91.89	8.18

Notes: * includes bed charges, attendant charges, physiotherapy, food and material, blood, oxygen cylinder etc, other services and expenditure not classified elsewhere

Table 3.6: The Distribution of Public Subsidies on Health in India, 2004, By Disease

Disease	2004				
	Public Subsidy per hospital day (INR)	Public Subsidy per OP visit (INR)	Total Subsidies (INR Billions)	OOP expenses (INR billions)	Subsidies/OOP
Heart Disease	2,092	465	23.92	58.18	0.41
Hypertension	916	204	6.62	44.00	0.15
Other Respiratory	813	181	7.80	30.64	0.25
Asthma	651	145	5.72	31.54	0.18
Joints & Pain	960	213	10.42	41.94	0.25
Kidney/Urinary	1,332	296	8.39	41.75	0.20
Neurological	1,065	237	7.98	28.97	0.28
Psychiatric	531	118	1.47	6.87	0.21
Diabetes	744	165	4.29	36.43	0.12
Accidents/Injury	939	209	21.19	53.62	0.40
Cancer	1,566	348	13.38	26.38	0.51
NCD	1,151	225	111.17	400.31	0.28
NCD (No Injuries)	1,247	227	89.98	346.69	0.26
Non-NCD	802	178	108.79	445.87	0.24
Total	962	196	219.96	846.18	0.26

Table 3.7: Sources of Funds for Out of Pocket Spending on Health Care on Inpatient Care in India, 2004, By Disease

Disease	2004				
	Out of pocket spending on hospital stays (INR billions)	**Household Income or Savings (% share)**	**Borrowing (% share)**	**Contributions from friends & family (% share)**	**Other (incl. sale of assets) (% share)**
Heart Disease	28.4	49.5	26.6	12.5	11.4
Hypertension	3.6	50.5	28.1	17.3	4.1
Other Respiratory	4.1	56.8	29.8	10.2	3.1
Asthma	4.1	44.9	39.2	9.0	6.9
Joints & Pain	7.5	53.6	29.6	12.1	4.7
Kidney/Urinary	14.9	47.0	37.7	10.5	4.8
Neurological	11.4	38.3	32.1	9.3	20.3
Psychiatric	1.7	38.0	49.5	9.4	3.2
Diabetes	4.1	54.7	33.4	9.4	2.4
Accidents/Injury	28.5	39.1	39.0	14.8	7.0
Cancer	16.1	43.4	35.4	14.0	7.2
NCD	***124.3***	***45.4***	***33.7***	***12.5***	***8.4***
NCD (No Injury)	***95.8***	***47.2***	***32.1***	***11.8***	***8.9***
Non-NCD	***93.3***	***50.8***	***33.6***	***11.9***	***3.7***
Total	***217.6***	***47.7***	***33.7***	***12.2***	***6.4***

Table 3.8: Sources of Funds for Out of Pocket Spending on Health Care on Inpatient Care in India, 1995-96, By Disease

Disease	1995-96				
	Out of pocket spending on hospital stays (INR billions)	**Household Income or Savings (% share)**	**Borrowing (% share)**	**Reimbursement (% share)**	**Other (incl. sale of assets) (% share)**
Heart Disease	6.2	65.1	17.5	3.7	13.7
Hypertension	0.9	55.6	22.0	4.7	17.7
Other Respiratory	0.6	55.9	30.3	3.5	10.3
Asthma	0.5	46.7	29.7	0.5	23.0
Joints & Pain	1.8	44.5	36.8	1.2	17.5
Kidney/Urinary	3.7	37.4	36.8	10.9	14.8
Neurological	1.0	37.4	34.6	2.0	26.0
Psychiatric	0.9	27.3	33.3	8.3	31.1
Diabetes	0.5	51.1	34.9	1.8	12.2
Accidents/Injury	5.3	34.4	36.3	11.1	18.2
Cancer	3.0	44.0	31.7	2.7	21.6
NCD	***24.5***	***46.4***	***30.0***	***6.1***	***17.4***
NCD (No Injury)	***19.2***	***49.8***	***28.3***	***4.7***	***17.2***
Non-NCD	***23.7***	***45.9***	***37.8***	***1.7***	***14.6***
Total	***48.2***	***46.2***	***33.9***	***3.9***	***16.0***

Table 3.9: Out of Pocket Health Expenditures per Capita (by Disease) across Expenditure Quintiles for India, 2004

Expenditure Quintile	Per Capita Out of Pocket Spending (INR) on:						Proportion of Per Capita HH Income (%)		
	Heart Disease	Accidents	Cancer	All NCD	Non-NCD	Health	All NCD	NCD	All Health Spending
I	13.62	27.12	8.98	126.48	251.88	378.36	3.53	7.03	10.56
II	20.80	37.52	14.08	200.93	327.06	527.99	3.78	6.15	9.92
III	41.59	50.50	17.49	347.89	398.49	746.37	5.08	5.82	10.90
IV	63.28	49.52	25.34	429.68	457.93	887.61	5.03	5.36	10.39
V	173.78	102.09	72.82	981.92	766.67	1,748.58	6.68	5.21	11.89
Combined	***53.91***	***49.69***	***23.63***	***371.41***	***412.68***	***784.10***	***5.17***	***5.75***	***10.92***

Table 3.10: Out of Pocket Health Expenditures per Capita (by Disease) across Expenditure Quintiles for Rural India, 2004

Expenditure Quintile	Per Capita Out of Pocket Spending (INR) on:						Proportion of Per Capita HH Income (%)		
	Heart Disease	Accidents	Cancer	All NCD	Non-NCD	Health	All NCD	NCD	All Health Spending
I	7.07	22.31	9.38	89.97	232.57	322.54	2.91	7.52	10.42
II	9.79	34.50	10.69	145.41	294.89	440.29	3.32	6.73	10.05
III	18.58	49.20	13.98	280.40	379.08	659.49	5.12	6.92	12.04
IV	35.18	44.76	18.34	293.38	445.81	739.19	4.26	6.48	10.74
V	119.19	99.78	66.13	774.96	763.00	1,537.97	6.90	6.79	13.69
Combined	***32.51***	***46.76***	***21.12***	***285.23***	***396.81***	***682.04***	***4.92***	***6.84***	***11.76***

Table 3.11: Out of Pocket Health Expenditures per Capita (by Disease) across Expenditure Quintiles for Urban India, 2004

Expenditure Quintile	Per Capita Out of Pocket Spending (INR) on:						Proportion of Per Capita HH Income (%)		
	Heart Disease	Accidents	Cancer	All NCD	Non-NCD	Health	All NCD	Non-NCD	All Health Spending
I	31.99	40.62	7.86	228.91	306.04	534.95	4.62	6.18	10.80
II	48.80	45.20	22.71	342.08	408.86	750.94	4.44	5.31	9.75
III	109.30	54.33	27.83	546.42	455.56	1,001.98	5.02	4.19	9.21
IV	166.06	66.95	50.96	928.26	502.28	1,430.54	6.35	3.44	9.79
V	346.66	109.40	94.01	1,637.31	778.27	2,415.59	6.37	3.03	9.40
Combined	***116.68***	***58.28***	***34.18***	***624.16***	***459.25***	***1,083.41***	***5.56***	***4.09***	***9.64***

Table 3.12: The Impact of NCDs on Catastrophic Spending and Impoverishment among Indian Households, 2004

Explanatory Variables	Dependent variable: Catastrophic Spending	Dependent Variable: Poverty Indicator
Dummy for cardiovascular disease	5.138 (0.120)	1.027 (0.091)
Dummy for Diabetes	4.724 (0.236)	0.426 (0.205)
Dummy for Accidents	5.134 (0.104)	0.908 (0.075)
Dummy for Cancer	5.841 (0.174)	1.558 (0.156)
Dummy for other NCDs	5.015 (0.087)	0.888 (0.052)
Dummy for Communicable Diseases	4.897 (0.078)	0.712 (0.034)
Average Age	0.013 (0.002)	-0.040 (0.001)
Proportion of Females	-0.312 (0.137)	0.562 (0.044)
Highest educated adult household member	0.018 (0.006)	-0.132 (0.002)
Dummy for Rural Residence	0.505 (0.058)	0.022 (0.022)
Constant	-6.532 (0.132)	0.619 (0.039)
Number of Observations	**72,596**	**72,596**

Note: Data are from the 60th round (2004) of the National Sample Survey. Standard errors are reported in parentheses.

CHAPTER 4. HOUSEHOLD INCOME LOSSES FROM NCDS

4.1. Introduction

We now direct our attention to the second key element of the "cost" of NCDs: namely an annualized measure of the *indirect costs* (income losses) associated with morbidity/disability and premature mortality from NCDs that are borne by households. The main motivation for estimating these costs is to highlight the potential impact that illnesses can have on incomes, even if sometimes medical expenditures are limited by household resources or lack of insurance. Recent literature on the economic impacts of illness has not always taken this fact into account. For instance, Xu et al. (2003) in their work on catastrophic financial implications of ill health focus solely on medical expenditures when, in fact, for some families it is the income losses that are likely paramount. Similarly, Doorslaer et al. (2006) in their analysis of the impoverishing 'impacts' of ill health seem to suggest that in the absence of medical expenditure, the income/consumption of the household would likely have remained unaffected. In fact, this would usually not be the case if ill health also affected household income levels.

4.2. Data and Methods

This section is divided into two parts. The first sub-section describes the data we use. The second describes the methodology.

4.2.1. Data

The data for the calculations we undertake here come from several sources. We relied to a great extent on morbidity and hospitalization data from the health care utilization and expenditure surveys of India's National Sample Survey Organization for the year 2004 and 1995-96. These surveys provided detailed self-reported information on ailments in 15-day reference period, and on hospitalizations in the year preceding the survey. Survey data included self-reported causes of morbidity/hospitalization, the length of the period of hospitalization, the length of time a hospitalized person reported being ill (including, both before and after hospitalization) and the length of ailments reported during the 15-day reference period preceding the survey. The surveys also provided information on the nature of the ailment/hospitalization on the sub-set of *dead* individuals who were hospitalized in the year preceding the survey, or who were ill in the 15 days preceding the survey. However, for individuals that did not seek treatment (or were not hospitalized) no information on cause of death was available in the 2004 survey.[4]

Another source of data that we utilized was a large labor force survey undertaken by the National Sample Survey Organization in 2004-5[5]. This "employment-unemployment" survey provided information on educational attainment, age, sex, activity status (employed or unemployed), status of employment (casual, regular, or self-employed), residence (rural or

[4]This information was available for dead individuals in the 1995-96 survey, if they did not access health care in the reference period(s).

[5]This is the 61st round of the National Sample Survey that focused on Employment and unemployment situation in India.

urban), and wages[6]. The survey covered nearly 125 thousand households and was representative at the national, provincial and sub-provincial levels.

Finally, we used information on mortality (including by cause of death) from two additional sources: statistics published by the World Health Organization on its burden of disease website (WHO 2004) and data from the Registrar General of India on medical certification of causes of death in designated hospitals (Registrar General of India 2007). Some other categories of demographic data (such as total population, population age distribution, all-cause mortality rates) and life tables were obtained from the Registrar General of India.

4.2.2. Methods

We first estimated *annual* income losses using a standard cost-of-illness approach. As a first step, we classified the population with NCD into two groups (a) those individuals who died in 2004 on account of NCDs; and (b) individuals who reported ill with a NCD (but did not die). Note in this connection that individuals with an NCD, even if they do not die, might remain ill for an extended period, or acquire a disability that may hamper their ability to effectively participate in the labor market. At the same time, one might expect income losses associated with dead individuals to be larger if other family members are unable to step in to replace any associated household income losses.

Three different methods were used to assess the size of the population with an NCD in India, and to distribute this population into individuals who died during the preceding year and those that did not. The **first method** relied primarily on data from the National Sample Survey Organization health surveys for 2004 and 1995-96. *Sample-weighted* estimates of dead individuals for whom the cause of death (by disease) was identifiable were first constructed for the year 2004. If a person was hospitalized, we attributed the death for that individual to the reported disease for which he or she was hospitalized. Very few deaths were reported for ill (but not hospitalized persons) exclusively in the 15-day reference period, and so these were omitted from our analysis.

One might suspect that the distribution of deaths constructed in this manner is biased since we do not really know the *immediate* cause of death, as for instance a person discharged from a hospital after a CABG, but then being run over by a car while crossing the street from the hospital. While we do not know this immediate cause of death for any individual in the 2004 survey, the 1995-96 NSSO health survey did provide separate self-reported information on the cause of death of household members by survey respondents, including for individuals who were hospitalized in the one year preceding the survey and individuals reporting illness in a 15-day reference period. Restricting our sample of deaths to only to the inpatient cases in 1995-96 resulted in a match of about 70% between the hospitalized condition and the specific cause of death as identified by the respondent. In about 20% of the cases, however, the cause of death could not be identified by the respondent. Overall, at least for the data in the year 1995-96, there appears to be a reasonably good match between the cause of death as reported by survey respondents and the cause as identified by the disease for which a person was hospitalized in the one year preceding the survey. Of course, deaths were also reported among persons who were not hospitalized during

[6] We used data on 'current daily status' of a person's employment in the 61st round of the national sample survey which relied on respondent activity over a 7 day reference period.

the survey. We assumed that the disease-specific distribution of deaths for the non-hospitalized cases was the same as that of the cases that were hospitalized.

Individual deaths were further divided into two groups: those aged 15 years and above, and those aged below 15 years. There were two reasons for making this distinction. Firstly, aggregate income losses for the under-15 age group will most likely arise from care-giving by other family members rather than a loss of the patient's own work income. In a country with substantial amounts of child labor such as India, this is probably not a satisfactory assumption. We do not address this concern here, except to argue that child labor, more often than not, is heavily exploited and underpaid and further that, any labor earnings of the child are potentially outweighed by long-run productivity losses owing to inadequate investments in health and education made on his (or her) behalf. More significantly, making this distinction helped to address an important concern regarding survey responses on respiratory illnesses. Because there were only three questions relating to respiratory conditions in the National Sample Survey – pertaining to tuberculosis, asthma and "other respiratory illnesses" – there was the obvious danger of categorizing as NCDs several childhood respiratory conditions that are usually considered under a separate heading in ICD-9/10 classifications.[7]

The total estimated (sample-weighted) all-cause deaths among those who were hospitalized in the year preceding the survey were 0.96 million from the National Sample Survey data (out of a total of 4.03 million all cause deaths in the survey). This was a much smaller number than estimates of all-cause deaths based on death rates of 7.5 per 1,000 population and population estimates for 2004 provided by the Registrar General of India. This latter estimate came to roughly 8.1 million deaths. For this reason we upwardly adjusted our survey estimate of deaths to equal the estimate of the Registrar General of India (RGI) and used the ratio of RGI all-cause deaths to the survey estimates of all-cause deaths (8.1 divided by 0.96) to scale up sample survey based estimates of deaths from each disease.

Individuals (in the sample survey) who did not die in the year preceding the survey were sub-divided into those reporting an NCD in the reference period of 15-days preceding the survey (but not hospitalized) and all hospitalized cases. This distinction helped to focus attention on serious (and lengthy) cases of illness resulting in hospitalization. By comparison, the 15-day reference period better identifies shorter periods of illness, although long-running chronic conditions are also presumably captured from survey responses, given that the survey question on ailments in the 15-day reference period did not explicitly distinguish between acute and chronic cases. The survey did not contain adequate information on disabilities associated with disease, NCD or otherwise; so it was difficult to identify income losses associated with being unable to work due to disability. In an effort to account for this, we used the length of the period for which a person reported ill (rather than days spent as inpatient in a hospital, which were considerably fewer) as our indicator of work time lost. It is possible that, at least for some individuals, the period of disability extended well beyond the period of illness. If so, our methods would result in a downwardly biased estimate of the true cost of ill-health from NCDs (or, for that matter, communicable conditions). It is also possible that reported ill days overstate household income losses due to morbidity, especially if firms provide sick leave and other financial benefits to the affected individual. This point has been made in Abegunde et al. (2007)

[7]Of course, some child respiratory conditions may well be considered NCDs. This would likely bias our estimates downwards, although we believe this bias to be small.

in their critique of the method that we use here. Excluding any consideration of ill days in our calculations would likely be a lower bound to the "true" measure of income losses based on this method. To address this in some measure we also estimated income losses under the assumption that income losses occur only if an individual was hospitalized, or died.

Under our **second method** estimates of days ill by disease for individuals who did not die in the preceding year, were derived from the National Sample Survey data, just as described in the preceding paragraph. However, the method differs from the previous approach in its disease-specific distribution of deaths. Specifically, this method relied on information on medical certification of the causes of death (MCCD) for 2004 in a large sample of hospitals as reported in the Registrar General of India (2007) to construct the distribution of deaths by disease. Unlike self-reported causes of death in the sample survey (a sort of verbal autopsy), the hospital-based certification of cause of death is undertaken by medical professionals and more likely to be accurate. As noted in Chapter 2, while detailed by age and sex, this data did not cover all of the estimated deaths in India; probably no more than 6 percent of all deaths were certified in this manner. It might also be reasonable to assume that medically certified deaths are a better reflection of deaths among residents in major urban centers than for deaths in remote rural areas and small towns. Specific health conditions may also be more likely to be medically certified, in particular, traffic deaths, since they involve record-keeping by the police. Deaths among males are also more likely to be medically certified given issues of succession and property ownership that are more likely to be male-related.

Overall, MCCD records provided information on a total of 534 thousand deaths throughout India in the year 2004. This is considerably less than the estimated 8.1 million deaths from "all causes" in the year 2004 based on population and death rate estimates of the Registrar General of India. As before (as in the first method) we assumed that the cause-specific distribution of medically certified deaths was the same as for all deaths (including uncertified ones) in the population. This was used to allocate all 8.1 million deaths in the population by cause.

Just as under the two earlier methods, our **third method** too estimated the distribution (and magnitude) of ill days (by disease) for persons who did not die during the reference period from the National Sample Survey data for 2004. However, in assessing the distribution of cause of death by disease, this method relied on the distribution of deaths (by cause) as reported by the World Health Organization under its burden of disease program (WHO 2004).

Estimates of the distribution of deaths (for the same total magnitude of all-cause mortality), by disease category, under the three methods outlined above are provided in Table 4.1. Tables 4.2a-d provide information on the average number of days individuals were ill, by disease, under the 15-day reference period, the total number of cases reporting ill in the 15-day reference period (by disease), the total number of hospitalized cases in the one year reference period, the average length of an inpatient stay and the average length of days a hospitalized person reported being ill in the one-year reference period. The estimates are reported separately for individuals under 15 years of age and individuals over 15 years of age.

Estimating Annual Income Losses

To estimate lost income under this method, we matched information on deaths and morbidity to estimates of wage losses of the affected individuals and households. We used two methods to construct these dates, both of which are described below.

Both methods rely on *imputing* a (daily) wage to each individual in the household health care survey above the age of 15 years. For this purpose we estimated Mincer equations that describe the relationship between the natural log of the daily wage rate to indicators of educational attainment and experience and other controls. This exercise involved a number of technical issues. Because no wage information was available in the NSS health care utilization and expenditure survey, we used a separate unemployment-employment (or labor force) survey conducted by India's National Sample Survey Organization for the year 2004-5 to estimate the Mincer wage equations referred to above. The results of this estimation exercise are reported in Tables 4.3a-c. Separate equations were estimated for men and women (in rural and urban areas) and by status of employment, to reflect potentially different conditions in their respective labor markets. The estimation of Mincer equations requires some care, particularly to take account of statistical problems related to selection and endogeneity. We did not address these concerns here and estimated this equation by ordinary least squares (OLS) methods, noting simply that in previous work on India, the results from the OLS procedure did not differ much from the coefficient estimates produced by more sophisticated econometric tools used to address them (Duraisamy 2000). The labor force survey (NSSO 61st round) did not provide any information on the earnings of the self-employed. Thus we assigned the all India average wage (by combining regular and casual workers together) to them, but after adjusting to take account of rural-urban and gender differences. Moreover, we did not have any information on the educational status of dead individuals in the sample, or the characteristics of caregivers. To them we imputed the *average wage*, corresponding to each specific disease, of currently alive individuals reporting that same disease. Although this assumption is somewhat *ad hoc*, our household health survey data had no information on care-giving by household members to their sick relatives.

Under the first method, the imputed wage was (a) multiplied by the number of days spent as ill for each individual reporting sick, and further multiplied by 24.33 in case of the 15 day reference period to convert it into annual terms and (b) multiplied by the number of ill days in the case of hospitalization cases that are reported annually. This calculation was undertaken for all persons reporting ill in the preceding 15 days, or those who were hospitalized, by disease group (and for dead individuals). In addition, for persons who had died in the preceding year (whether they reported being hospitalized or ill or not) we multiplied their imputed daily wage by 182.5 (365 divided by 2) to estimate annual income foregone on account of premature death (by disease group). The assumption underlying this last calculation was that all deaths occur in the middle of each year. Finally, we assumed that the imputed wage for caregivers was the same as the average of the imputed wages for sick individuals in each disease group. To estimate income losses for caregivers, we multiplied the imputed wage by one-half of the number of total ill days (including both the 15 day reference period and hospitalizations). The total for these different categories of income losses (hospitalization, premature death, illness among non-hospitalized cases and caregivers) was taken to be our estimate of annual income losses to households affected by illness (NCD or other).

There are two points to note about the method used above for calculating income losses. We use imputed wages for all *sick* individuals and not just those currently working. Thus we assign a measure of productivity to all working age individuals and not just the employed. Our second

method differs from the first only in the way we apply (the same) imputed wages to calculate income losses. Specifically, in this case, income losses for sick individuals are considered only if they were reported as working in the survey. No income loss is assigned to caregivers, who are assumed to be non-working members of the household. For dead individuals, we make the simple assumption that their employment rate is/was the same as their counterparts who are currently alive, conditional on the disease category. This method likely describes the lower bound to income losses experienced by the household from NCDs.

4.3. Results and Discussion

Our results under the two different methods for calculating income losses are described in Tables 4.5 and 4.6. Assuming that all care-givers and sick individuals above the age of 15 years are productive yielded an annual income loss of one trillion rupees in 2004. Much of this was in the form of income losses arising from days spent ill and in care-giving effort. The loss on account of premature death was lower, reflecting the chronic nature of NCDs, so that care and treatment amount cumulatively to much larger amounts than incomes foregone by households owing to the premature death of their members from NCDs.

More than one-third of all income losses are due to CVD and hypertension. Another 15 percent are accounted for by diabetes, so that nearly half of all income losses from NCDs occur on account of a fairly narrow range of conditions and their co-morbidities. Another significant chunk (roughly in the region of 20 percent) of all income losses are related to asthma and other respiratory conditions. Accidents and injuries make up for about 6-7 percent of all annual income losses.

Annual income loses based on an imputed wage for all individuals above the age of 15 years will not be an accurate reflection of household declines in income due to NCDs if not everybody works, or if safety nets exist that protect individuals from loss of income during ill health or if there is survivor pension that provides support to the family of a deceased income earner. The latter is not a major concern in India given that only 10 percent of the work force is employed in the formal sector where such protections exist. However, the issue of work force participation most certainly is. Our sample survey data reveal that overall work force participation rate (proportion of people aged 15 years and above with NCDs who actually worked) was only about 47 percent (inclusive of injury cases). If we consider only those who are working, the resulting income losses would be considerably lower than the estimates presented in Table 4.5. Indeed, when we limited ourselves to those who are working, we end up with much lower estimates of the annual income losses to households associated with NCDs – roughly INR 280 billion – as seen in table 4.6. Our findings with regard to the relative importance of different types of health conditions are also the same, although the contribution of CVD is now slightly lower than in Table 4.5, and that of accidents and injuries slightly higher. The latter reflects the higher work force participation rate among accident victims – around 65 percent in our survey, compared to the rest of the CVD.

Because average imputed wage earnings per person (based on the results from the Mincer equations) came to about INR 22 thousand annually, much lower than India's GDP per adult worker, we are concerned whether our indicator of income was comprehensive enough to capture aggregate income losses to affected households. For one, the survey question on wages does not

include benefits provided by the employer in the form of contributions to savings schemes, health benefits and the like. These can be as high as 30 percent in the formal sector. More crucially, however, focusing on household expenditure excludes information on household savings which, in India, is known to be quite high – national savings rates are close to 30 percent of GDP according to the most recent estimates available. For this reason we also considered an alternative formulation under which each individual aged 15 years or older was assumed to earn an amount equivalent to India's GDP per adult worker. The adoption of this alternative method resulted in estimates of income losses that were almost twice as high as the case with survey based imputed wages, although we do not present the results here.

Taking account of income losses associated with ill health is an important step in appreciating that it is not only out of pocket expenses but also earnings foregone by households that constitute a significant financial risk from NCDs. Our analysis suggests that irrespective of the metric used, there are significant income losses experienced by households whose members experience NCDs in India. From a policy perspective, the lack of social safety nets and the decline of the inter-familial linkages as a source of financial support imply that the burden of these income losses associated with NCDs will fall primarily on individuals with NCDs (or the household that s/he is a part of).

Although we have tried to take account of a number of complexities in available Indian data, more rigorous evidence must await the availability of better quality (and longitudinal) data that provides us with good disease-specific information, as well as on analyses that can better help address the challenge of isolating the impact of competing health risks. Thus far, we have relied upon the assumption that competing risks are statistically independent, which simplifies our task of estimating income losses on account of NCDs, a somewhat unsatisfactory state of affairs, which likely biases upwards our estimates of income losses. Chapter 6 takes up this concern more directly.

It should also be noted that adding up income losses among households that had one or more members experiencing an NCD does not imply anything about declines in income for the economy as a whole. If individuals who die are easily replaced in the labor market by other (previously unemployed) workers, no loss in national income will occur. Estimating losses in national income requires somewhat different techniques, which we illustrate in Chapter 5.

Table 4.1: The All India Distribution of Deaths by Disease: Estimates using Alternative Methods, 2004

Disease	Unadjusted NSS Data	Unadjusted MCCD Data	Unadjusted WHO Data	Adjusted NSS Data	Adjusted MCCD Data	Adjusted WHO Data
CVD (excl. hypertension)	155,782	138,881	2,760,300	1,313,927	2,105,215	2,152,541
Hypertension	13,393	8,194	49,700	112,961	124,207	38,757
Respiratory Illnesses (≥ 15)	5,461	24,808	552,400	46,062	376,047	430,773
Asthma	61,060	8,194	57,100	515,006	124,207	44,528
Disorders of Joints/Pain	2,929	329	7,100	24,704	4,987	5,537
Disease of kidney/urinary system	45,572	11,623	132,800	384,368	176,185	103,560
Neurological Disorders	28,636	17,435	98,400	241,531	264,287	76,734
Psychiatric Disorders	680	688	84,000	5,732	10,429	65,505
Diabetes	24,449	13,136	156,200	206,214	199,121	121,808
Accidents & Injuries	72,058	114,889	1,049,500	607,769	1,741,534	818,423
Cancers & Other Tumors	95,479	19,577	757,800	805,303	296,756	590,949
Other NCD	n. a.	427	454,900	n. a.	6,472	354,741
All NCD	***505,499***	***358,181***	***6,160,200***	***4,263,577***	***5,429,453***	***4,803,857***
All other conditions (plus undiagnosed)	***454,070***	***175,739***	***4,218,300***	***3,829,801***	***2,663,925***	***3,289,521***
All Diseases	***959,569***	***533,920***	***10,378,500***	***8,093,378***	***8,093,378***	***8,093,378***

Note: Deaths (by cause) in NSS data from its 60th round carried out in 2004, MCCD data for 2001 and the WHO data were scaled up (or down) to equal the estimated number of population deaths. The latter estimated was arrived at by multiplying the (all cause) death rate by total population size. Mortality data (by cause) from the NSS are self-reported, and are weighted, using sampling weights.

Table 4.2a: Length of Illness and Health Care Utilization, By Disease, among Individuals (Alive) aged 15 years and above, 2004

Health Condition	Hospitalized Cases in 1 Year Preceding the Survey			Ailments (Annual) based on 15 day Reference Period (excluding hospitalizations)	
	Number (000s)	Average Length of Stay (days)	Average Length of Illness (days)	Number (000s)	Average Length of Illness (days)
CVD (excl. hypertension)	1,417	9.7	78.4	2,713	14.0
Hypertension	674	6.8	74.3	5,319	14.0
Respiratory Illnesses	494	7.6	43.2	4,095	8.7
Asthma	787	8.7	80.5	3,406	13.2
Disorders of Joints/Pain	668	12.4	66.1	6,611	13.4
Disease of kidney/urinary system	1,046	9.8	46.1	893	13.2
Neurological Disorders	742	13.0	86.1	1,836	13.1
Psychiatric Disorders	242	16.2	102.3	639	14.4
Diabetes	540	10.2	87.9	3,637	14.7
Accidents & Injuries	2,319	13.7	47.7	2,113	10.1
Cancers & Other Tumors	695	15.1	73.1	505	13.3
All NCD	***9,725***	***11.3***	***65.9***	***31,896***	***12.8***
All other conditions (incl. undiagnosed)	***13,790***	***8.3***	***37.9***	***43,950***	***9.5***
All Diseases	***23,515***	***9.5***	***49.2***	***75,845***	***10.9***

Note: Authors' estimates, based on data from the 60th round (2004) of the National Sample Survey Organization that surveyed nearly 80 thousand households on health care utilization, expenditure and other information. The number of illness episodes in columns (5) and (6) is "annualized" by multiplying the by 24.33 the number reported in the 15-day reference period. We assumed that all respiratory illnesses among individuals 15 and over were NCD; and among those aged 15 and below, non-NCD.

Table 4.2b: Length of Illness and Health Care Utilization, by Disease, among individuals (alive) Aged less than 15 years, 2004

Health Condition	Hospitalized Cases in 1 Year Preceding the Survey			Ailments (Annual) based on 15 day Reference Period (excluding hospitalizations)	
	Number (000s)	Average Length of Stay (days)	Average Length of Illness (days)	Number (000s)	Average Length of Illness (days)
CVD (excl. hypertension)	51	15.3	98.4	61	14.5
Hypertension	1	6.6	19.1	18	9.2
Asthma	131	6.3	32.2	317	9.9
Disorders of Joints/Pain	93	14.9	51.9	122	12.2
Disease of kidney/urinary system	152	8.3	36.5	112	12.4
Neurological Disorders	172	7.0	50.6	248	13.0
Psychiatric Disorders	24	6.8	37.3	56	14.6
Diabetes	21	3.4	330	14	15.0
Accidents & Injuries	538	7.5	26.2	649	8.2
Cancers & Other Tumors	49	13.4	57.4	36	13.2
All NCD	***1,242***	***8.5***	***42.8***	***1,634***	***10.5***
All other conditions (incl. undiagnosed)	***4,536***	***7.4***	***22.6***	***26,373***	***6.2***
All Diseases	***5,778***	***7.6***	***27.0***	***28,007***	***6.5***

Note: Authors' estimates, based on data from the 60th round (2004) of the National Sample Survey Organization that surveyed nearly 80 thousand households on health care utilization, expenditure and other information. The number of illness episodes in columns (5) and (6) is "annualized" by multiplying the by 24.33 the number reported in the 15-day reference period. We assumed that all respiratory illnesses among individuals 15 and over were NCD; and among those aged 15 and below, non-NCD.

Table 4.2c: Length of Illness and Health Care Utilization, by Disease, Dead Individuals, Age 15 Years and Above, 2004

Health Condition	Hospitalized Cases in 1 Year Preceding the Survey		
	Number of Hospital Stays (000s)	Number of Individuals (000s)	Average Length of Illness (days) per Stay
CVD (excl. hypertension)	196	150	20.9
Hypertension	14	13	13.9
Respiratory Conditions	68	5	14.5
Asthma	91	60	31.0
Disorders of Joints/Pain	4	3	12.0
Disease of kidney/urinary system	49	38	26.4
Neurological Disorders	54	22	30.0
Psychiatric Disorders	1	1	16.0
Diabetes	37	23	46.2
Accidents & Injuries	107	54	21.0
Cancers & Other Tumors	154	95	23.4
All NCD	***781***	***470***	***23.9***
All other conditions (incl. undiagnosed)	***509***	***307***	***25.8***
All Diseases	***1,289***	***776***	***24.7***

Note: Authors' estimates, based on data from the 60th round (2004) of the National Sample Survey Organization that surveyed nearly 80 thousand households on health care utilization, expenditure and other information. Note that some individuals would have multiple hospital stays for different reasons. The 3rd column indicates individuals by the reason for their ***last*** hospitalization prior to death.

Table 4.2d: Length of Illness and Health Care Utilization, by Disease, Dead Individuals, Less than 15 Years, 2004

Health Condition	Hospitalized Cases in 1 Year Preceding the Survey		
	Number of Stays (000s)	Number of Individuals (000s)	Average Length of Illness (days)
CVD (excl. hypertension)	5.5	5.5	4.8
Hypertension	0	0	n. a.
Asthma	1.6	1.6	15.0
Disorders of Joints/Pain	0	0	n. a.
Disease of kidney/urinary system	2.3	2.3	56.5
Neurological Disorders	6.6	6.6	26.0
Psychiatric Disorders	0	0	n. a.
Diabetes	1.1	1.1	10.0
Accidents & Injuries	18.1	18.1	15.6
Cancers & Other Tumors	0.6	0.6	15.0
All NCD	***35.7***	***35.7***	***18.3***
All other conditions (incl. undiagnosed)	***147.5***	***147.5***	***10.4***
All Diseases	***183.2***	***183.2***	***11.9***

Note: Authors' estimates, based on data from the 60th round (2004) of the National Sample Survey Organization that surveyed nearly 80 thousand households on health care utilization, expenditure and other information. We assumed that all respiratory illnesses among individuals 15 and over were NCD; and among those aged 15 and below, non-NCD.

Table 4.3a: Estimating the Mincer Equation:
Regression Results for All Workers Aged 15 Years and older, 2004

Explanatory Variables	Rural		Urban	
	Males	**Females**	**Males**	**Females**
Intercept	3.657* (0.019)	3.283* (0.034)	4.260* (0.021)	3.815* (0.042)
Primary education = 1, if completed, 0 otherwise	0.155* (0.010)	0.0927* (0.036)	-0.0724* (0.018)	0.050 (0.039)
Middle Education = 1, if completed, 0 otherwise	0.266* (0.012)	0.109* (0.026)	0.060* (0.018)	0.124* (0.045)
Secondary education = 1, if completed, 0 otherwise	0.607* (0.019)	0.611* (0.057)	0.421* (0.019)	0.824* (0.050)
Higher-secondary education = 1 if completed, 0 otherwise	0.883* (0.146)	0.323 (0.562)	1.188* (0.061)	1.168* (0.238)
= 1 if college educated or higher, 0 otherwise	1.335* (0.038)	1.439* (0.068)	1.083* (0.023)	1.409* (0.036)
= 1, if technical diploma/certificate, 0 otherwise	0.532* (0.257)	-0.572 (0.579)	0.360* (0.076)	0.412 (0.283)
Experience	0.003* (0.001)	0.003 (0.002)	-0.005* (0.002)	-0.009 (0.029)
Experience-squared	-0.00001 (0.00002)	-0.00005+ (0.00003)	0.00025* (0.00004)	0.00012* (0.00005)
R-squared	***0.177***	***0.112***	***0.272***	***0.338***
Number of Observations	***49,782***	***19,555***	***43,965***	***9,804***

Note: Authors' estimates using household surveys on employment and unemployment undertaken by the National Sample Survey Organization for 2003-4. Estimates are based on OLS methods and do not consider selection and/or endogeneity problems. The dependent variable is the natural log of the daily wage. Self-employed individuals were excluded from the regression.

Table 4.3b: Estimating the Mincer Equation:
Regression Results for Casual Workers Aged 15 Years and older, 2004

Explanatory Variables	Rural		Urban	
	Males	**Females**	**Males**	**Females**
Intercept	3.475* (0.013)	3.192* (0.021)	3.619 (0.028)	3.567* (0.079)
Primary education = 1, if completed, 0 otherwise	0.168* (0.010)	0.095* (0.018)	0.164* (0.024)	0.095* (0.045)
Middle Education = 1, if completed, 0 otherwise	0.206* (0.010)	0.096* (0.023)	0.179* (0.023)	0.029 (0.064)
Secondary education = 1, if completed, 0 otherwise	0.274* (0.017)	0.135* (0.037)	0.295* (0.029)	0.264* (0.109)
Higher-secondary education = 1 if completed, 0 otherwise	-0.023 (0.102)	-0.848* (0.180)	-0.063 (0.197)	0.373* (0.038)
= 1 if college educated or higher, 0 otherwise	0.294* (0.053)	0.193 (0.147)	0.332* (0.076)	0.584* (0.163)
= 1, if technical diploma/certificate, 0 otherwise	0.003 (0.153)	0.762* (0.206)	0.672+ (0.359)	No observations
Experience	0.013* (0.001)	0.008* (0.002)	0.024* (0.003)	-0.002 (0.005)
Experience-squared	-0.00018* (0.00001)	-0.00013* (0.00002)	-0.00033* (0.00005)	-0.00002 (0.00007)
R-squared	***0.036***	***0.007***	***0.055***	***0.021***
Number of Observations	***36,271***	***16,843***	***11,595***	***3,151***

Note: Authors' estimates using household surveys on employment and unemployment undertaken by the National Sample Survey Organization for 2003-4. Estimates are based on OLS methods and do not consider selection and/or endogeneity problems. The dependent variable is the natural log of the daily wage. Self-employed individuals were excluded from the regression.

Table 4.3c: Estimating the Mincer Equation:
Regression Results for Regular Workers Aged 15 Years and older, 2004

Explanatory Variables	Rural		Urban	
	Males	**Females**	**Males**	**Females**
Intercept	4.254* (0.022)	3.831* (0.090)	4.490* (0.023)	3.950* (0.046)
Primary education = 1, if completed, 0 otherwise	-0.049 (0.034)	-0.036 (0.201)	-0.306* (0.021)	-0.096 (0.064)
Middle Education = 1, if completed, 0 otherwise	0.133* (0.033)	0.001 (0.079)	-0.131* (0.019)	-0.026 (0.060)
Secondary education = 1, if completed, 0 otherwise	0.537* (0.031)	0.624* (0.089)	0.184* (0.020)	0.651* (0.060)
Higher-secondary education = 1 if completed, 0 otherwise	0.898* (0.154)	0.540* (0.725)	0.881* (0.060)	0.922* (0.240)
= 1 if college educated or higher, 0 otherwise	0.958* (0.047)	1.077* (0.085)	0.797* (0.023)	1.200* (0.048)
= 1, if technical diploma/certificate, 0 otherwise	0.154* (0.259)	-1.818* (0.725)	0.375* (0.074)	0.463* (0.280)
Experience	-0.015* (0.003)	-0.016* (0.006)	-0.001 (0.002)	-0.002 (0.004)
Experience-squared	0.00047* (0.00007)	0.00025* 0.00012)	0.00024* (0.00004)	0.000039* (0.00009)
R-squared	***0.167***	***0.182***	***0.251***	***0.267***
Number of Observations	***13,511***	***2,712***	***32,370***	***6,653***

Note: Authors' estimates using household surveys on employment and unemployment undertaken by the National Sample Survey Organization for 2003-4. Estimates are based on OLS methods and do not consider selection and/or endogeneity problems. The dependent variable is the natural log of the daily wage. Self-employed individuals were excluded from the regression.

Table 4.5: Annual Income Losses to Households Affected by NCDs in India, 2004 (Estimate 1: Imputed wages for all working and non-working adults)

Health Condition	Income Losses (in Billions of INR) due to			
	Illness	**Care-giving**	**Premature death**	**Total**
CVD (excl. hypertension)	83.9	43.0	16.7-30.7	144-158
Hypertension	131.9	66.1	1.2-1.4	199
Respiratory Conditions	48.5	38.4	0.5-5.2	87-92
Asthma	66.3	35.4	0.5-5.2	102-107
Disorders of Joints/Pain	116.2	59.2	0.1-0.3	175
Disease of kidney/urinary system	26.6	14.6	2.3-4.8	44-46
Neurological Disorders	37.9	21.4	2.0-2.8	61-62
Psychiatric Disorders	12.9	7.0	0.1-0.7	20-21
Diabetes	106.6	53.7	2.2-2.3	163
Accidents & Injuries	36.3	22.2	5.3-20.3	64-79
Cancers & Other Tumors	12.7	6.7	3.0-8.0	22-27
All NCD	***679.8***	***367.8***	***46.3-65.5***	***1,094-1,113***
NCD (excluding injuries)	***643.5***	***345.6***	***41.0-45.2***	***1,030-1,034***

Note: Authors' estimates, based on data from the 60th round (2004) of the National Sample Survey Organization that surveyed nearly 80 thousand households on health care utilization, expenditure and other information; combined with mortality data from the Medical Certification of Causes of Death (MCCD) of the Registrar General of India and the Burden of Disease statistics of the World Health Organization. The range of estimates for income losses arises due to premature death reflects the differing composition of causes of death in the National sample Survey, MCCD and the WHO data.

Table 4.6: Annual Income Loss due to NCDs, 2004
(Estimate 2: Imputed Wages only to working adults)

Health Condition	Income Losses in (Billions of INR) due to:		
	Illness	**Premature death**	**Total**
CVD (excl. hypertension)	29.7	7.6-12.5	37-42
Hypertension	42.3	0.2-0.6	43
Respiratory Conditions	23.8	0.2-1.5	24-25
Asthma	25.5	0.2-1.8	26-27
Disorders of Joints/Pain	41.0	0.0-0.2	41
Disease of kidney/urinary system	12.9	0.7-2.5	14-15
Neurological Disorders	10.3	0.3-0.8	11
Psychiatric Disorders	3.0	0.0-0.3	3
Diabetes	40.5	0.5-0.8	41
Accidents & Injuries	21.7	3.5-10.1	25-32
Cancers & Other Tumors	4.4	1.1-2.9	5-7
All NCD	***255.4***	***22.5-27.5***	***278-283***
All NCD (excluding injuries)	***233.5***	***17.7-17.9***	***251***

Note: Authors' estimates, based on data from the 60th round (2004) of the National Sample Survey Organization that surveyed nearly 80 thousand households on health care utilization, expenditure and other information; combined with mortality data from the Medical Certification of Causes of Death (MCCD) of the Registrar General of India and the Burden of Disease statistics of the World Health Organization. The range of estimates for income losses arises due to premature death reflects the differing composition of causes of death in the National sample Survey, MCCD and the WHO data.

CHAPTER 5. IMPACT OF NCDS ON INDIA'S NATIONAL INCOME AND AGGREGATE WELL-BEING

5.1. Introduction

We now direct our attention to a second key element of the "cost" of NCDs: namely the implications for the economy/society as a whole. In this chapter we develop estimates of two different versions of aggregate impacts: one on the gross domestic product (GDP) or national income, and the other on the value of statistical lives lost.

5.2. Methods and Data

Estimating Annual Income Losses: The Production Function Approach

A standard way to estimate national income losses associated with ill health is to visualize an *aggregate production function* that links national output (or GDP) to indicators of "base" labor, capital and human capital indicators (such as educational achievement, work experience and health). To calculate the impact of NCDs on GDP we need to answer the following question: How much would national income change when there are changes in educational achievement, number of workers, life expectancy and capital stock due to ill health and death associated with NCD? A technical way of putting this is to say we are interested in the *total-derivative* of national income with respect to NCD.

The usual way to get at this total derivative is to use specific functional forms for the aggregate production function, such as a Cobb-Douglas formulation such as in equation (5.1) below

$$GDP = AK^{\beta}H^{1-\beta} \tag{5.1}$$

Here, K is an indicator of the stock of physical capital, and H is an indicator of the stock of human capital. The parameter β denotes the share of physical capital in total income and, therefore, $1-\beta$ is the share of human capital in national income. **A** is a technology parameter. Furthermore, we could write the human capital stock H as a function of a unit of labor (or "base" labor) times an indicator of the human capital embedded in labor (**Q**), which depends on health (such as life expectancy at birth), schooling, and experience (see equation (5.2)). That is

$$\begin{aligned} H &= LQ \\ Q &= e^{\alpha leb+\theta_1 s+\theta_2 t+\theta_3 t^2} \\ H &= Le^{\alpha leb+\theta_1 s+\theta_2 t+\theta_3 t^2} \end{aligned} \tag{5.2}$$

We obtained one set of parameter estimates of $\beta, \alpha, \theta_1, \theta_2, \theta_3$ from a recent paper by Bloom, Canning and Sevilla (2004) that used a panel of a cross-section of countries, and another set of estimates from Duraisamy and Mahal (2005) who estimated a similar (but not identical)

specification for a panel for a cross-section of Indian states. Table 5.1 reports the results of regression coefficients from these two papers.

The impact of NCD on national output was then assessed by estimating the impact on each of its determinants. We estimated the impact of NCD on the labor force and on other indicators of human capital - life expectancy at birth, schooling, and experience – factors that enter into the aggregate production function. Specifically, we inquired what the life expectancy at birth would have been had there not been any NCD cases in the population in India, and similarly for schooling and experience. To figure out the impact of eliminating NCD on life expectancy at birth, we used the most recent *abridged* life tables from the Registrar General of India. Assuming that the share of NCDs in total deaths in each age group was the same as that reported in the MCCD data, we re-estimated age-specific mortality rates after "removing" all mortality due to NCD, and constructed a new set of life tables with these lowered mortality rates. In recalculating life-tables in the *absence* of NCD, one option is to assume that the risks of death from other (non-NCD) causes are statistically independent of NCD. This is not a realistic assumption, but to address the possibility that the risks are dependent across illnesses is an entire project in and of itself. To partially address this concern, in our calculations we assumed that age specific mortality rates after the age of 65 years remain unchanged even after NCDs are eliminated, owing to co-morbidities and competing risks. This is an area where further work might be useful (Honore and Lleras-Muney, 2006). Under our assumptions, we obtained an estimated of 71.0 years after elimination of deaths due to NCDs (compared to 63.6 years prior to the elimination of NCDs).

Sample survey data on experience and educational attainment of individuals with (and without) NCD was used to assess what the experience and educational levels would have been in the absence of NCD in the Indian population. Specifically, we inquired whether accounting for the experience and educational levels of individuals who were ill and/or died of NCD would have substantially changed the average levels of education and experience in the labor force. In this exercise, we assumed that any labor time "gained" (in the 15 years and over age-group) on account of less time spent being ill (or dying prematurely), or not being involved in care-giving activities acts to ***add*** to the labor force in the 15+ age category. Again, a more careful analysis (that we did not pursue) would need to examine the potential labor market impacts of adding these individuals back to the labor force. Estimates of average schooling, experience and experience squared in the baseline were obtained for two groups in the population – those with NCDs and for the population as a whole (for our projections, only the latter is relevant and shown in Table 5.2). To get at the values of these variables in the case where there were no NCDs, we considered the higher labor force (715 million and 671 million in Table 5.2) and assumed that all the extra laborers were endowed with the average schooling and experience of individuals currently reporting NCDs. The additional labor time included not only the persons who would now be alive, but also the additional labor time saved by reduced morbidity from NCDs. Because the education and experience variables among the NCD-population are higher, the reduction in NCDs increases the average of these variables for the population as a whole.

Given the econometric specifications in Table 5.1, we also needed to make assumptions about how the physical capital stock will be affected by NCDs. Presumably, both foreign and domestic investment would respond to improvements in health, such as the elimination of morbidity and mortality due to NCDs. Given that foreign direct investment flows into India are

relatively small compared to the size of its economy we focused on the impact of NCDs on domestic investment. Even here, we limited ourselves to the impact of NCD related health expenses on net domestic investment and capital, public and private. We considered three possible scenarios relating to the impact of NCD on domestic investment: (a) *all of the out of pocket spending on NCD* came out of savings (and investment); (b) only half of the spending on NCD was from reduced savings; and (c) savings were not affected at all by NCD expenditures. These scenarios had virtually no effect on our results and so in Table 5.2 we report the results for the case where all of the savings come out of investment. Table 5.2 also presents our estimates of different explanatory variables under two major alternative scenarios – with and without morbidity and mortality due to NCDs.

A technical issue of direct relevance to these calculations was the estimation of the stock of capital. We used data provided by India's Central Statistical Organization (CSO) on a time series of net private investment to construct a corresponding capital stock series. This was done was assuming an annual depreciation rate of 5 percent, following a "straight-line" depreciation method. No information on annual government investment was available; although data on government spending was available from government budget documents. We assumed that the portion of government spending under the "capital account" was essentially government investment, with the rest being consumption expenditure. With this information, estimates of government capital stock were constructed using methods identical to that of private capital stock. Three scenarios of the impact of public spending on health associated with NCD on government investment were considered. Government subsidies on health were assumed to directly come out of government investment allocations. Because the BCS and the DM models do not distinguish between public and private capital, we add up the two sets of estimates (for public and private stocks of capital) for our simulation exercises.

Our analysis does not consider other factors that might also influence national output. Specifically, it underplays demand-side factors, such as the fact that increased health spending might lead to rising incomes via some type of multiplier effect. The reason for doing so is our reliance on the empirical counterpart of the neoclassical (Solow) model of economic growth that assumes full employment via flexible prices. Bringing in health spending as a demand factor in this model will essentially result in health spending influencing relative prices and the composition of national output. This possibility is probably best modeled in terms of computable general equilibrium (CGE) models that have their own problems (Bloom and Mahal 1997). In the presence of a demand-side effect, our method of calculating the aggregate economic impacts of NCDs will probably result in an overestimate of the true effect of NCDs on national output.

Estimating Welfare Loss: The Value of Statistical Life Years Lost due to NCDs

To complement estimates of the potential impact of NCDs on India's GDP, we estimated the value of statistical life years foregone due to NCDs in 2004. This exercise is quite different from estimating losses to national income and is best interpreted as an indicator of the "welfare loss" that occurs due to NCDs.

There are a number of other technical issues that are worth noting here, and which have to do with the allocation of the value of statistical life year losses to a specific year (2004 in our case). First, as a practical matter, since all individuals must die at some point in time it makes little sense to attribute the entire welfare loss associated with a death (the value of a statistical

life) to its specific cause. Indeed the most appropriate option is to value the years lost by 'premature' nature of the death associated with NCDs. For instance, if were to focus on a single birth cohort, what matters for our purposes is that the life expectancy at birth in India would rise to 71 years (from 63.6 years), were NCDs to be eliminated without increasing the risks of death from other causes until the age of 65.[8] It is this average loss of 7.4 years of life that we wish to evaluate monetarily.

Second, there are two ways of approaching this valuation: we could seek to value the years of life foregone by individuals who die in a given year due to NCDs (ex post) or value the number of years that a cohort born in a given year would not enjoy (ex ante valuation). If we value the years lost by deaths from NCDs in a given year, we would need to figure out the collective numbers of years that they would have lived, had they not acquired a NCD. On the other hand, if we focus on births, we would value the addition to the life expectancy (at birth) that a birth cohort in a given year would enjoy were there to be no NCD. Because, the additional years of life occur some time in the future, discounting will be necessary. The ex-post method will yield higher estimates because the additional years gained from eliminating NCDs are much closer to the time they are being valued. To be conservative, we simply use the ex ante method – that is value the difference in the value of statistical life years of a given birth cohort with (and without) NCDs.

Third, it should be noted that our estimates will not provide anything more than an indicative assessment of the potential welfare gains foregone, since we are valuing only the addition to the (statistical) lives of individuals who were born in 2004. The value of a healthy life foregone to individuals with NCD who do not die (including any persons disabled due to NCD) is excluded from the calculations for that specific year. Similarly, the life tables we use do not allow for the likelihood of ongoing technological change that might lower the risk of NCD mortality for the cohort born this year and thus we might even overestimate the welfare gains from eliminating NCDs.

The financial value of a life lost was calculated on the basis of the estimates reported in Viscusi and Aldy (2003). They summarize the results of a very large number of cross-country studies, in addition to providing estimates of their own, and suggest that the income elasticity of the value of a statistical life ranges between 0.5 and 0.6 (a mid-point of 0.55). Studies for the United States suggest a value of statistical life of the order of US$6 million (Kniesner et al. 2005) for workers with incomes in the range from US$30,000-US$40,000. We use the information on average imputed daily wages (as well as per capita income based on a simple division of GDP by the working age population) as our indicators of incomes to construct two corresponding indicators of the value of a statistical life using the Viscusi-Aldy results. In general, GDP per worker (INR 41,096) is higher than the imputed wages (INR 23,225) estimated from household survey data and results in higher estimates of the value of life.

Based on the estimated value of a statistical life of given duration, we calculated the annualized value of a statistical life year for a person born in 2004, using a standard annuitization formula (Viscusi and Aldy 2003). Specifically, if VSLY is the value of a statistical life year (constant for the rest of a person's life) for a person of a specific age, V the value of a statistical

[8]After the age of 65 years, we assume that competing risks increase by just enough to balance any reduction in mortality associated with NCDs.

life, "r" the rate of discount, and L the number of years this person can expect to live, we have that

$$VSLY = \frac{\left(\frac{r}{1+r}\right)V}{\left(1-(1+r)^{L}\right)} \quad \text{(C1)}$$

5.3. Findings and Discussion

Referring again to Table 5.2, we compared two scenarios to the baseline (the existing situation). Under the first of these scenarios we estimated the values on the set of baseline explanatory variables used in Bloom, Canning and Sevilla (2004) and in Duraisamy and Mahal (2005), if mortality and morbidity due to NCD were completely eliminated and labor time lost equaled the total number of days individuals reported as ill from NCDs but half the year for a person dying during the year. Under the second scenario, the number of days of work-time lost was assumed to be half a year each for a person dying during the year, and the number days spent as an inpatient of a hospital during the year. These reflect the possibility of changing work force participation rates on account of death or morbidity associated with NCDs. The two scenarios are referred to as Case 1, and Case 2, respectively.

Table 5.3 reports our main findings. Our analysis suggests that were NCD to be completely eliminated, the estimated GDP in a year such as 2004 would have been 5 to 10 percent higher under the Bloom, Canning and Sevilla estimates, and 4 to 9 percent higher under the Duraisamy and Mahal estimates. Per capita GDP would also be higher. The primary driver of these results on GDP is the change that is due to life expectancy at birth. In this, our findings differ from those of Abegunde et al. (2007) whose focus is on a Solow-type production function downplays the influence of the quality of labor (life expectancy) on national output.

Estimating Impacts on the Value of Statistical Life Years

If our interest is in the welfare implications of eliminating NCDs, the size of the GDP (or GDP per capita) is probably not the right metric as it captures only one dimension of the potential gains that result. Indeed, the more significant gain is likely to be the increase in the number of years lived. For this reason, we focus on the value of statistical lives that could be saved by eliminating NCDs. We used two sets of estimates for annual income in India – the average imputed wage for people with NCDs in our sample survey; and GDP per adult worker. This information was combined with information on the value of a statistical life of US$4.35 million for a sample of workers in the United States, and an income elasticity of the value of a statistical life of 0.55 (US$1=INR 45 in 2004), to obtain the value of a statistical life for India. This was roughly INR 90.9 million if we used the GDP per worker as an estimate of income and INR 89.7 million if we used the imputed wage method (or about US$2 million in both cases).

Using a discount rate of 5 percent and a life expectancy for a worker aged 25 of 47.5 years (based on life tables for India) we obtained the value of a statistical life year as INR 473 thousand (using the GDP per worker method) and INR 467 thousand (using the imputed wage method). These estimates were used to assess the potential gains to newborns in the year 2004 in

terms of the value of additional life years lived. Because the gains in 7.4 additional life years (on average) due to the elimination of NCDs occurring far in the future, the present discounted monetary value of this gain was in the range of INR 133 thousand and INR135 thousand. With roughly 25.9 million births in 2004, the potential gains to the cohort born in 2004 could be anywhere between INR 3,445 billion and INR 3,497 billion. These (potential) welfare gains amount to between 13 percent and 14 percent of GDP – slightly higher than our estimates of the impact of NCDs on GDP reported in Table 5.3.

More precise estimates must await the availability of better quality data that provides us with good disease-specific information, as well as on analyses that can better help address the challenge of isolating the impact of competing health risks. In addition, for our calculations we relied upon the implicit assumption that competing risks are statistically independent, an assumption that simplifies our task of estimating the value of life lost on account of disease, a somewhat unsatisfactory state of affairs. In the next chapter we take up this issue more directly.

Overall, there appear to be significant aggregate economic impacts of NCDs on India, whether measured in terms of potential GDP (or GDP per capita) foregone, or a welfare measure such as the combined statistical value of life years that could be gained were NCDs to be eliminated for any birth cohort. This conclusion is similar in spirit to that of Abegunde et al. (2007) and others who have used alternative methods to assess the aggregate economic impacts of NCDs. Thus there are potentially large gains to be had from investing in cheap interventions that can help either treat (or prevent) NCDs. Were we to include the income (or welfare) losses resulting from disability associated with NCDs, the potential welfare (and income) gains are likely to be considerably higher.

Table 5.1: Estimates of Regression Coefficients Used to Simulate Impact of NCD on GDP

Explanatory Variables	Ln GDP BCS Specification	Ln GDP DM Specification
Ln (Labor)	0.708	0.522
Ln (Capital)	0.342	0.340
Life Expectancy at Birth	0.013	
Ln (Life Expectancy at Birth)		0.723
Years of Schooling	0.082	
Ln (Years of Schooling)		0.256
Experience	0.266	
Experience-Squared	-0.005	

Sources: Duraisamy and Mahal (2005), Table 6 (DM); Bloom, Canning and Sevilla (2004) Table 3 (BCS). The DM specification did not include experience variables owing to the high degree of multi-collinearity across schooling and experience in the cross-province panel dataset for India.

Table 5.2: Values of Key Explanatory Variables for Simulating Impact of NCD on GDP in 2004

Variables	With NCD	Without NCD	
		Case 1	Case 2
Labor (15+) (millions)	667.69	715.11	670.58
Private Capital (INR billions)	29,552	29,952	29,952
"Public" Capital (INR billions)	13,476	13,588	13,588
Life Expectancy at Birth (Years)	63.6	71.0	71.0
Average Schooling (Years)	4.65	4.64	4.65
Experience	25.89	26.93	25.96
Experience-Squared	1008.22	1,084.28	1,013.16

Note: In our calculation of life expectancy at birth, with and without NCDs, we assumed competing risks of mortality (from communicable diseases) to be independent of risks of mortality from NCD. The baseline estimate of life expectancy at birth (63.6 years) differs from official estimates owing to our use of abridged life tables so as to correspond better with age distribution of deaths reported in MCCD. The "increase" in labor force is artificial in that we are *adding* labor time saved on account of avoided illness, lower care-giving and avoided deaths. **Case 1** assumes that labor time lost occurs both due to illness as well as health. **Case 2** assumes that only the time spent as an inpatient in a hospitals (plus death) is not recovered.

Table 5.3: The Impact of NCD on GDP and Per Capita GDP in India, 2004

Variables of Interest	BCS Method		DM Method	
	Case 1	Case 2	Case 1	Case 2
Change in GDP (percent)	4.48	10.25	12.62	8.95
Change in Per Capita GDP (percent)	4.35	10.02	12.39	8.72

Note: BCS Estimates are based on regression results reported in Table 3 of Bloom, Canning and Sevilla (2004, p.10), and the numbers presented in Table 5.2. DM estimates are from Duraisamy and Mahal (2005), Table 6. Per Capita GDP estimates were calculated as percent change in GDP minus the percent change in population..

CHAPTER 6. THE IMPACT OF NCDS ON ECONOMIC OUTCOMES IN INDIA: TAKING ACCOUNT OF COMPETING RISKS

6.1. Introduction

As noted in Chapter 2, standard methods for assessing the cost of illness and/or economic losses typically assume that the risks of morbidity/mortality from NCDs and other (non-NCD) conditions are statistically independent. While this generally makes it easier to undertake the desired analyses, this assumption is inappropriate owing to the existence of statistically dependent competing risks. In this chapter we aim to partially address this difficulty. Our purpose is to illustrate, using cross-sectional household survey data for India, the use of a propensity score matching approach to address the bias resulting from not taking account of *interdependent* competing risks when attributing direct health care expenses, and other economic impacts to NCD.

For each individual with NCD (in this chapter we use CVD, cancers and injuries for illustrative purposes), we find a control possessing similar observed pre-determined characteristics. We can then assess the economic impact of acquiring NCD by comparing the outcome for each person with his, or her, matched control. We show below that our matched control group is quite different from our random sample of people, both in terms of their observed characteristics such as education level, age, location of residence, and in terms of their health and economic outcomes. Matching to the control group therefore makes a significant difference to our estimates of the economic impact of CVD, cancers and injuries.

The dataset - the 60th round of the National Sample Survey Organization, conducted in 2004 – has been previously described. As noted, the survey collected information on the socioeconomic and demographic characteristics of the households and their members, in addition to hospitalization in the year preceding the survey, and on reported morbidity in a reference period of 15 days preceding the survey. We had information on the work status of household members, including whether they were involuntarily unemployed, not currently working, self employed, whether working for wages, and so forth. Information was collected on the nature of ailments, the type of treatment sought (public or private) and on the number of outpatient visits and inpatient days. Moreover, information was collected on the amounts spent on treatment for each health condition. Self-reported information was available for several health conditions. Because our purpose in this chapter is to illustrate the potential consequences of competing risks, we focus on three conditions: cardiovascular disease, cancers and injuries. In the 60th round survey, respondents who reported suffering from "heart disease" or "hypertension" were classified as experiencing CVD. The survey data were combined with independent information on poverty lines (or survival expenditure levels) obtained from the Indian Planning Commission for the two years in question.

6.2. Methods

We focused on the association between NCDs and economic outcomes. Firstly we inquired about the relationship between a person's work status and NCD. For this purpose we

considered a broader definition of 'not working,' including, besides the involuntarily unemployed, individuals attending educational institutions, or involved in domestic work and pensioners. This was done owing to the extremely small numbers of involuntarily unemployed individuals in Indian household surveys and high rates of "disguised unemployment," which suggested a need to consider alternative ways to assessing individuals' employment status.

Following Xu et al. (2003) and Doorslaer et al. (2006, 2007), we considered two measures of the impact of NCD-related health sending on the economic status of individuals. The first was an indicator of whether the health spending was "catastrophic." Here "catastrophic" spending (for each individual) was defined as occurring when hospitalization spending for that person as a proportion of *ability to pay* (household consumption spending *less* combined survival income for all household members) exceeded a certain threshold: we used a threshold of 30 percent for our analysis, although other cut-offs are obviously possible. Survival income was defined as the poverty line level of expenditure *multiplied* by household size. Mathematically, for each individual "i" in household "j", we defined a variable D_{ij} as

$$D_{ij} = \frac{h_{ij}}{E_j - n_j P}$$

Here, h_{ij} is the health spending of individual "i" in household "j", E_j is total household consumption spending, n_j is the size of household "j", and P is the poverty line level of spending in this economy. Catastrophic spending is said to occur whenever D_{ij} exceeds 0.3 in our framework. Note that this approach to defining catastrophic spending at the *individual level* ascribes to each *individual* the potentially catastrophic implications (to their household) of their individual-specific health spending. Non-sick members of the household would not impose any catastrophic financial consequences on the household under this method. This approach seems to us reasonable, with one caveat. The measure of the impact of NCD-related health spending on catastrophic spending that we use *underestimates* the contribution of individual-specific health spending to the household's economic burden. This is because if there are multiple individuals who spend on hospitalization within the same household, their expenditures may be catastrophic in 'combination' but not individually so. Of course, the same argument holds for the economic burden of communicable diseases. To an extent, matching, by putting similar individuals together, addresses this concern if both NCDs and CDs are experienced within the same household. However, this 'correction' will not work if households have multiple members with NCDs.

We also used an indicator of the impoverishing effects of an individual's health spending. Specifically, we considered health spending as impoverishing to the household if, after subtracting it from household spending, an individual household member's per capita expenditure moved *him/her* from above a poverty-line level of spending to below it. Again, consider an individual "i" and household "j" and a variable E_{ij}, where (a) $E^{b}{}_{ij} = \frac{E_j}{n_j}$ indicates the

individual's spending (gross of health spending); (b) $E^{a}{}_{ij} = \frac{E_j - h_{ij}}{n_j}$ as the individual's spending *net* of his (her) specific health spending.

If $E^{b}{}_{ij} > P$ and if $E^{a}{}_{ij} < P$, we say that the health expenses of this individual are impoverishing the household in question. Of course, modelling the poverty impact in the manner of the previous paragraph requires the assumption that there are *no economies of scale* in the allocation of household spending. Incorporating such considerations, by using equivalence scales, such as in Xu et al. (2003), or as in Doorslaer et al. (2006) is straightforward.

We used the propensity score matching method to compare hospitalization rates, length of inpatient stays, amounts spent out-of-pocket for health care, unemployment status, work status, and measures of catastrophic spending and impoverishment for individuals who reported CVD, cancer, and injuries, respectively with those who did not.

The sampling approach of India's National Sample Survey Organization introduced some complications in this endeavour. Because self-reported morbidity information on individuals was available only for those individuals who were hospitalized in the year preceding the survey, and in the 15-day reference period preceding the survey, it is possible that some individuals with chronic conditions were under-recorded in our analysis. Consider an individual who suffered an acute myocardial infarction two years earlier and is now taking medication to keep blood pressure and other complications in check. While the specific question in the survey instrument does allow for such conditions to be reported – namely, "ailments that started more than 15 days ago and are continuing," it is not clear, if under field conditions, an individual did (or did not) adequately identify them. There is some evidence of this phenomenon based on estimates of survey-based NCD prevalence in Table 2.1 If such omissions are significant, our method may understate the potential health care costs of NCD. As another example, many individuals may not be aware (and, therefore, would not have reported) suffering from hypertension. This last omission could result in propensity score matching methods overstating the per person health care costs of CVD because severe cases are more likely to be reported.

The major worry, however, is that having a specific NCD and being counted in our "treatment" group is itself non-random and may correlate with an individual's other confounding characteristics. Propensity score matching methods help to generate a set of controls (individuals who self-report themselves *not* to have that NCD condition) corresponding to treatment cases (individuals who report themselves to have the specific NCD). Specifically, individuals who have a specific NCD are matched to individuals who do not have that specific NCD but do possess similar predicted probabilities (propensity score) of having that NCD, conditional on a set of observable characteristics.

The key assumption in this approach is that conditional on the propensity score, assignment to the treatment (with NCD) and control (without NCD) groups can be taken to be random (Rosenbaum and Rubin 1982). If this is the case, then the difference in outcomes between treatment and control groups can be directly compared to give the effect of "treatment". However, the control group is only truly valid if the likelihood of reporting the specific health condition is equal for each individual after conditioning on the controls we use. One test of this

assumption is that conditional on the propensity score, the observable predetermined characteristics of the two groups have similar distributions. Even if this "balancing" property is satisfied, we still have to assume that selection to the treatment group is *not* based on unobservable characteristics that also affect our outcome variables. If the likelihood of reporting a CVD is correlated with unobserved confounders we may be measuring the effect not of the CVD but of these confounders. In the absence of real experimental data, estimating the effect of having CVD adjusting for observable confounders, as we do, seems better than not adjusting at all, even if it falls short of adjusting for all possible confounding effects and likely to better address biases relating to competing risks. Our cross-sectional data are ill equipped to address this concern, which a longitudinal dataset is better equipped to address.

We used two procedures, which all use propensity scores, to assess "nearness" between control and treated cases: the stratification method and the nearest neighbour method (Becker and Ichino 2002). Both methods all yielded very similar estimates of the impact (three types) of NCD conditions on outcomes. These conditions were cardiovascular disease, cancers and injuries that accounted for nearly one-sixth of all hospitalizations in 2004 according to NSS data. Treatment cases and control cases were further restricted to a common support, thereby eliminating cases in which the treatment and nearest control may be quite far apart. The "propensity score" on which these individuals were matched was constructed by a logit regression of treatment status (for example, 1 if CVD, 0 if not) on observables that included age categories, region of origin (north, south, central, west), rural origin, indicators of primary, secondary and higher levels of education; indicators of caste. Separate matching exercises were undertaken for males and females. The list of explanatory variables used for this matching exercise includes only individual characteristics, and does not include household expenditures, household size, marital status, health expenditures, or asset holdings, since these variables are all likely to be endogenous. Including endogenous household level variables in the matching would bias our results.

6.3. Findings

We describe our results separately by cardiovascular disease, cancers and injuries. According to the National Sample Survey data of 2004, there were nearly 1.7 million hospital stays on account of heart disease, 0.9 million hospital stays due to cancer and 3.0 million hospital stays associated with accidents and injuries. In addition, there were 68 million outpatient visits each associated with CVD and accidents/injuries and about 13 million visits for cancer. In presenting our findings, we do not report results for the first stage logit regressions that were used to construct propensity scores except to note that the likelihood of reporting cancers and CVD rises with age and educational attainment and is lower for members of lower castes. In addition, there were regional variations in reported prevalence rates of cancers, CVD and injuries.

Cardiovascular Disease

We used the estimated propensity scores from the first-stage logit regressions to match each individual reporting CVD (the treatment group) with a control individual who did not report CVD (including individuals who might have reported other health conditions classified as NCD). We use the nearest neighbour matching (random assignment if equidistant and with replacement)

methods. Tables 6.1a and 6.1b summarize sample means for three groups, separately for males and females: individuals with CVD (the treatment group); individuals from the random sample who are matched to the treatment group under the nearest neighbour rule (the non-CVD control group); and the full set of individuals without CVD in the random sample. Notice that for our pre-determined variables--age, sex, religion, and ethnicity--there are considerable differences in the sample means between the treatment group (the column 1 in Table 6.1a and Table 6.1b) and the unmatched group (column 3). However, once the nearest neighbour criterion is used to generate a matched set of controls, the sample means of the pre-determined variables of the matched control group, shown in column 2 of Table 6.1a and 6.1b, are considerably closer to those of the treatment group (individuals reporting CVD). In the analysis that follows, this similarity between matched treated and control groups occurs repeatedly, so we limit our focus to outcome variables.

Tables 6.1a and 6.1b also show that when we compare the outcomes of interest of the treatment with the matched control group -- hospitalization rates, likelihood of outpatient visits, health expenditures, impoverishment, and catastrophic spending rates -- the differences in sample means, with few exceptions, are large (in contrast to the set of pre-determined variables). These differences, all else the same, will be due to CVD. Moreover, the outcome variables can be very different between the matched control group and the full set of individuals in the survey who do not report a CVD. This indicates that individuals with the same pre-determined characteristics as individuals with CVD differ in their outcomes from the average of the non-CVD sample.

Table 6.2 presents our findings on the effect of CVD on health care utilization, health spending, the likelihood of catastrophic spending and impoverishment among households and employment status. For each variable we compare the outcome for the individuals with CVD with that for a set of matched controls. All health care utilization and spending is measured for the individual (most surveys look at household utilization and expenditure – we have individual level data). Columns 2 and 3 of Table 6.2 report the differences in outcomes using the nearest neighbor matching where each individual with CVD is matched with the individual in the random sample with the closest propensity score. In cases where two or more individuals are equally close we choose between them randomly to make the match. In the context of our analysis, there is very large number of potential matches. In columns 4 and 5 we split individuals with CVD into strata, based on their propensity scores, and match them with all the individuals from the random sample that fall in the same stratum. We report the size of the average difference between the outcome for individuals with CVD and the matched control group, and a standard error of this difference.

The results of the two matching methods are quite similar. We find that individuals with CVD report greater use of health services, higher levels of out of pocket health spending and resulting catastrophic spending and impoverishment in their households in comparison to their counterparts in the control group. For instance, males with CVD are about 46 percentage points more likely to report hospitalization in the last year than the matched controls. They are likely to report 4.3 days more of inpatient care, 19.4 percent point greater likelihood of imposing catastrophic expenses on the households to which they belong and an 8.1 percent point greater likelihood of impoverishing their household. They also use more health care services in both the public and the private sectors. Females with CVD too, report higher health care use, health

spending, and risks of impoverishing their households than their matched counterparts. Compared to their matched counterparts, however, males with CVD impose a greater economic burden than females with CVD. Specifically, the likelihood of incurring catastrophic spending in the case of a woman with CVD is 13.2 percent, and of impoverishment, 5.3 percent. These estimates would suggest that the number of individuals incurring catastrophic spending on account of CVD in 2004 was likely to be *at least* 1.4-2.0 million; and CVD would have impoverished *at least* 0.6-0.8 million people. The actual numbers may actually be much higher due to the fact that our analysis excludes individuals who may have underreported cases for which acute conditions occurred outside the reference period, and any CVD-related income losses; and because we excluded individuals who died in the year preceding the survey because of missing information on covariates in the first-stage propensity score regression.

We also carried out similar analyses for the 1995-96 health care utilization and expenditure survey of the National Sample Survey Organization here, although we do not present the detailed results here. Given the cross-sectional nature of the data, the controls are obviously different in the two surveys. It is noteworthy though that additional health care expenses due to CVD (in current INR) more than doubled over the period from 1995-96 to 2004, and inpatient lengths of stay declined. The impacts on catastrophic spending appear not to have changed much over the two periods, possibly reflecting the substantial gains in household incomes in India over this period. The impacts on measures of unemployment also are roughly similar in the two periods.

In contrast, the average treatment effect of CVD on poverty increased quite sharply from 1995-96 to 2004, despite rising incomes and lowered overall poverty rates. This would suggest a story where rising incomes from a process of economic growth over the period led to the poor crossing over above the poverty line over this period, but these gains were partially eroded by out of pocket spending associated with CVD that led others to fall below the poverty line. This argument is also consistent with constrained public sector health spending characteristic of this period.

Cancers

Table 6.3a and 6.3b report summary statistics for the treatment group, the matched control group (no cancers) and unmatched control group (no cancers) using nearest neighbour matching (random assignment if equidistant and with replacement). Note from these tables that when we compare the outcomes of interest of the treatment with the matched control group -- hospitalization rates, the likelihood of outpatient visits, health expenditures, impoverishment, and catastrophic spending rates -- the differences in sample means, with few exceptions, continue to be large. These differences, all else the same, can be considered the effects of cancer. Note also that the outcome variables are often very different between the matched control group and the full set of individuals in the survey who do not report cancer (unmatched control group). This indicates that individuals with the same pre-determined characteristics as individuals with cancer differ in their outcomes from the average of the non-cancer sample.

Table 6.4 presents our findings on the effect that cancer has on health care utilization, health spending, the likelihood of catastrophic spending and impoverishment among households and employment status. For each variable we compare the outcome for the individuals with

cancer with a set of matched controls. Columns 2 and 3 of Table 6.4 report the differences in outcomes using the nearest neighbor matching; and in columns 4 and 5 we report results based on the "stratification" method. As in the case of results for CVD, the results of the two matching methods are quite similar in the case of cancer.

We find that individuals with cancer report greater use of health services, higher levels of out of pocket health spending and greater rates of catastrophic spending and impoverishment in their households in comparison to their counterparts in the control group, who do not report cancer. For instance, males with cancer are about 73 percentage points more likely to report hospitalization in the last year than matched controls. They are likely to report an extra 12.5 days of inpatient care, a 43.9 percentage point greater likelihood of imposing catastrophic expenses on the households to which they belong and a 24 percent point greater likelihood of impoverishing their household. They also use more health care services in both the public and the private sectors. Females with cancer also report higher health care use, health spending, and risks of impoverishing their households than their matched counterparts.

Compared to persons with CVD, individuals with cancer whether male or female, report much greater spending on and utilization of inpatient care, a greater likelihood of incurring catastrophic expenditures and impoverishment of the household. Individuals reporting CVD, on the other hand, report a greater use of outpatient services. Overall, cancers seem to pose a greater threat to the economic well being of the households. Overall, cancers are likely to have resulted in at least 0.6 million individuals reporting catastrophic levels of health spending and at least 0.4 million people falling into poverty. As noted in the case of CVD, these are likely to be substantial underestimates of the true impact of cancers on catastrophic spending and impoverishment on India's population.

We undertook a similar matching score analysis using data from the 1995-96 survey round of the National Sample Survey. Although the detailed results are not presented here, we found that additional health care expenses due to cancer (in current INR) relative to matched controls (which differ for 1995-96 and 2004) increased multi-fold over the period from 1995-96 to 2004; and both inpatient care and outpatient care use increased. The average treatment effect of cancer on poverty, and the incidence of catastrophic expenditures increased quite sharply from 1995-96 to 2004. *Prima facie*, the adverse economic impacts of cancers are larger than CVD. The impacts on measures of unemployment were roughly similar in the two periods.

Injuries

Table 6.5a and 6.5b and Table 6.6 summarize our findings on the effect that injuries have on health care utilization, health spending, the likelihood of catastrophic spending and impoverishment among households and employment status. For each variable we compared the outcome for the individuals with cancer with a set of matched controls. Columns 2 and 3 of Table 5.15 report the differences in outcomes using the nearest neighbor matching; and in columns 4 and 5 we report results based on the "stratification" method.

We find that individuals with injuries report greater use of health services, higher levels of out of pocket health spending and greater rates of catastrophic spending and impoverishment in their households in comparison to their counterparts in the control group, who do not report

injuries. For instance, males with injuries are about 77 percentage points more likely to report hospitalization in the last year than the matched controls. They are likely to report 11.4 days more of inpatient care, 32.2 percentage point greater likelihood of imposing catastrophic expenses on the households to which they belong and a 17 percentage point greater likelihood of impoverishing their household. They also use more health care services in both the public and the private sectors. Females with injuries too, report higher health care use, health spending, and risks of impoverishing their households than their matched counterparts. Overall, injuries seem to lie between CVD and cancers in terms of the economic impact on households – and likely to have resulted in at least 1.7 million individuals incurring catastrophic levels of health spending; and 0.9 million falling into poverty at least.

A recent study by Mohanan (2008) for India compares economic outcomes for households that had one (or more members) experiencing a traffic injury in the state of Karnataka with "similar" households, with similarity defined in terms of age, choice of transport, educational attainment, household size, sex and caste. Our estimates of additional health spending on injury (although not directly comparable), reported in table 6.6 are remarkably close to estimates of traffic injury-related health spending (Mohanan 2008, p.17). Our results are also similar in that the treatment group reports lower levels of labour activity (at work) than the control group.

6.4. Discussion

The analysis of this chapter lends further support to the arguments made in earlier chapters (and in other papers on the subject) that individuals with NCD in India (and the households to which they belong) face serious economic challenges compared to their counterparts who have not been affected by NCD. These challenges include a substantial risk of income losses, an increased burden of care-giving and out-of-pocket health care spending. It is possible that some of these lost incomes and health expenditures may be recouped by allowances for sick leave, health insurance and reimbursements for health expenses by employers, or financial support from the extended family or community. It is well known, however, and this is further supported by our analyses in Chapter 3, that formal health insurance coverage in India is still relatively limited. Although insurance by means of financial support from friends and family members may exists and there is *de facto* insurance in the form of subsidized public sector services, there are large numbers of people in India who are exposed to a large burden of out of pocket spending from NCDs.

Our analysis suggests that estimates of the impact of NCDs ought to adjust for competing risks in assessing the economic impacts of disease. The preliminary results in this chapter point to a 5 percent to 20 percent reduction in estimates of household economic impacts that do not use matched controls. The significance of our findings is tempered by our relatively small-sized treatment group, and the fact that we had only a limited set of pre-determined variables to match. Ideally, one would have liked information on smoking history, alcohol consumption, family history of heart disease/cancer and obesity. Unfortunately, the National Sample Surveys do not include this type of historical information in the survey instrument. Indeed, the lack of a longitudinal dataset to examine these questions (which really underpins the preceding sentence) is serious issue of concern. If unobservable characteristics influenced the risk for acquiring an NCD, or health care utilization – such as high rates of discounting the future, or if health

facilities were in close proximity in the past (enabling early treatment and medical advice), matching on currently observable characteristics will not yield reliable estimates of the economic impact of NCDs in India. This remains an area of potential importance for future research in NCDs.

Table 6.1a: Summary Statistics for Males Reporting CVD (Treatment) and Males Not Reporting CVD (Control), 2004

Variable	Treatment Individuals (CVD)	Matched Control Individuals (No CVD)	All Individuals (Not Reporting CVD)
Explanatory Variables in Propensity Score regression			
Average age (in years)	57.33	53.74	26.81
Share of Age Group (20-49) (%)	22.50	22.50	40.48
Share of Age Group (50-79) (%)	69.24	69.24	14.97
Share of Age Group (80+) (%)	5.27	5.27	0.79
Share North (%)	9.82	9.82	10.07
Share West (%)	20.45	20.45	16.49
Share South (%)	35.43	35.43	18.88
Share Central (%)	13.53	13.53	22.62
Completed Primary Only (%)	32.13	32.13	31.76
Completed Secondary Only (%)	21.50	21.50	13.77
College Education or Higher (%)	15.98	15.98	6.11
Rural Residence (%)	41.30	41.30	66.01
Proportion belonging to SC/ST (%)	14.37	14.37	28.78

Outcome Variables			
Outpatient Visit in Last 2 Weeks (%)	78.70	20.50	9.02
Health Expenses in Last 2 weeks (INR)	350.35	83.20	28.60
Hospitalization in Last One Year (%)	60.51	14.51	7.95
Hospital Expenses in Last One Year (INR)	10,492	1,192	581
Inpatient Days	5.85	1.54	0.83
Likelihood Catastrophic Spending (%)	24.68	5.28	2.70
Likelihood of Impoverishment (%)	10.19	2.09	1.18
Involuntary unemployed (%)	0.48	0.98	1.54
Individuals not working (%)	45.01	33.41	48.23
Number of individuals	**2,484**	**177,550**	**192,698**

Source: Authors' calculations, using household survey data for 2004 for India.
Note: Matched control group for the treatment group was generated by identifying the individual with the closest propensity score under the nearest neighbor (random matching) methodology. See Becker and Ichino (2002) for more details.

Table 6.1b: Summary Statistics for Females Reporting CVD (Treatment) and Females Not Reporting CVD (Control), 2004

Variable	Treatment Individuals (CVD)	Matched Control Individuals (No CVD)	All Individuals (Not Reporting CVD)
Explanatory Variables in Propensity Score regression			
Average age (in years)	55.93	52.09	27.57
Share of Age Group (20-49) (%)	28.47	28.47	41.55
Share of Age Group (50-79) (%)	63.79	63.79	16.48
Share of Age Group (80+) (%)	5.33	5.33	0.79
Share North (%)	10.77	10.77	9.78
Share West (%)	20.96	20.96	16.48
Share South (%)	37.05	37.05	20.38
Share Central (%)	12.45	12.45	22.01
Completed Primary Only (%)	27.13	27.13	25.10
Completed Secondary Only (%)	9.27	9.27	9.15
College Education or Higher (%)	4.37	4.37	3.50
Rural Residence (%)	44.83	44.83	66.08
Proportion belonging to SC/ST (%)	14.67	14.67	28.85
Outpatient Visit in Last 2 Weeks (%)	82.76	21.76	9.82

Health Expenses in Last 2 weeks (INR)	289.66	64.29	26.90
Hospitalization in Last One Year (%)	47.93	11.93	7.43
Hospital Expenses in Last One Year (INR)	6,241	1,104	502
Inpatient Days	4.27	1.17	0.68
Likelihood Catastrophic Spending (%)	17.16	3.96	2.48
Likelihood of Impoverishment (%)	6.86	1.56	1.01
Involuntary unemployed (%)	0.15	0.25	0.45
Individuals not working (%)	86.70	79.90	81.89
Number of individuals	**2,610**	**164,556**	**184,527**

Source: Authors' calculations, using household survey data for 2004 for India.
Note: Matched control group for the treatment group was generated by identifying the individual with the closest propensity score under the nearest neighbor (random matching) methodology. See Becker and Ichino (2002) for more details.

Table 6.2: Average "Treatment" Effects of CVD on Health Care Use, Health Spending, Employment and Poverty: Estimates from 2 Different Matching Methods, 2004

Indicator	Nearest Neighbor Method(Random Draw)		Stratification Method	
	Males	**Females**	**Males**	**Females**
Last 2 Weeks				
Health spending (INR)	267.15 (14.14)	225.37 (10.05)	269.56 (14.51)	227.85 (10.11)
Outpatient visits (percent)	58.20 (0.80)	61.00 (0.80)	58.10 (0.80)	61.70 (0.70)
Last One Year				
Health Spending (INR)	9,030 (633)	5,137 (646)	9,030 (634)	5,192 (646)
Inpatient Stays (percent)	46.00 (1.00)	36.00 (1.00)	45.90 (1.00)	36.30 (1.00)
Inpatient Days (Number)	4.31 (0.20)	3.10 (0.23)	4.32 (0.20)	3.14 (0.23)
Inpatient Days (Public)	1.95 (0.16)	1.43 (0.15)	1.94 (0.16)	1.44 (0.14)
Inpatient Days (Private)	2.37 (0.15)	1.66 (0.19)	2.39 (0.15)	1.70 (0.19)
Economic Impact				
Catastrophic Expenditure (percent)	19.40 (0.90)	13.20 (0.70)	19.40 (0.90)	13.30 (0.70)
Poverty Impact (percent)	8.10 (0.60)	5.30 (0.50)	8.00 (0.60)	5.40 (0.50)
Involuntarily unemployed (percent)	-0.50 (0.20)	-0.10 (0.10)	-0.50 (0.10)	-0.10 (0.10)
Not currently employed (percent)	11.60 (1.00)	6.80 (0.70)	11.00 (0.90)	6.80 (0.70)
Observations (Treatment)	**2,484**	**2,610**	**2,484**	**2,610**
Observations (Control)	**177,550**	**164,556**	**192,698**	**181,151**

Note: Estimates are of the average treatment effect, under each matching method; the radius was taken to be 0.01 under the "radius method"; t-statistics are reported in parentheses below estimates of the *average* treatment effect.

Table 6.3a: Summary Statistics for Males Reporting Cancers (Treatment) and Males Not Reporting Cancers (Control), 2004

Variable	Treatment Individuals (Cancer)	Matched Control Individuals (No Cancer)	All Individuals (Not Reporting Cancer)
Outcome Variables			
Outpatient Visit in Last 2 Weeks (%)	64.58	16.28	9.82
Health Expenses in Last 2 weeks (INR)	704.35	56.75	31.53
Hospitalization in Last One Year (%)	86.01	12.71	8.49
Hospital Expenses in Last One Year (INR)	18,307	1,226	676
Inpatient Days	13.94	1.41	0.87
Likelihood Catastrophic Spending (%)	48.81	4.91	2.90
Likelihood of Impoverishment (%)	26.19	2.09	1.25
Involuntary unemployed (%)	1.49	1.39	1.52
Individuals not working (%)	46.73	29.73	48.20
Number of individuals	**336**	**139,937**	**194,846**

Source: Authors' calculations, using household survey data for 2004 for India.
Note: Matched control group for the treatment group was generated by identifying the individual with the closest propensity score under the nearest neighbor (random matching) methodology. See Becker and Ichino (2002) for more details.

Table 6.3b: Summary Statistics for Females Reporting Cancers (Treatment) and Females Not Reporting Cancers (Control), 2004

Variable	Treatment Individuals (Cancer)	Matched Control Individuals (No Cancer)	All Individuals (Not Reporting Cancer)
Outcome Variables			
Outpatient Visit in Last 2 Weeks (%)	57.98	15.88	10.70
Health Expenses in Last 2 weeks (INR)	468.51	39.88	29.28
Hospitalization in Last One Year (%)	90.46	10.86	7.76
Hospital Expenses in Last One Year (INR)	18,536	882	530
Inpatient Days	15.99	0.99	0.68
Likelihood Catastrophic Spending (%)	48.99	3.79	2.55
Likelihood of Impoverishment (%)	27.16	1.56	1.02
Involuntary unemployed (%)	0.00	0.40	0.45
Individuals not working (%)	80.00	74.40	81.96
Number of individuals	**545**	**137,149**	**186,592**

Source: Authors' calculations, using household survey data for 2004 for India.
Note: Matched control group for the treatment group was generated by identifying the individual with the closest propensity score under the nearest neighbor (random matching) methodology. See Becker and Ichino (2002) for more details.

Table 6.4: Average "Treatment" Effects of Cancer on Outpatient Visits, Hospitalization and Health Spending: Estimates from 2 Different Matching Methods, 2004

Indicator	Nearest Neighbor Method(Random Draw)		Stratification Method	
	Males	**Females**	**Males**	**Females**
Last Two Weeks				
Health spending (INR)	647.60 (131.74)	420.63 (55.75)	647.72 (131.79)	425.61 (55.64)
Outpatient visits (percent)	48.30 (2.60)	42.10 (2.10)	48.70 (2.60)	43.00 (2.10)
Last One Year				
Health Spending (INR)	17,081 (2,029)	17,654 (1,521)	17,141 (2,017)	17,771 (1,517)
Inpatient Stays (percent)	73.30 (1.90)	79.60 (1.30)	73.70 (1.90)	80.10 (1.30)
Inpatient Days (Number)	12.53 (1.15)	15.00 (1.01)	12.62 (1.14)	15.04 (1.01)
Inpatient Days (Public)	7.88 (1.09)	8.07 (0.86)	7.94 (1.09)	8.08 (0.86)
Inpatient Days (Private)	4.65 (0.63)	6.93 (0.73)	4.68 (0.63)	6.97 (0.73)
Economic Impact				
Catastrophic Expenditure (percent)	43.90 (2.70)	45.20 (2.10)	44.20 (2.70)	45.40 (2.10)
Poverty Impact (percent)	24.10 (2.40)	25.60 (1.90)	24.20 (2.40)	25.70 (1.90)
Involuntarily unemployed (percent)	0.10 (0.70)	-0.40 (0.02)	0.10 (0.70)	-0.50 (0.02)
Not currently employed (percent)	17.00 (2.70)	5.60 (1.70)	17.00 (2.50)	5.10 (1.70)
Observations (Treatment)	**336**	**545**	**336**	**545**
Observations (Control)	**139,937**	**150,201**	**186,101**	**185,976**

Note: Estimates are of the average treatment effect, under each matching method; standard errors are reported in parentheses below estimates of the *average* treatment effect. INR = Indian Rupees.

Table 6.5a: Summary Statistics for Males Reporting Injuries (Treatment) and Males Not Reporting Injuries (Control)

Variable	Treatment Individuals (Injuries)	Matched Control Individuals (No Injuries)	All Individuals (Not Reporting Injuries)
Outcome Variables			
Outpatient Visit in Last 2 Weeks (%)	41.07	10.97	9.48
Health Expenses in Last 2 weeks (INR)	185.48	36.71	30.60
Hospitalization in Last One Year (%)	85.69	8.69	7.56
Hospital Expenses in Last One Year (INR)	9,792	705	582
Inpatient Days	12.30	0.87	0.73
Likelihood Catastrophic Spending (%)	35.35	3.15	2.54
Likelihood of Impoverishment (%)	17.98	1.28	1.07
Involuntary unemployed (%)	1.48	1.68	1.52
Individuals not working (%)	38.38	37.18	48.33
Number of individuals	**2,642**	**189,862**	**192,540**

Source: Authors' calculations, using household survey data for 2004 for India.
Note: Matched control group for the treatment group was generated by identifying the individual with the closest propensity score under the nearest neighbor (random matching) methodology. See Becker and Ichino (2002) for more details.

Table 6.5b: Summary Statistics for Females Reporting Injuries (Treatment) and Females Not Reporting Injuries (Control)

Variable	Treatment Individuals (Injuries)	Matched Control Individuals (No Injuries)	All Individuals (Not Reporting Injuries)
Outcome Variables			
Outpatient Visit in Last 2 Weeks (%)	49.49	15.69	10.62
Health Expenses in Last 2 weeks (INR)	308.39	43.75	29.54
Hospitalization in Last One Year (%)	80.30	9.50	7.58
Hospital Expenses in Last One Year (INR)	6,968	739	545
Inpatient Days	9.57	0.87	0.68
Likelihood Catastrophic Spending (%)	30.63	3.23	2.52
Likelihood of Impoverishment (%)	13.63	1.33	1.02
Involuntary unemployed (%)	0.37	0.27	0.45
Individuals not working (%)	81.23	78.73	81.96
Number of individuals	**1,071**	**180,183**	**186,066**

Source: Authors' calculations, using household survey data for 2004 for India.
Note: Matched control group for the treatment group was generated by identifying the individual with the closest propensity score under the nearest neighbor (random matching) methodology. See Becker and Ichino (2002) for more details.

Table 6.6: Average "Treatment" Effects of Injuries on Outpatient Visits, Hospitalization and Health Spending: Estimates from Twp Different Matching Methods, 2004

Indicator	Nearest Neighbor Method(Random Draw)		Stratification Method	
	Males	**Females**	**Males**	**Females**
Last 2 Weeks				
Health spending (INR)	148.77 (11.91)	164.64 (19.48)	148.77 (11.91)	166.42 (19.34)
Outpatient visits (percent)	30.10 (1.00)	33.80 (1.50)	30.20 (1.00)	34.40 (1.50)
Last One Year				
Health Spending (INR)	9,087 (420)	6,229 (468)	9,088 (418)	6,246 (458)
Inpatient Stays (percent)	77.00 (0.70)	70.80 (1.20)	77.10 (0.70)	70.90 (1.20)
Inpatient Days (Number)	11.43 (0.45)	8.70 (0.53)	11.45 (0.45)	8.70 (0.53)
Inpatient Days (Public)	5.60 (0.35)	4.63 (0.46)	5.60 (0.35)	4.62 (0.46)
Inpatient Days (Private)	5.83 (0.33)	4.07 (0.33)	5.85 (0.33)	4.09 (0.33)
Economic Impact				
Catastrophic Expenditure (percent)	32.20 (0.90)	27.40 (1.40)	32.30 (0.90)	27.40 (1.40)
Poverty Impact (percent)	16.70 (0.70)	12.30 (1.00)	16.70 (0.70)	12.40 (1.00)
Involuntarily unemployed (percent)	-0.20 (0.20)	0.10 (0.20)	-0.10 (0.20)	-0.00 (0.20)
Not currently employed (percent)	1.70 (1.00)	2.50 (1.20)	0.90 (0.80)	3.00 (1.20)
Observations (Treatment)	**2,642**	**1,071**	**2,642**	**1,071**
Observations (Control)	**189,862**	**180,183**	**192,539**	**185,786**

Note: Estimates are of the average treatment effect, under each matching method; the radius was taken to be 0.01 under the "radius method"; t-statistics are reported in parentheses below estimates of the *average* treatment effect.

CHAPTER 7. CONCLUSION: RESEARCH AND POLICY IMPLICATIONS

7.1. Research

Along with other recent efforts in the field, this paper constitutes a first step in the overall research goal of assessing the economic impacts of NCDs in India and other similarly placed developing countries. As noted at various points in the preceding text, there are several methodological weaknesses in the study, ranging from its use of household survey data that may underestimate the prevalence of disease, not taking full account of disabilities associated with NCDs, the inadequate treatment of competing disease risks in assessing economic impacts, and perhaps in its inability to adequately consider (and bring together) scenarios that take a more careful account of disease prevalence estimates from elsewhere in the literature, such as those of the Shah et al. (2004), the World Health Survey data, and so forth. We believe that all of these are valid concerns and ought properly, to belong to any reasonable agenda for future work on the economic impacts of NCDs in India. Here we consolidate some of more important research ideas emerging from earlier chapters, add some new ones, and highlight what we think are likely to be some of the more productive avenues for further work.

Perhaps the biggest single gap that exists in India relates to information on disease-specific morbidity and mortality on a scale appropriate for India and an appropriate linkage of this information to economic variables, ranging from health spending to socioeconomic status of households. In a major recent effort to address at least part of this challenge, Prabhat Jha and colleagues at the University of Toronto, along with researchers in India and the Registrar General in India (RGI) are seeking to improve cause of death reporting in data collected by the RGI. We are unsure whether this (ongoing) study will also collect information on morbidity patterns and construct prevalence estimates of various health conditions. In fact, it provides an ideal opportunity collect such information, perhaps in the form of sub-studies and pilots that could be simultaneously undertaken.

We also believe that longitudinal studies that focus on the economic angle of health are needed to better take account of the poverty impacts of NCDs (and other health conditions). There are none that we are currently aware of on a suitably large scale, although one example of an exceptionally high quality work is that of Angus Deaton, Abhijit Bannerjee and colleagues around the district of Udaipur in Rajasthan. Another interesting survey in the pipeline is the NIH funded Longitudinal Ageing Study of India (LASI) led by David Bloom and colleagues at Harvard and Rand, the first wave of which is expected to take place in 2010-11. Other, small scale multi-period studies have been undertaken by the World Health Organization and other groups.

It may be a while before these studies can bear fruition. Thus, it might be more useful, at least in the short-run, to exploit what appear to be excellent sources of longitudinal information on health and financing – namely the Indian railways and the armed forces. On the one hand, their employees (current or retired), because of their access to subsidized facilities, are less likely to fall into poverty than the average Indian. On the other hand, the excellent record-keeping that is likely at these organizations offers the opportunity (if accessible) to really explore the linkages between health spending, lost work days and NCDs in a setting which is likely to allow for better

estimation of the challenges arising from the existence of co-morbidities and competing risks. Disease-specific information on economic outcomes, a particularly serious gap, is more likely to become available if such studies were to be undertaken.

Missing also in the existing work is good information on care-giving and support within the family, as well as within communities, related to the financial and disease burdens associated with NCDs. The NSS health care utilization and expenditure data offer a useful data source for this purpose, given that they document some information on the support systems for Indians aged 60 years and above. But this information is very limited, and is generally expressed in qualitative terms. Moreover, we know little about how families respond to crises in the presence of NCDs (or NCD-related deaths) among prime income earners, who appear to be increased risk of NCDs in India.

7.2. Policy Implications

Irrespective of what these more refined analyses may or may not conclude at some point in the future, it is unlikely that they will overturn the major conclusions reported here - that NCDs constitute a significant economic burden on India. This study specifically points to the high levels of out of pocket spending incurred by households that have members with NCDs, the limited levels of insurance coverage (including subsidized public services) and the income losses that befall affected households. Moreover, these findings strengthen conclusions by other recent studies on the economic implications of ill health for India (Garg and Karan 2008; Doorslaer et al. 2006; Yip and Mahal 2008) that emphasize the associated risks of catastrophic spending and impoverishment. The study also points to the adverse aggregate economic implications of NCDs.

How to address these economic challenges in a cost effective and equitable manner while ensuring financial risk protection for affected households is an obviously important policy goal. Governments at the national and state levels in India are beginning to wake up to this challenge. The Indian state of Andhra Pradesh, for instance, launched the Arogyasri health insurance scheme in 2007 on a pilot basis and is now in the final stages of extending it throughout the state. The scheme provides for a tax funded insurance plan that (fully) covers all poor people in the state for care sought for a wide range of high-end treatments at public and private health care providers. Moreover, the state government has used the financial clout resulting from the large financial base of the scheme to negotiate quite reasonable rates for a range of different interventions in tertiary facilities. On a national level, the government of India also recently introduced the Rashtriya Swasthya Bima Yojana (RSBY) that provides financial coverage for health care for up to INR 30 thousand to poor households. These schemes run on a "cashless" basis in that any health care expenses covered under the schemes are paid directly by the insurer to the health care provider, greater reducing inconvenience to households who might otherwise have to run after insurance agencies to get their out of pocket expenses reimbursed.

Clearly these schemes mark a fairly radical departure from the situation until the first half of this decade where a long period of decline (following the 1991 fiscal crisis) in public financing of health led households to increasingly rely on the private sector and out of pocket spending to meet their health care requirements. Whether these new schemes provides adequate financial risk protection to people who need such protection the most, and their ability to do so in an efficient manner is, however, still open to question. There are questions about how well

they target poor households and there are serious questions about their ability to contain health care costs. The Arogyasri scheme, although ostensibly directed towards the poor, has ended up covering nearly 80 percent of the population of Andhra Pradesh (about 64 million people) owing to the way it has defined a 'poor' household as one holding a ration card. Moreover, the scheme does not emphasize preventive aspects of health, so that it is likely to lead to pressures for more advanced treatment methods and promote either health care cost inflation, or alternatively, financial breakdown. Similarly, the RSBY scheme appears not to have any built-in mechanisms to promote preventive care, and is geared primarily to curative treatment. It is also unclear what the implications of these schemes would be for the public health care sector, that has often served as a provider of the last resort and as a competitor to the private sector, albeit inefficiently, for the less well off. Moreover, there are concerns about the quality of care provided to the insurees given the limited regulatory capacity over health care provision in India. As further steps are taken towards scaling up, our analysis points to the need to evaluate these schemes from a variety of different perspectives.

Treatment, however, ought to be only part of the picture. Long term sustainability of financing mechanisms, requires the diffusion of more effective prevention methods, so that early onset of NCDs can be prevented and their effects on long term disability limited. This calls firstly for curtailing tobacco consumption and smoking that have been linked to cardiovascular disease and different types of cancers. To be sure, the Indian government has recently initiated steps such as the banning of smoking in public places. However, there is a long way to go in terms of implementation, particularly in the use of 'bidis' that are popular among lower socioeconomic groups. Other interventions, such as the promotion of physical exercise, may not be as urgent for rural populations; although the same is not true for urban populations in India. Sedentary lifestyles, common among Indian middle classes probably reflect some combination of prevailing social norms, and importantly a lack of opportunity for undertaking physical exercise, particularly in the larger cities. Existing constraints include limited spaces for walking or bicycling and call for a fundamental rethinking about urban planning in India. Dietary habits of Indian households could also be targeted, whether by means of changing agricultural pricing policies, taxes (subsidies) on less (more) nutritionally desirable foods and public health messages; and the significant costs of respiratory conditions points to addressing indoor air pollution and workplace conditions, particularly in the informal sector that tends to stay under the policy radar. Prevention ought also to be a major focus of concern in education in Indian medical schools, where the predominant focus has been on high-end clinical interventions at the cost of expertise in community medicine and public health.

By highlighting the large economic consequences of injuries and deaths, a significant portion of which are traffic-related in India, our study points to the need for effective measures to promote traffic safety, including better training of drivers, the use of seat belts and helmets, improved vehicle designs and roads, separate lanes for different classes of traffic (when possible), developing trauma centers and so forth. The existing literature points to a number of lacunae in this regard, including the extensive use of bribes in the grant of drivers' licenses and lack of helmet use, particularly in the smaller towns and cities of India. The well known problems of private sector providers turning away traffic injury 'police' cases needs increased policy attention, as also a focus on trauma centers that are urgently needed. The increasing use of 108 ambulance services on a call-center platform to speedily recover and help direct patients to

needed emergency care in many parts of India is an important innovation in this direction. Further work on assessing the net economic benefits from 108 services is obviously desirable.

Traffic injuries are only one component of the category of accidents and injuries. Particularly important are suicides and burn injuries, underpinned in India by significant violence against women, often in the context of dowry demands. As is usually the case in India, there already exist a range of laws and regulatory mechanisms to this end, so the issue is often one of implementation and information provision. The emergence of women's groups in different settings in India – among sex workers, self-help groups in villages and elsewhere – has helped in some cases to empower women and to help protect them against this violence. Policies to further strengthen these groups including providing economic opportunities via expanded microfinance mechanisms may be a useful direction to pursue.

Finally, we wish to highlight a very important closing observation. Many of the issues highlighted here are not specific to NCDs. An efficient and equitable health care system becomes a key tool for NCD control as it is for control of other health conditions. However, with the NCDs becoming more common, improving efficiency, quality, and access to a sound health care system is good strategy for NCD control. Likewise, efforts to improve health care delivery and access for NCDs will improve the infrastructure for the broader health care system. The ultimate challenge is to strategically focus on policies that will yield the best returns.

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