ABSTRACT

Title of Dissertation: LIVING ARRANGEMENTS AND HEALTH OF THE ELDERLY IN INDIA.

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Do multigenerational (co-residential) families have protective effects on elderly health? Demographic literature on aging in developing countries has started to examine this question as the contours of global population have been undergoing dramatic changes. Nevertheless, the theoretical and empirical literature on the relative benefits for the elderly of residing in multigenerational households versus living alone, have remained remarkably elusive. In part, the empirical inconsistency is a result of a significant methodological gap in the extant literature: most empirical studies are based on cross-sectional data where the authors have been largely unsuccessful in eliminating explanations based on the possible selection effects.

India offers an interesting context to study this relationship as the country experiences a growing elderly population coupled with a severe lack of institutional systems of care for the aged. This dissertation draws data from the *India Human Development Survey (2004-05)* - a nationally representative, multi-topic data set of 41,554 households. It focuses on the relationship between household composition-whether the elderly are living independently, with children, or with other relatives-and short-term morbidity in the last month. The analysis uses standard multivariate regression models and a relatively unconventional technique-propensity score analysis to account for the endogeneity/selectivity problem.

Three particularly salient conclusions are drawn from this research. First, household level analyses using propensity score methods highlight the importance of multigenerational families to the health of the elderly. These results also suggest health effects of household wealth, urban location, the number of adults in the household, and (male) gender. A second set of analyses show that multigenerational families also spend more on medical care when the elderly do get sick. Moreover the same set of household variables that predict better elderly health (wealth, urbanization, adults, gender) also predict higher medical expenditures. Finally, multilevel analyses, using district-level data from the *Census of India (2001),* corroborate the "urban advantage" finding and demonstrate that health of the elderly is affected not only by household compositional factors (e.g. living arrangements) but also by the larger context created by urbanization.

LIVING ARRANGEMENTS AND HEALTH OF THE ELDERLY IN INDIA

By

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To my parents….

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CHAPTER 1: STATEMENT OF THE PROBLEM AND CONTRIBUTION OF THIS DISSERTATION

Statement of the problem

Do multigenerational extended families have protective health effects on the elderly in India? If so, what are the factors that affect the strength of the hypothesized positive association between co-residence (living with adult children and/or family members) and elderly well-being? Do compositional factors such as household wealth mediate the relationship between co-residence and better health outcomes and/or higher illness associated health spending among the older population? Does context in terms of level of economic development and medical infrastructure influences the association between living arrangements and elderly wellbeing? Are there gender differences in the aging experiences of men and women in terms of their health outcomes?

In developing countries, with shrinking family sizes as a result of profound socioeconomic and demographic transformations, these aging issues have permeated the recent academic and policy debates. The current dissertation systematically examines these questions and provides answers based on robust empirical findings.

Contribution of this dissertation

This dissertation's contribution to the fields of social demography and aging is both empirical and methodological. Past studies on India have provided descriptive summaries of living arrangement patterns of the elderly. Studies from both biomedical and social science perspectives have examined health outcomes and health behaviors of the elderly. However a systematic examination of the link between the two phenomena-household structure and health-has been missing from the demographic literature on India. Hence, one of the unique contributions of this dissertation is that it has taken a step further by empirically examining both the health and the living arrangement dimensions of aging simultaneously. This dissertation takes advantage of a relatively new and an extremely rich dataset (the *Indian Human Development Survey*, 2004-05) that allowed for measurement and empirical investigation of the links between living arrangements and health of the elderly. Previous analysis of this topic has not only been limited in the demographic literature on India but is often not theoretically grounded. This dissertation has advanced this field of research by developing a conceptual framework that draws from some dominant tradition of study on families and intergenerational relationships (e.g. frameworks of familism and the rational choice framework). Incorporation of these perspectives has helped in informing and understanding the results that follow from the empirical analyses of this dissertation.

This dissertation makes a significant methodological contribution to the field of aging in developing countries. Demographers have a longstanding tradition of engaging in

debates about drawing causal inferences from observational data (Moffitt, 2001; 2005; Smith 2003). However, researchers are often limited by the data in their ability to examine causality. Similarly, in this dissertation the causal undertone of the living arrangement and health link cannot be downplayed. Social scientists and statisticians alike have developed a range of measures and complex statistical procedures based on the counterfactual model of causality.

Health research using a non-experimental, observational design has a related problem of selection bias. Experimental designs can estimate a causal effect by comparing a treatment group with a control group (i.e. the group that does not experience the treatment), but health research based on observational data can be biased either because of self-selection or some systematic judgment by the researcher in selecting units to be assigned to treatment. This dissertation employs alternative analytical strategies (i.e. the propensity score methods) to "correct" for sample selection bias due to observable differences between treatment and comparison groups. Propensity score methods (e.g. matching) essentially simulate an experimental design after the data have been collected. The propensity score methods artificially create treatment and control groups by balancing the distributions of all observed covariates before estimating treatment effects. This methodological approach has been primarily used in statistical and biomedical literature but less commonly in sociological research. This dissertation adopts an array of specifications of the propensity score methods and makes a unique methodological contribution to the field of aging by improving our understanding of causal relationships.

This however does not suggest that the current dissertation has *proved* causality. Instead, these methodological approaches/specifications have increased the confidence in the estimates that follow from the analyses. In other words, by using propensity score methods as a complement to the standard regression techniques, the results from this dissertation give additional validation to support the causal argument in the living arrangement-health link.

This dissertation makes several significant contributions to the field of aging in developing countries. Recognizing the importance of context (rural-urban and regional differences) in shaping health outcomes in developing countries, this dissertation also conducts multi-level analyses to examine the distinct roles of household level and contextual level factors in shaping the association between living arrangements and elderly wellbeing. To the best of my knowledge, no other study on India has located their analyses of living arrangements in the contextual perspective. Furthermore, in order to extend existing knowledge on health care and health expenditures research in developing countries, this dissertation closely examined expenditure patterns on health care for the elderly who have reported themselves sick in the past one month.

Finally, a related yet important contribution of this dissertation is for policy makers and program designers. In practice, policy makers have to make difficult investment decisions in resource-poor developing countries. In the absence of randomized,

experimental trials (which are neither ethical nor realistic options), developmental investments on health, public policy and family planning programs require adequate understanding of causal inferences based on observational data. The current dissertation is a step towards that direction.

The results from this dissertation highlight the need for developing conceptual tools to better our understanding of macro-level contextual factors as well as micro-level intra-household allocation of resources that influence health behaviors of the population (here, the aged). Examining these issues-living arrangements, health outcomes, medical expenditures, wellbeing- is an important exercise in not only enriching the demographic literature on aging in India but also in informing policy makers about a high risk group. This dissertation makes a timely contribution to the field of aging because India is now engaged in a careful reassessment of national retirement and insurance policies.

CHAPTER 2: BACKGROUND

Preamble: Aging Research in Developing Countries

The contours of global population have undergone marked changes over the past several decades. With the notable exception of countries in the African continent, the populations in most developing nations are aging rapidly (Palloni, 2000). The combination of high fertility and declining mortality (particularly due to medical breakthroughs) during the twentieth century has resulted in large and rapid increases in elderly population as successively larger cohorts step into old age. In addition, the ongoing demographic regime of sharp decline in fertility rates (triggered by improvements in birth control technology, women's increased labor force participation and increasing demand for child "quality" as opposed to quantity) in most developing countries, will result in an increasing proportion of elderly persons to the total population in the near future. More specifically, though the world population is projected to increase 3.6 times from 1950 to 2050, the elderly population will increase by a factor of 11; moreover the 80+ age group will increase by a factor of 27 (National Institute on Aging, 2007; United Nations, 2008). Furthermore, studies on developing countries have indicated that most of this growth will take place in developing countries and over half of it will be in Asia, in two major population giants of Asia-India and China (Rajan, et al 1999; Rajan, et al, 2003).

Table 2.1 shows the phenomenal rate of global population aging. The table presents availability ratios estimated in 1995 and projected to 2020-25 for selected regions of the world. What is interesting about this table is that it highlights the increased homogeneity projected to prevail in 2020 as opposed to heterogeneity in 1995. It is important to note that the convergence of this indicator of aging is "not just the result of the smoothing effects embedded in the persistence of a demographic regime, but an outcome of more rapid population aging countries with late demographic transitions" (Palloni, 2000: 3).

[Table 2.1 about here]

Literature on aging in developing countries has often referred to the rapid aging phenomenon as a "problem". The reasons are straightforward. The twin factors leading to sharp changes in the age structure of the population in developing countries is well known-sharp fertility decline after 1970 and mortality decline after 1950. However these changes in the population structure are faster than the changes that take place in the social and economic conditions in such countries. More specifically, the institutional context in most countries is characterized by insufficiently developed capital markets, high risk and economic uncertainty as well as lack of social security schemes and pension plans. Palloni (2000) rightly describes this process as "incongruence between the speed of the aging process and the institutional context". These processes in turn have important demographic and social consequences. First, the elderly who are attaining the age of 60 or 65 now or in the near future belong to cohorts whose wage earning history is fragile. Again, these are also the cohorts whose

levels of education are lower than they are among the elderly in developed countries (ibid). The educational composition of this group makes them economically vulnerable as they are less likely to have access to income derived from savings and accumulated assets.

Second, there is a marked gender disparity in health and socioeconomic outcomes among the elderly. Elderly females not only have higher levels of mortality but the fact that their education and labor force participation rates have historically stayed at lower levels, make them totally dependent on other family members for support and care. Furthermore, literature has consistently demonstrated that women in developing countries, where public assistance is meager, are more likely to end up in poverty in their old age. In urban China, 41 percent of old women have annual incomes below an extreme poverty line compared to 4 percent of old men; in Venezuela, women account for two-thirds of old people in the lowest income decline; in India, majority of the elderly women in both rural (58 percent) and urban (65 percent) are entirely economically dependent on others for food, clothing and healthcare (Cangping, Wu, 1991; Mitchell, D, 1993; Kumar & Anand, 2006; Smeeding, et al. 2008). Since most of the elderly persons (especially women) in such countries live with their families- the dominant living arrangement-their economic security and wellbeing are largely contingent on the economic capacity of the family unit.

These changes also triggered a surge of interest in elderly living arrangements in developing countries among sociologists, family demographers and economists. The

theme of living arrangement, however, has been approached from different perspectives. For example sociologists consider living arrangements under the broader issue of household and family organization; economists look at it in their research of intergenerational transfers and demographers have recently started exploring the issue of living arrangement as a consequence of fertility change and population aging. Regardless of the approaches and goals, there is no doubt that demographic changes occurring in most developing countries have certainly led to a new impetus in studying living arrangements in these countries. This surge of interest in living arrangements in the face of a rapidly aging population in India has been the motivation behind the current dissertation. I provide a synthesis of existing empirical literature on living arrangements in the next chapter.

Hence, given this background it is no surprise why the Second World Assembly on Ageing convened by the United nations in April 2002, adopted the Madrid International Plan of Action on Ageing (MIPAA) called for public action and intellectual discourses in three major areas: (a) aging and development; (b) health and wellbeing into old age; and (c) enabling and supportive environments for the aged. In this connection, the MIPAA also emphasized the importance of studying living arrangements of the older adults in developing countries as living arrangements have implications for macroeconomics and infrastructure of the society in such countries. While there is an increasing recognition and concern about aging and its ramifications among the scientific community, knowledge about actual living conditions and how they affect older adult well-being is limited in most developing countries and more

specifically in India. This dissertation addresses this gap by analyzing the relationship between living arrangement and well-being of the elderly, while highlighting socio-economic determinants at both individual and contextual levels.

In the next sections, I summarize recent demographic developments in India that sets the stage for a more detailed empirical investigation. In the process I also review the recent changes in government policies as a response to the rapid population aging in the country. The next chapter will provide a description of the theories, models and empirical literature pertaining to intergenerational relationships, living arrangements and health of the elderly in developing countries.

Setting the Stage: The Indian Demographic Scenario

Recent estimates show that India has almost 80 million elderly persons above the age of 60 (as compared to China's 127 million); which constituted around 8 percent of the total population (National Sample Survey Organization ,61st Round-2004-05; India Human Development Survey, 2004-05). In addition, projections indicate that the elderly population (age group 60 and above) is expected to increase to 179 million in 2031 and further to 301 million in 2051 (Rajan, et al, 2003). By the year 2025, the elderly population in India and China combined will account for 38% of the world's total elderly population (Rajan & Liebig, 2003).

There are several factors that are contributing to the aging of India's population including falling fertility rates and increasing life expectancy. An Indian born in 1950, for example, could expect to live for 37 years whereas today India's life expectancy at birth has doubled to 69 years; by 2050 it is projected to increase to 76 years. While this is not exactly comparable to the developed world (where average life expectancy is 78 years), it is similar to the average of other developing countries (66 years) and is projected to rise to another decade by midcentury. This trend reflects significant declines in infant and adult mortality rates and improvements in survival rates at all ages. As a result, India's population will rise from 1.2 billion today to an estimated 1.6 billion by 2050, with a much larger share of the elderly population (See Figure 2.1).

[Figure 2.1 about here]

However, studies have consistently pointed out that India's elderly potentially face significant economic insecurity (Rajan & Mathew, 2008; Bloom, et al 2010) due to lack of social security provisions, informal sector employment and risk of major health expenditures, making majority of elderly fully or partially dependent on others for meeting basic needs (Table 2.2). Elderly women are particularly vulnerable given the differences in men and women's marital histories, allocation of economic resources/land ownership and employment opportunities which are further exacerbated in patriarchal settings. More specifically, the longer life expectancy of women, on average and the normative age gap between husband and wife make widowhood more likely for women than men. In India, data show that among elderly,

while 56 percent of women are widows only 18 percent of men are widowers. Among the oldest (70+), 75 percent of women are widows, while only 28 percent of men are widows (India Human Development Survey, 2004-5; Census of India, 2001).

[Table 2.2 about here]

Finally, though the Indian government has started planning for its aging population (discussed at a greater length in the next sections), there is no systematic study on India that looks at the potential dramatic implications of population aging on familial/social support systems and disease burdens. The current dissertation is a step in that direction.

The concept of old age in India

The concept of old age differs across societies and has been undergoing a great deal of change. Studies have perceived aging in different contexts as the outcome of biological, demographic, sociological, psychological and other processes. As Hermanova (1988), rightly points out that the chronological age does not necessarily measure physiological or psychological age. In the Indian context, aging has multiple dimensions. Conventionally, aging is associated with wisdom, respect and relieves the elderly from family responsibilities. However it has been also argued that women in general experience greater continuity of roles (ongoing contributions to domestic chores and kin-keeping activities) as they age as compared to men who experience role disruption (Yount, 2009). Again, both elderly men and women seem to be

negatively affected from a sense of isolation and loneliness, absence of a meaningful role in social life, material insecurity and increased dependence on others.

Finally, as mentioned earlier, aging in India has a unique gender dimension as in many other developing countries. Women tend to marry older men; hence women are more likely to be widowed and live in the widowed state for longer periods. Studies on widows are relatively fewer in number, but most studies concur that widows form a particularly disadvantaged group in terms of health and economic resources. More specifically, studies on south Asia and elsewhere have consistently demonstrated economic deprivation associated with widowhood as a result of lower levels of education, limited income earning opportunities, restrictions on remarriage and patriarchal kinship norms (Rahman, 1990; Chen, M & Drez, 1992; Agarwal, B, 1998). Additionally, data (Census of India, 2001; National Family Health Survey, India, 2005-06) as well as empirical studies (Chaudhuri & Roy, 2007) from India also demonstrate that older women are also more likely to live alone than older men. These patterns not only highlight the vulnerabilities of the elderly men and women but is also indicative of the elderly persons' (particularly, elderly women's) tremendous dependence on family for support and care. These different dimensions of the aging process in India have been examined in this dissertation while understanding the link between living arrangement and health outcomes of the elderly.

Socioeconomic transformations and the changing face of aging in India

India has been undergoing rapid economic transformation including urbanization, modernization and globalization that seems to have complicated matters further; it has been often argued that developing countries like India are not institutionally adapted to handle the transition from traditional social support systems for the elderly to more modern ones (Treas & Logue, 1986). Further, the concept of family as a single unit is fast changing with fragmentation and out-migration of young family members, thereby increasing the challenges and vulnerabilities of the elderly persons who are staying behind.

Compounding this set of changes are the changing social expectations regarding filial obligations. Nuclear households, characterized by individuality and independence are increasingly preferred among young married/unmarried adults, particularly in urban settings. Arguing in similar vein, some authors have noted a possible change that would take place in recent future-increased share of Indians living in cities leading to greater number of women participating in paid employment (Bloom, et al 2010). In a setting where women are expected to be the primary caregivers, working outside home would decrease their ability to care for aging parents/in-laws (although it might increase their capacity to provide their parents with financial assistance). Irrespective of the nature of the association, studies have consistently expressed concerns over women's increased income earning opportunities and the associated implications for living arrangement and elderly care.

In light of these demographic and socioeconomic changes, the government of India has introduced policies to tackle the growing challenge of population aging. Some of such plans and policies are discussed in the next section.

Pension System and the Parental Responsibility Law

Given the above socioeconomic transformations in the face of rapid population aging, there is a widespread belief that erosion of the traditional family systems whereby the elderly commonly reside with children or relatives will hinder the levels of elderly wellbeing. This outcome is likely if this newer potential regime with lower levels of co-residence is not accompanied by scaling up the institutional support for the elderly (in terms of pension and insurance schemes) and changes in familial transfers. Although India has had a long standing tradition of providing pension support, this has been limited only to handful of those elderly who worked in the formal, organized sector (Chanana & Talwar, 1987). Beginning in 1957, several states in India have also provided financial support and in-kind assistance for the indigent elderly, ranging from Rs 75 to Rs 300 (about $2 to $7.50) per month. In addition, the Indian government with assistance of the state governments established the National Old Age Pension Scheme (NOAPS) and Widow Pension Scheme to provide some relief to the elderly who are destitute (i.e. below the poverty line). However data from India demonstrate that less than 8 percent of those aged 60 and older receive pension from NOAPS and less than 3 percent of widows receive the widow pension (Desai, et al, 2010). These observations are echoed by other authors who have concluded that most

of the Indian government schemes for the elderly are under-funded and that the older population is grossly under-served (Ponnuswami, 1999; Dandekar, 1996; Rajan, et al, 2004)

Against this background, the Indian government (like some other countries such as Singapore and Thailand) has introduced laws to re-assert family obligations toward the elderly (Knodel, et, al. 1997). The law-Maintenance and Welfare of Parents and Senior Citizens Act, 2007-mandates adult children to provide care and financial support for their elderly parents (See Box 2.1 for a detailed description of this law). Typically, to maintain a living, the elderly rely on personal savings, family or government support. I have identified two issues with this recent legislation. First, with legislation for parental support it is clear that it is primarily the responsibility of the family, rather than the government to care for their elderly. This can be particularly problematic for dual-earner families where caring for the elderly can get challenging and expensive. Second, neither does the legislation take into consideration the income and work status of the care-giving adult child, nor does it considers the possibility of intergenerational conflicts that may arise due to co-residence (Hermalin & Yang, 2004). However without a systematic examination of the link between living arrangement and elderly health, it is premature to judge the multifaceted implications of this family based policy. The next chapters focus on the living arrangement-health link while paying careful attention to the direction of causality.

[Box 2.1 about here]

Table 2.1: Availability ratios for selected regions in the world

Region	Availability ratios	
	1990	2020-25
Eastern Asia	7.2	4.6
South Central Asia	9.4	7.3
South Eastern Asia	9.9	6.8
Western Asia	9.3	7.2
Eastern Europe	4.6	3.6
South America	8.7	6
North America	4.8	3.5

Source: United Nations, World Population Prospects (1998 revision); Adapted from Palloni (2000)

Note: AR is the ratio of population aged 15-59 to the population aged 60+. One can calculate the age specific ARs for age *x, AR(x),* as the ratio population aged *x* to the population aged *x-t(x)* (Palloni, 2000).

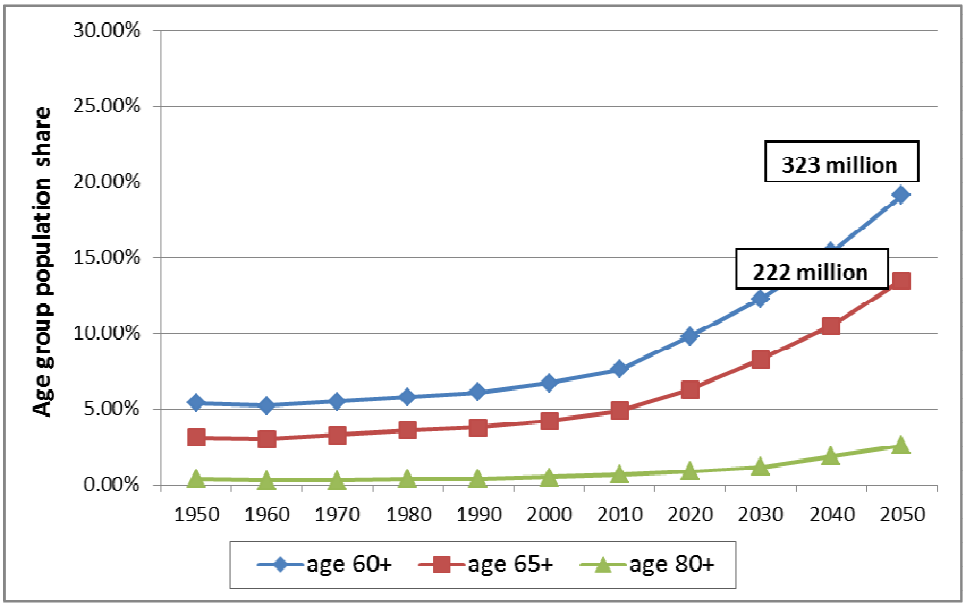
Table 2.2: Dependency Status among Elderly in India (per cent)

Dependency Status	Rural		Urban		Total		
	Male	Female	Male	Female	Male	Female	Total
Not dependent	36.4	24.7	38.6	22.4	37.2	23.8	30.6
Partially dependent	18.6	17.1	16	13.4	17.6	15.6	16.6
Fully dependent	45	58.2	45.4	64.2	45.2	60.6	52.8
No. of Elderly	10491	9954	6286	6473	16777	16428	33205

Source: 52nd *National Sample Survey Organization*, India (1995-1996) quoted in Rajan & Mathew (2008).

Note: The authors used the concept of "Dependency status" to indirectly assess the level of poverty among Indian elderly according to gender and place of residence. The elderly in the sample were asked to describe their state of their economic dependence. It can be presumed that partially and fully dependent elderly are the ones who are very likely to coreside with other family members including adult children, given their poor financial status to support themselves.

Figure 2.1: India's changing age structure and population aging



Source: United Nations, World Population Prospects (2008 revision)

Box 2.1: The government of India's family based campaigns in the face of population aging

Maintenance and Welfare of Parents and Senior Citizens Act, 2007
Ministry of Social Justice and Empowerment, Government of India

"**An Act to provide for more effective provisions for the maintenance and welfare of parents and senior citizens guaranteed and recognized under the Constitution**"
(*The Gazette of India*, Ministry of Law and Justice, New Delhi, India)

- The Act mandates that adult children who have abandoned their parents or have treated their elderly parents with neglect in their homes will have to face penal provisions and imprisonment up to three months or a fine of Rs 5000 ($110 approx) or both.
- Tribunals have been set up across states to take up cases of senior citizens and address reconciliation and maintenance issues
- The Act empowers senior citizens to contest their own cases in the tribunals. The tribunals can also ask adult children or relatives to provide maintenance of up to Rs 10,000 ($219 approx) monthly to elderly parents/senior citizens.

The Act has been fully implemented in 7 states and is partially implemented in all except 4 states

Full report accessed at: http://socialjustice.nic.in/oldageact.php?pageid=1

CHAPTER 3: REVIEW OF THEORETICAL AND EMPIRICAL LITERATURE ON LIVING ARRANGEMENTS AND WELL-BEING OF THE ELDERLY

Given the general overview of the demographic scenario of the developing world and India, in particular (i.e. Chapter 2), this chapter will focus specifically on the links between household structure (e.g. living arrangements) and well- being of the elderly. To do so, this chapter will provide a synthesis of theories and models and will also review issues drawn from empirical studies on developing countries. The goal of this chapter is to show how theoretical and empirical literature on households, norms and intergenerational transfers locate living arrangements of the elderly. This exercise will be useful in constructing the conceptual map for this dissertation project (will be discussed at length in Chapter 4). I will conclude this chapter by reviewing the current status of aging research in India and how I contribute to this limited but growing body of literature.

Living arrangements and health of the elderly: Theoretical Perspectives

The study of levels, patterns and changes of living arrangements among the elderly has been an important though not always a central feature of sociology and demography of the family (Levy, 1965; Berkner, 1972; Wall, 1989; Smith 1993). Classical theories on family that considered effects of industrialization purported that there will be convergence of multigenerational family systems to the conjugal type where nuclear family becomes a more independent kinship unit (Goode, 1963). These

theories also argued that there will be loss of status and control by older persons, as a result of family disintegration (Cowgill & Homes, 1972). However, these classical theories did not withstand empirical testing which led to alternative explanations that borrowed ideas from different disciplines (Elman & Uhlenberg, 1995). Using the 1910 Public Use Sample (PUS) data, the authors' empirical examination revealed a very high prevalence of multi-generational living arrangements among older persons in the United States during the first half of the twentieth century, contrary to what was suggested by the convergence theory (ibid). Furthermore, the argument about loss of power and authority was also not supported by the findings of this study. Specifically, the authors showed that in most cases the elderly persons were heads of households suggesting that the elderly continued to provide economic and within-the home. support.

Several theoretical perspectives, spanning diverse academic disciplines, have conceptualized living arrangements of the elderly as a key element of broader patterns of household organization and intergenerational transfers. However to understand the links between living arrangements and elderly well being, there is a need to locate the theme within the broader and distinguished tradition of studies of families and households. Thus in this section, I will review some of the dominant frameworks, namely evolutionary perspective, framework of familism, rational choice and utility maximizing perspectives, to study the links between household structure and wellbeing of the elderly. In the process, I will also briefly describe theories (e.g. theories of preferences and diffusion) that explain the recent trends in living

arrangement patterns which in turn have important consequences for elderly wellbeing. Surprisingly, the theoretical literature is not very clear on this score for although most of the explanations are usually in the expected direction (i.e. living with children and kin is associated with better health outcomes among the elderly), there are few that suggest the opposite.

Intergenerational transfers and the evolutionary framework

Several authors have developed frameworks that link intergenerational transfers to formulations based on evolutionary theories. Although the focus of these theories has been more on explaining fertility behavior but in the process the theories do shed light on the potential link between multigenerational families and wellbeing of the elderly. Proponents (Kaplan, 1994; Lee 1997)of these theories suggest that strong kin networks, familial bonds and the prevalence of household extension were dominant in earlier societies where they operated as mechanisms to spread the high costs of childbearing and sustain a high fertility regime that offset high infant and childhood mortality. These arguments stress the role of grandparents as an important source of support to younger relatives. The authors argue that strong family bonds and household organization were designed not only to reduce the costs of supporting and caring for grandchildren, but also to improved the general wellbeing of everybody involved. Echoing similar observations, (though not invoking evolutionary principles) Caldwell's (1976) theory of intergenerational flows links strong multigenerational

family ties to the maintenance of high fertility and improvements in general wellbeing of all members involved. However Palloni (2000) argues that though the intergenerational transfers and evolutionary interpretations are important in understanding modern day living arrangement patterns, the evolutionary argument is "excessively loose as it does not identify precise mechanisms ensuring the persistence of networks, bonds and exchanges that result in a high density of transfers toward the elderly, and as part of these, co-residence with children and kin" (ibid: p 27).

Rational choice and utility maximizing framework

Historically, the dominant model of family decisionmaking (Becker, 1974, 1991) in economics is based on the rational choice framework in which living arrangement decisions are made from a discrete set of alternatives as summarized by a household production function (Schwatrz, et al 1984; Wolf, 1994). These authors argue that variations in children's willingness to "supply" coresidence are incorporated into the framework and can be viewed as operating through household production and/or division of household output. This framework is similar to the exchange and reciprocity models that view interactions among family members as being very much like interactions between two unrelated parties. From these perspectives, elderly parents can "buy" the care and attention of their adult children with promises to provide the latter with bequests or other transfers (Bernheim, *et al* 1985). Caring and coresiding with elderly parents, for example, could be given in response to resources received long ago, perhaps in return to parental investment in schooling, caring for a

young grandchild, help with buying a home or land or in response to expected future compensation, as with a bequest.

A related perspective is looking at the living arrangement decisions from a utility maximizing framework. In this framework, utility of each possible living arrangement is compared and the individual chooses the living arrangement that yields highest possible long-term utility. Most of the recent studies on patterns and determinants of living arrangement in developed countries are conceptualized within this framework (McGarry and Schoeni, 2000; Fontaine, et al, 2009). However in the context of developing countries where coresiding with adult children is near universal, utility maximizing frameworks do not explain motivations for living arrangement decisions.

Frameworks of Familism

The theoretical literature that connects living arrangement with elderly wellbeing is based on cooperative models where families are characterized as exhibiting *intergenerational solidarity*-that helps them to function as cohesive units (Bengtson, et al 1991; 2000). According to the authors, intergenerational family solidarity is a multifaceted, multidimensional construct that is reflected not only through several dimensions of parent-child interaction (e.g. resource sharing, affection, emotional support) but also in the strength of familism norms. In some societies, such as the United States, where individuality and independence are given more prority, older adults may prefer to live independently. In other settings, where demonstration of

filial piety is important, coresidence with adult children is normative. Thus the same family behaviors (and hence family arrangements) may have different implications for health outcomes across different societies (Krause & Liang, 1993; Chen *et al* 2008).

In contrast to this idea of solidarity and cooperation, authors have also recognized that parents and children, husbands and wives, adult children and elderly parents may sometimes hold *different* interests. Later authors (Connidus & McMullin, 2002; Bengtson, et al, 2002) have helped to move this debate forward by incorporating the concept of *structured ambivalence*. Drawing upon critical theory, the structured ambivalence construct normalizes the occurrence of conflict in intergenerational relations, suggesting it is a backdrop to all social interaction. Hence relations between household members can create tensions and they may involve unpleasant interactions that may have damaging consequences to individuals' wellbeing. Thus analyses exploring the association between the household context and health outcomes should recognize the dialectic between the dimensions of solidarity and aspects of conflict.

Finally, as pointed out by Bianchi et al (2008), norms and their attendant meanings for individuals imply an element of social control; individuals who violate these norms are likely to face a cost or penalty for doing so. In the case of coresidence with elderly parents, adult children may allow their elderly parents to live with them not only because they feel obligated to do so as a part of being "good" daughter/son but because the cost of violating this expectation outweighs other potential costs, such as

loss of privacy or increased tension among family members, that may arise from coresidence.

Other frameworks

Finally, there are frameworks that theoretically conceptualize non-economic reasons such as traditional obligations and duties, sense of family values and cultural expectations that determine living arrangement choice and its association with elderly wellbeing. Several studies, especially in the context of developing nations have used this framework while examining socioeconomic correlates of older adult wellbeing; Hermalin *et al* (2004) theoretically conceptualized cultural expectations in intergenerational caregiving obligations in their comparative cohort analysis. Similarly, Chen & Short's (2008) empirical analysis in the context of China was based on the theoretical premise that the relationship between living arrangements and elderly wellbeing is shaped by normative ideas about family responsibilities. In this connection, it may be useful to reflect on terms like "enforceable trust" that intergenerational relationships carry, suggesting that families have power to ensure exchanges beyond what the market might produce (*ibid*). A related idea in social psychology is the concept of a "support bank" (Antonucci, 1990)- a reserve of gifts and goodwill produced and consumed over an individual's lifetime. This perspective would suggest that in effect, children "owe" their parents and "good children"-who have internalized the notion of filial responsibility by staying with them and taking care of them-provide a return to the investments that parents have incurred long ago.

However as discussed earlier, recent demographic and socioeconomic transformations challenge the fundamental theoretical premise of the "cultural expectations" framework. Given the theoretical inconclusiveness, India provides a particularly interesting context (with the changing socio-demographic scene) to test some of the theoretical observations discussed above. The conceptual framework and the hypotheses (discussed in the next set of chapters) of this dissertation examines some of the theoretical issues while providing a nuanced understanding of the complexities associated with living arrangements and elderly wellbeing.

The role of preferences and the multiplying effects of diffusion in explaining recent trends in living arrangement patterns

The role of preferences in an era of rapid socioeconomic changes cannot be overlooked. In conventional demographic literature, the role of preferences was primarily discussed in the context of fertility. Lesthaeghe (1983) has argued in favor of the hypothesis that a number of demographic changes including low fertility are attributable to individualism. More specifically, Lesthaeghe & Meekers (1986) envisaged that individualism emerges as an ideological consequence of the advent of a post-modern society, the spread of affluence and the availability of enhanced social transfers and government sponsored safety nets. Similar arguments can be constructed to explain and predict changes in living arrangement patterns among the elderly in developing countries. Building his theory on Lesthaeghe's work, Palloni

(2000) contended that growth of individualism is facilitated by reorganization of production and by technological developments that make possible an adequate supply of goods (e.g. companionship) that were traditionally produced by households. Palloni (2000) further argued that other goods such caring for elderly and children, also become available outside the household and the opportunity costs for production of these goods by individuals within a household become steeper. Hence the combination of individualistic ideology, technological and material developments may have important consequences on the link between living arrangement and elderly wellbeing. Given the limited availability of data on preferences, this dissertation has conducted a contextual analysis to study the interaction between individual and regional (e.g. economic development, urbanization) level factors in examining the link between living arrangement and elderly wellbeing. Though role of preferences cannot be measured directly, but the simultaneous examination of individual and contextual level characteristics will provide an indirect understanding of the issues predicted by this school of thought.

Finally, the multiplying effect of diffusion is not commonly discussed in aging and living arrangements literature. This perspective is akin to the norms and cultural expectations framework. The possibility that norms of living arrangements among the elderly may be diffused and adopted when the whole set of material conditions that led to their emergence elsewhere are not yet realized in a particular place and time, has not received attention in the existing theoretical literature (Palloni, 2000). Like the role of preferences, the effect of diffusion has its origins in demographic

explanations of fertility behavior, which argues that fertility decline in developing countries post 1970 is not just a product of availability of contraceptives but of the social acceptance of a low fertility norm (Rosero-Bixby & Casterline, 1993; Basu & Amin, 2000). Similarly, Palloni (2000) argued that it could well happen that under a minimum set of conditions regarding social transfers, for example, the norm of living alone becomes accepted and practiced among groups that have not yet completely developed all conditions that lead to higher prevalence of living alone in other places. The lure of what is "western" is often generalized and powerful and it may turn out to be stronger under the onslaught of rapid population aging in developing countries (ibid; Wolf, 1994). Thus if this theoretical perspective holds true, then the expected direction of association between living alone and elderly wellbeing might get reconfigured. However, empirical testing of this perspective is difficult as it requires long time series data or alternatively, microdata for different social groups at two or more points in time, knowledge of co-residential preferences and simultaneous assessment of economic conditions, all of which are not readily available for most developing countries (Palloni, 2000).

Summing up: Theoretical perspectives

The above review clearly shows that there is a multitude of alternative theoretical models explaining the link between household structure and elderly wellbeing. However it can be argued that these concepts (intergenerational transfers, evolution, solidarity, ambivalence, exchange, reciprocity and kinship norms) are not competing, antagonistic approaches to family relationships; rather they are just different ways to

describe and explain the complexities of adult child-elderly parent relationships (Bengtson, *et al*, 2002). Furthermore, in essence, conflict perspectives on family behavior often align with "quid-pro-quo" models of exchange. Again, solidarity models of the family share more affinity with altruistic motivations of family behavior (Bianchi, *et al*, 2008). Hence each of these alternative models shows us something slightly different about how family members attempt to stay together, what pulls them away and how they negotiate their differences (Bengtson *et al*, 2002). Similarly, happenstance, culture, social identities and norms are also likely to play a role in determining the relative importance of alternative motives, behaviors and outcomes (Bianchi, *et al* 2008). Additionally, from a life course perspective, coresidence with adult children can be viewed as a pathway in the family's life course that is most likely to be determined by family-role transitions as well as cumulative trajectories of economic needs and resources of both parents and children (Choi, N, 2003). Finally, as discussed above, preferences and diffusion seem to play important conditional roles in the living arrangement and elderly wellbeing relationship. However, given the nature and availability of data to study aging in most developing countries (including India), looking at these effects remain largely beyond the scope of the current empirical preoccupation.

Empirical studies from Asia and beyond

It is well known that in developing countries (in particular, Asia) filial piety and a strong sense of obligation toward parents and elderly alike are dominant forms of family behaviors. Theoretically, elderly living alone would typically receive less care

and would be more vulnerable to social isolation thereby adversely affecting their physical and emotional wellbeing. However empirical studies on relative benefits of coresiding with adult children versus living alone, in both developing and developed countries are remarkably elusive on this score. Specifically, the review of studies in the next sections reveals that empirical evidence is not always consistent with this imagery.

As indicated earlier, in settings where intergenerational ties are traditionally strong, co-residing with adult children often has beneficial effects on older adult wellbeing despite changing socioeconomic and demographic conditions. For example, a recent study of rural Taiwanese elders demonstrated that living alone was associated with much higher levels of stress, when compared with other types of living arrangements (Wang, *et al*, 2002). Studies based in China (Cui, 2002; Chen & Short, 2008) have consistently reported that elderly who were living alone were disadvantaged in all measures of physical and emotional health, highlighting the importance of family and cultural context to wellbeing of the elderly. Furthermore, studies looking at gender differences in co-residence patterns (Knodel & Ofstedal, 2003; Yount, 2009) have also emphasized that older women not only have higher likelihood to live with adult children but also experience stronger wellbeing outcomes than older men, primarily because of poorer health, widowhood status and fewer economic resources.

Interestingly, though family support for elderly have remained the traditional ideal type for most developing societies, handful of studies on Asia, Africa and Middle

East have reported less conclusive findings on the association between co-residence and older adult wellbeing. In her analysis of familial support for medical expenditure of elderly in rural Pakistan, Kochar (1999) using an intra-household allocation framework, found that the benefits to the elderly is not clear. Specifically, the author finds that medical expenditures on co-residing older males do not change with changes in household income and the income of adult males in the household (*ibid*). In the seven-country UNU study, Hashimoto (1991) found that in countries of Thailand, Egypt, Brazil and Zimbabwe there was no significant relationship between physical disability and type of living arrangement chosen among the aged. The author's results tentatively suggest that co-residence is not always perceived to be the best solution for the elderly who are ill or disabled.

Furthermore, Sibai, et al (2009) in the context of Lebanon concluded that though presence of adult child is often responsive to health and socioeconomic needs of older parents, but it is not immediately clear whether co-residence with married children offers a similar advantage as in the case of co-residence with unmarried children. On a slightly different note, contrary to popular belief (of son preference in living arrangement decisions), Logan & Bian (1999) found that older parents in some major cities of China preferred *not* to live with a married son if situations allowed. Finally, studies on older adults' residential preferences (Kim & Ree, 1997 in rural Korea and Holmes-Eber, 1997, in Tunisia) show that there has been a shift in preferences towards independent living over co-residence after controlling for health status, economic condition and availability of kin. These findings raise questions whether

co-residence with adult children is often a matter of choice or is a forced necessity for poorer older adults.

So what can one conclude from these disparate findings? Perhaps the best way to characterize these empirical findings is that they are somewhat inconclusive, though positive associations are more common than negative ones. Part of the reason for these mixed results might be as a result of how they define different focal populations (married versus widowed elderly), the indicators of socioeconomic standing and types of controls used (Palloni, 2000) or the way they have conceptualized health such as subjective wellbeing, functional status, disability and mortality. Finally, most of such studies discussed here are based on cross-sectional data where the authors have been largely unsuccessful in eliminating the possible selection effects and hence it be argued that perhaps, elderly who live alone in these studies are a healthier group at the start. In this dissertation I address this specific problem of endogeneity/selectivity by adopting a multistage analytical procedure to adjust for these biases (discussed in detail in next chapter).

Aging research in India

Much of the early aging research on India was primarily motivated by an interest in fertility dynamics. Several authors have examined association between desired number of children and the security children provide during old age (Cain, 1986; Dharmalingam, 1994; Kumar, 2003). These studies have empirically argued that old –

age security or risk insurance as an important factor in explaining fertility motivation, thereby emphasizing how reproductive behavior is Asia (in particular South Asia) is closely linked with such welfare concerns. However with the rapid graying of the global population, demographic literature on India has been undergoing a gradual shift towards issues related to aging. Though literature on living arrangements have been particularly scant, recent studies (Rajan, et al, 1995; Rajan & Kumar, 2003; Rajan, 2006) have provided detailed description of living arrangement patterns among the elderly in terms of headship, household size and marital status. Several studies from have also started examining the socioeconomic, cultural and biomedical factors influencing the health status of the elderly in the country. More specifically, there has been a growing body of literature (Willingen & Chadha, 2003; Shaji, et al, 2003) that focuses on the importance of social networks for the elderly in the face of socioeconomic changes pointing to dissolution of traditional family systems.

Furthermore, several studies have examined the health status of the elderly. Earlier studies of Nandal, et. al (1987), Gupta & Vohra (1987) and Shah (1993) have provided region/city specific empirical estimates of disease burden among the elderly. In addition, with the availability of nationally representative data (National Sample Survey, 52nd Round, 1995-96) on chronic ailments and disability among the elderly, studies (Gupta, 2001; Rajan, 2006) have provided detailed description of disease profile of the elderly in the country. Yet another cluster of studies come from the field of biomedical research that primarily focuses on identification of age related disease conditions and the role of gene changes, nutrition and DNA repair associated

with the aging process (Hasan, 1996; Rao & Bhaskar, 1996). However unlike many other developing countries, a systematic and simultaneous examination of how these two phenomena-household structure and health-are related is lacking in the demographic literature on India.

Notable exceptions include Sen & Noon (2007) who have examined the link between living arrangement and short term morbidity among the elderly and Pal (2006) who have studied both health and wealth effects of elderly coresidency arrangements while addressing the endogeniety bias by estimating a correlated recursive system of equations. As indicated in chapter 1, this dissertation differs from the above studies and contributes to the existing literature on living arrangements in two distinct ways; first, it addresses the issue of endogeniety by employing a powerful statistical technique which not only adjusts for selection bias but also has a larger methodological contribution in the demography of aging; second, this dissertation examines the strength of both compositional and contextual level effects in influencing the living arrangement and elderly wellbeing link.

Another dimension of aging that has gained attention in the context of developing countries, including India, is widowhood. Though studies on widows are relatively fewer in number, most studies conclude that widows form a particularly disadvantaged group in terms of health and economic resources. Studies on south Asia and elsewhere have consistently demonstrated economic deprivation associated with widowhood (Rahman, 1990; Chen, M & Drez, 1992; Agarwal, B, 1998). Studies

have shown that given limited income earning opportunities, restrictions on remarriage and patriarchal kinship norms, elderly widows' access to resources is much more dependent on living arrangements than in the case of elderly men. Furthermore, findings from studies on widows on South Asia and elsewhere have shown that an elderly widow's wellbeing in a patriarchal setting is overwhelmingly dependent on the living arrangement and gender of the co-residing adult child. Specifically, studies (Rahman & Menken, 1990) on developing countries have demonstrated that relative mortality risks are higher for elderly widows who live alone and elderly widows who live in households headed by individuals other than their sons. On the other hand, elderly widows who lived in households that include an adult son have the lowest mortality risks. Similar observations are made by Vlassof (1990) in her study on widows in the Indian state of Maharashtra. The author's findings demonstrate that older widows' emotional wellbeing (measured by using a self-reported happiness scale with categories happy, satisfied and unhappy) is improved when they co-reside with their sons while regularly receiving visits from their daughters. These findings clearly make a case for studying older adults by their marital status and living arrangements to explore if the interaction between the two (i.e. marital status and living arrangement) have any significant influence on their health outcomes. A descriptive analysis of the elderly by their living arrangements and marital status have been conducted in Chapter 5 of this dissertation, while all multivariate analyses in this dissertation have controlled for marital status to shed light into the differential experience of aging between men and women in India.

Drawing upon the theoretical models and empirical findings of this chapter, the next chapter builds the conceptual framework linking living arrangement and health of the elderly. Data, hypotheses and a road map to the analytical strategies followed in this dissertation are also developed in the next chapter.

CHAPTER 4: CONCEPTUAL FRAMEWORK AND ANALYTICAL STRATEGY

In this chapter, I first describe the conceptual framework to study the research questions posed in the earlier chapters. Then I discuss the data and describe the definitions and conceptualizations of the two important variables used in the empirical investigation, namely living arrangements and health outcome of the elderly. Additionally, I present the hypotheses that will be tested in the analytical chapters of this dissertation. I conclude this chapter by briefly pointing out the methodological issues encountered in this study and how I have addressed those issues with a multi-stage analytical strategy.

Conceptual Framework: Linking Household Structure to Health Outcomes of the Elderly

As shown in the previous chapter, living arrangement and health are important indicators to understand the status of elderly in India. There is scant but growing body of literature on India that provides descriptive picture of these two indicators-living arrangement and health-in the context of population aging. In the absence of institutional support, the concept of living arrangement refers to the familial systems of support and care for the elderly (Rajan, 1995a; 1999). Further, studies on living arrangement and aging on India have focused on different dimensions of living arrangements in terms of the type of family in which the elderly live, the headship they enjoy, the people they stay with, the kind of relationship they maintain with their

kin" (ibid). Similarly, as indicated in the literature review section of this dissertation, studies on older adult health have focused on physical conditions including disability (Shah, 1983; Darshan, et al, 1987) and psychiatric morbidity (Gupta & Vohra, 1987). However most of the literature on older adult health in India is primarily region specific local studies that provide overview of health patterns. An exception is the descriptive study of Rajan (2006) who utilized the nationally representative data- National Sample Survey, 52nd Round- to study health status of the elderly. This dissertation contributes to the demographic literature on aging in India by linking these two important indicators to gain better understanding of the pathways and determinants influencing the relationship between the two. Additionally, the conceptual framework maps the process of linking living arrangements of the elderly to their health outcomes, in a theoretical niche carved by the existing literature on households, families and intergenerational transfers (See Figure 4.1).

[Figure 4.1 about here]

As mentioned earlier the term "living arrangement" refers to household structure (Palloni, 2001). In this dissertation, I categorize household structure into three groups-living alone or with spouse, living with children and living with other family members (such as, nephew/niece, sibling in law and other family members). I have used the term "living arrangement" and "co-residential arrangements" interchangeably in this dissertation. In particular, when the elderly are living alone or only with a spouse, I have used the term "living independently" or "living alone". Again, when the elderly are living either with children or other family members, I

have used the term “co-residence” but have kept the two groups distinct in most analyses.

I have conceptualized health in terms of short term morbidity- cough, fever or diarrhea. Though the risks of disease and disability burdens increase with age my focus will be only on short term morbidity. This is primarily because of the complex causal nature of the relationship between living arrangement and health outcomes of the elderly (the endogeneity issue is discussed in a later section in this chapter). Furthermore, I have also examined how expenditures on medical care differ by living arrangements for the sick elderly (discussed in details in chapter 5 and chapter 9).

Based on the existing theoretical literature on living arrangements and health, my analysis will also consider how several individual and household characteristics of the elderly, such as age, gender, marital status, household wealth and social groups affect health outcomes. Furthermore, I have also identified few factors (over and beyond the household wealth) such as the presence of household amenities which I argue may play an intervening role in influencing the relationship between living arrangement and health outcomes.

Finally, I also shed light on how the larger macro-context can influence this relationship. More specifically, I argue that the relationship between living arrangement and health outcomes is influenced not only by compositional factors (i.e. individual and household characteristics) but also by the area/region/context where

the elderly reside. For example, contexts that provide higher institutional support (e.g. geriatric clinics, old age homes) for the elderly might have a conditioning effect on the household level relationship between living arrangement and health outcomes, than contexts that are infrastructurally poor in terms of elderly care services. Thus the conceptual framework (Figure 4.1) adds this contextual component to the living arrangement-health relationship.

Hypotheses

Based on this conceptual framework, I present the three main hypotheses that capture the overall relationship between living arrangement and health outcomes of the elderly. The current dissertation is organized around these three focal questions. Additional hypotheses examining the role of certain important control variables (such as gender, marital status, household wealth, etc.) in influencing the relationship between living arrangements and health outcomes are presented in each of the analyses chapters.

Hypothesis 1:

Co-residence with adult children as opposed to living independently is associated with decreased likelihood of short-term morbidity among the aged. In other words, co-residence has protective effects on the health of the elderly. (*Examined in chapters 6 and 7*)

Hypothesis 2a:

In contexts that have higher prevalence of institutional facilities (such as accessible health care, geriatric clinics, old age homes, transportation, etc.), co-residence of the

elderly persons with children and others (and hence higher care-receiving possibilities) will not be as beneficial to their (elderly) health outcomes. (*Examined in chapter 8*)

Hypothesis 2b:

The *positive* relationship between co-residence with adult children and elderly well-being is likely to *weaker*, where contextual effects are stronger (*Examined in chapter 8*)

Hypothesis 3:

Co-resident elderly (when sick) will be likely to make higher medical expenditures than the non-coresident elderly. Some of the higher expenditures for the co-resident elderly is explained by a household wealth effect that mediates the relationship between co-residence and health spending. (*Examined in chapter 9*)

Data: India Human Development Survey (2004-05)

This dissertation draws data from the India Human Development Survey (2004-05). The IHDS was carried out by researchers from the University of Maryland and a research organization in India, namely National Council of Applied Economic Research (NCAER), between 2004 and 2005. The nationally representative survey involved face-to-face interviews with people from 41,554 households located in 33 states and union territories, 384 districts, 1503 villages and 971 urban blocks located in 276 towns and cities in India. The survey collected information on income, consumption, employment, health and different aspects of gender and family

relationships from both male and female respondents. Data on a total of 215,754 individuals were collected from these households. The survey also collected information on institutions such as schools, medical facilities and village infrastructure.

To collect this information the IHDS administered two sets of questionnaires- household and women. The household questionnaire was administered to the individual who had most knowledge about income and expenditure of the household. Typically, this was the male head of the household. The health and education questionnaire was generally administered to a woman, often the wife of the male head of the household. The living arrangement variable used in this dissertation has been constructed using the household roster in the household questionnaire, where all household members are identified in terms of the relationship to the household head. Table 4.1 shows the distribution of all household members in the survey in their relation to the household head for the IHDS sample (N=215,754). The three distinct living arrangement categories are constructed based on this distribution.

As mentioned earlier, health related information was collected using the women's questionnaire. Most frequently it was the elderly woman (who is also the spouse of the household head) who answered the questions on short term illnesses that has affected any of the family members in the last 30 days.

[Table 4.1 about here]

The elderly sample (individuals aged 60 and above) is comprised of 17,904 persons of which 8963 are elderly males and 8941 are elderly females. The IHDS data indicate that the elderly constitute about 8 percent of the total population in India, with the proportion of elderly in the total population ranging from 7 to 10 percent in most states in India. However regional variations in proportion of elderly are marked with Kerala distinctively high (13 percent) while Assam (5 percent) and Delhi (4 percent) being especially low. Detailed analysis of regional differences in living arrangement patterns and health outcomes of the elderly is conducted in Chapter 10 of this dissertation.

Finally, turning to the two important variables in my analysis-living arrangement and health-IHDS indicates that co-residence is the dominant form of living arrangement in the country. Specifically, 83 percent of the elderly live with their children followed by 11 percent living alone or with their spouse and 5 percent living with others. About 11 percent of the elderly have reported being sick with short term morbidity-cough, diarrhea or fever- in the last 30 days.

Different dimensions of living arrangement and health measures along with other relevant factors mentioned above are explored in bivariate and multivariate analyses chapters of this dissertation. It is worth noting that since these two measures capture the central theme of this dissertation, detailed discussion will be provided in subsequent chapters as well.

Analytical Strategy and Methodological Issues

This dissertation follows a multi-stage analytical strategy. Figure 4.2 presents a road map of the analytical frameworks followed in this dissertation.

[Figure 4.2 about here]

The next chapter (Chapter 5) provides a broad overview of the basic associations using the IHDS data. In Chapter 6, I look at the association between living arrangement and older adult health outcome in a logistic regression analytical framework.

However, since the examination of this question on living arrangement and health is based on cross-sectional data, the living arrangement of the elderly is already predetermined. So it is not clear if living arrangement decisions determine elderly health or is it the other way round (i.e. reverse causality). In addition, there can be issues relating to selection bias, that is, are the types of people who choose to live with children also the types of people who are more (or less) prone to illness? Given these methodological issues, I have used propensity score methods to adjust for the selection bias in the relationship between living arrangement and health outcome. In addition, propensity score methods permit estimation of average causal effects which is not only useful from a methodological perspective but also has implications for policy. The salient features of this technique and results from the propensity score analyses are discussed in chapter 7.

In chapter 8, I highlight the importance of context in influencing the living arrangement-health link. This analysis is important in the context of India, given the tremendous spatial heterogeneity in socioeconomic outcomes (particularly, health) demonstrated consistently in several empirical studies.

In the final analysis chapter (Chapter 9) I investigate the relationship between living arrangement and expenditure on short term morbidity. Existing studies on health, medical expenditure and poverty have pointed out that Indian households spend significant proportions of their incomes on medical care. Some studies (Garg & Karan, 2008; Gupta, I. 2009; Balarajan, et al, 2011) have argued that out-of-pocket expenditures on health care are one of the leading causes of debt and household poverty in India. Hence given the higher risk of disease burden among the elderly, compounded by an absence of health insurance, examination of the role of living arrangements in determining medical expenditures is an important analytical exercise for India.

Table 4.1 Distribution of household members in relationship to the household head

Relationship to head	% (all) N=215,754	% (elderly sample) N= 17,904
Head	19.26	48.09
Wife/Husband	16.53	17.67
Son/daughter	41.96	0.13
Child-in-law	5.36	0.05
Grandchild	9.46	----
father/mother	3.10	29.37
brother/sister	1.63	0.89
parent-in-law	0.21	2.08
nephew/niece	1.23	0.04
sibling in law	0.62	0.23
other relative	0.53	1.36
servant/other	0.10	0.09

Source: IHDS 2004-05

Figure 4.1: Conceptual Framework: Living arrangements and Health of the Elderly

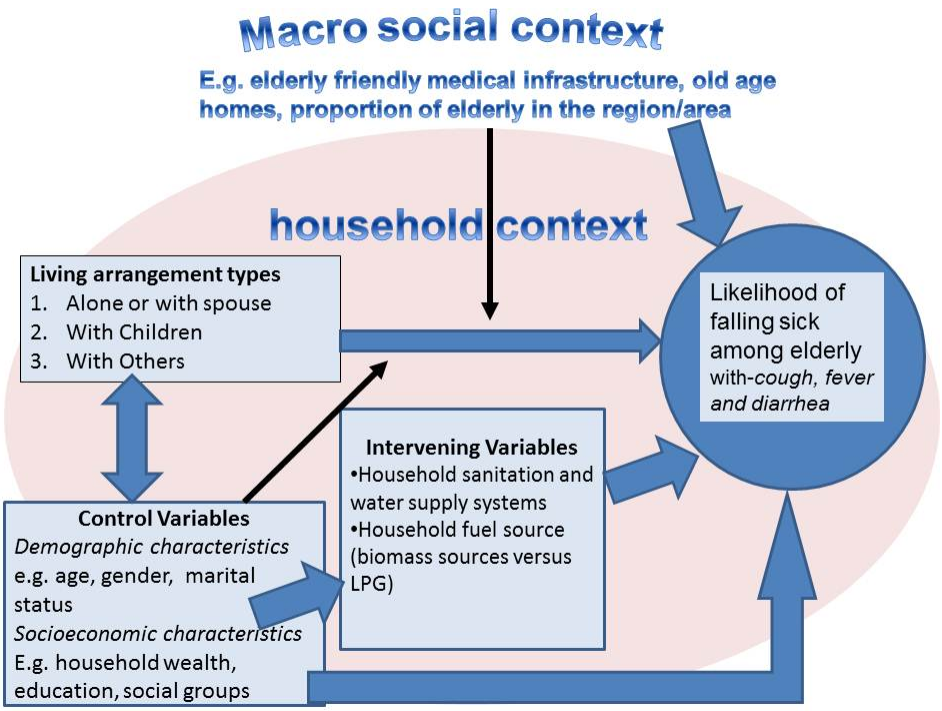
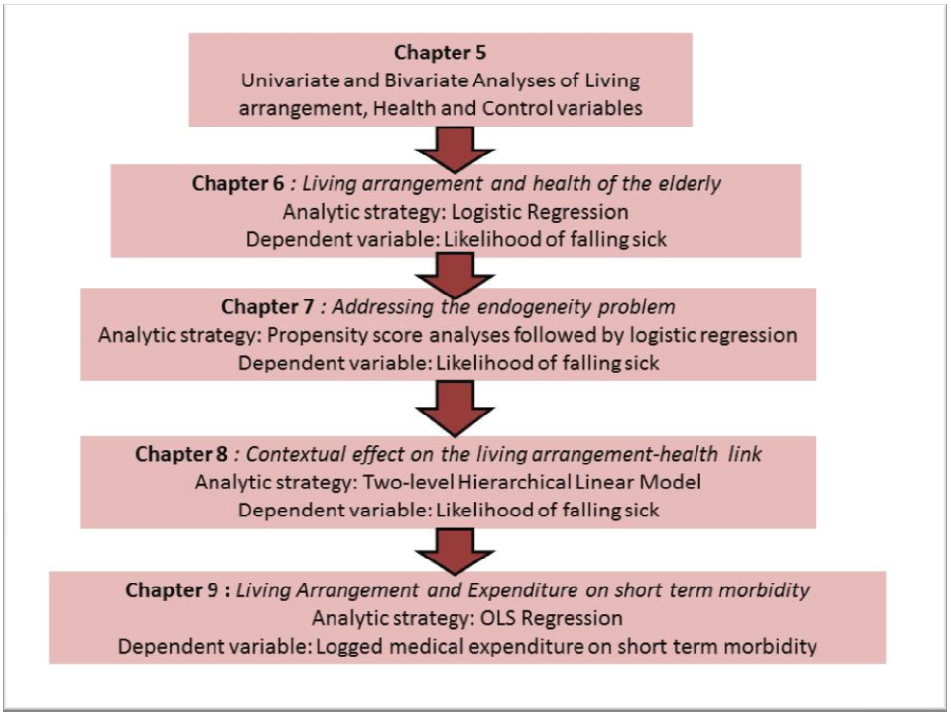


Figure 4.2: Roadmap of analytical frameworks followed in this dissertation



CHAPTER 5: LIVING ARRANGEMENTS AND HEALTH OF THE ELDERLY IN INDIA: A DESCRIPTIVE ANALYSIS

In this chapter I present bivariate associations between some of the relevant individual and household characteristics of the elderly. To test the research questions, raised in this dissertation, it is important to get a better understanding of the current health and socioeconomic conditions of the elderly by looking more closely at their individual distributions. The goal of this exercise is twofold: (1) to provide an overview of the socioeconomic and health dimensions of the elderly in terms of their living arrangement types, and (2) to explore if the patterns suggested by this descriptive analysis is borne out in the multivariate analyses conducted in the later chapters. In other words, this exercise informs the hypotheses to be tested and sets the stage for further multivariate analyses.

The structure of the descriptive analysis is organized as follows: first, I examine the different dimensions of living arrangement of the elderly by important socio-demographic and economic characteristics such as gender, age, marital status and household wealth. Next I turn to the health outcomes (minor illnesses, chronic illnesses and disability) of the elderly in India and explore how these outcomes differ by socioeconomic status. Finally, I look at the bivariate association between the

different dimensions of living arrangement and health outcomes together, as this is the central theme of the dissertation.

Living Arrangements Among the Elderly: Evidence from the IHDS data

The IHDS indicates that despite socioeconomic transformations and potential for family disintegration, most elderly persons continue to live with their children and other family members. Figures 5.1a and 5.1b show living arrangement patterns for elderly males and females. About 82 percent of elderly males and 84 percent of elderly females live with their children. Of the remaining some live either with other family members, such as brothers/sisters, nephew/niece, sibling-in-laws and other distant relatives or live independently (that is, with a spouse). 10 percent of elderly women live alone or with their spouses as compared to 13 percent of elderly men. The elderly who live with their spouses are mostly retired, or live in households engaged in small farming (Desai, et al, 2010: 143). Furthermore, residence of the elderly in multigenerational households is the most dominant form of living arrangement regardless of region (See Figure 5.2), place of residence, religion or caste groups (See Table 5.1).

[Figures 5.1a and 5.1b about here]

[Table 5.1 and Figure 5.2 about here]

Table 5.1 displays selected characteristics of the elderly by living arrangement types. The Table indicates that living with children is slightly less common in households that belong to the lowest economic quintile and those that have lowest levels of education. Some of the relationship with economic status is endogenous because

living alone likely results in less household wealth; but the strong relationship with education suggests that there may be a causal impact of economic standing on living arrangement as well.

A closer look at the group of elderly persons who live independently and are also at the lowest wealth quintile shows that widow/widowers are disproportionately represented in this category (approximately 60 percent of elderly widowers and 59 percent of elderly widows). Thus, widowhood status introduces additional vulnerability for the elderly in India. This can be particularly challenging for elderly women as given the normative age gap between husband and wife, widowhood is more common among elderly women (57 percent) than men (18 percent) (See Figure 5.3). Additionally, looking at the distribution of the elderly by living arrangements reveal that while most elderly live with their children (regardless of their marital status), a slightly higher percentage of elderly widows live alone (7 percent) as compared to elderly widowers (5 percent) re-emphasizing the vulnerability of elderly widows in India (See Figure 5.4).

The challenge is further compounded by the fact that elderly women are rarely accorded the status of head of the households in which they reside (See Figure 5.5). A majority of elderly men (81 per cent) are considered to be heads of the household, whereas elderly women are more commonly found either as mothers of the head (44 per cent) or the wife of the head (35 per cent). Studies on India and in other developing countries have shown that status within a household is associated with

control over resources and decision-making ability which in turn has implications for general wellbeing and access to health care. In India, when women are heads of the households, it is often because they are destitute widows with young children or living alone (Chen & Drez, 1992; Alam, 2006). Finally, living arrangement also has important implications for elderly women who are widowed, as woman's wellbeing upon widowhood greatly depends on whether her children (especially, adult sons) provide adequate support (Chen, 1998; Alam, 2006).

[Figures 5.3, 5.4 and 5.5 about here]

However, it is important to note that the figures and tables presented in this section draw from bivariate associations and hence cannot be interpreted as causal relationships. Also, the selected characteristics presented in Table 5.1 are not necessarily the determinants of living arrangements, but can also be a consequence of factors such as income, health and marital status. As discussed in the theoretical and empirical literature review sections, living arrangements may arise as fallout of family- coping strategy in the face of poverty and ill-health/disability among either the elderly parents or the children.

Health Outcomes Among the Elderly: Evidence from the IHDS data

Short Term Morbidity

In this section I will review health outcomes and expenditures for short term morbidity (cough, diarrhoea and fever), long term morbidity/chronic illnesses (such as diabetes, asthma, cancer) and disability (that prevent normal daily functioning) among the elderly using the IHDS data. As indicated before in the Data section

(chapter 4), the reference period for short term illnesses was 30 days and that for long term illnesses was one year in the IHDS. Since the central goal of this dissertation is to look at the association between living arrangements and health outcomes among the elderly, the review in this section will highlight the differences in health outcomes by living arrangement types.

Consistent with the literature on living arrangements and health in developing countries, the IHDS data show that the elderly living with children (10 percent) and those living with other relatives (11 percent) have substantially lower levels of short term morbidity than the elderly living independently (23 percent) (See Figure 5.6). This association highlights the importance of multigenerational families to the wellbeing of the elderly.

Surprisingly, there seem to be no difference in average number of days lost per illness when the elderly were incapacitated or unable to perform his or her usual daily activities. Specifically, on average the elderly living alone or with their spouses lost 6.45 days when ill, while the elderly living with their children and with others lost 6.44 and 6.36 days respectively per illness. This no-difference finding across living arrangement types may point to the fact that even though the elderly living in non-coresident settings experience higher frequency of morbidity, they cannot afford to avoid routine activities at home or work as they typically do not have adult members supporting them during their illness episodes.

[Figure 5.6 about here]

Long term Morbidity

The IHDS survey also asked if somebody in the household had been diagnosed by a physician for any of the 14 long-term illnesses identified by the IHDS researchers. Thus the IHDS investigation of chronic illnesses was limited to what had been diagnosed by a doctor. Since, getting a physician's diagnosis for a chronic illness is itself economically and socially structured, so the responses reported should not be interpreted as a proxy measure of prevalence of chronic illnesses (Desai, et al, 2010). Nevertheless, given the scant data on prevalence rate and medical responses to long-term illnesses among elderly in India, the IHDS data provides a rich set of information to examine how these illnesses differ by living arrangements and other household indicators.

Figure 5.7 presents the distribution of long-term morbidity among the elderly who had reported being diagnosed with long term illnesses in the last one year (N=3849). It is important to note here that the risk of being diagnosed with one of these illnesses increases with age. The IHDS data show that about 21 percent of the elderly have one of these illnesses, while only 6 percent of the working age population and only 1 percent of children have a diagnosed chronic illness (Desai, et al, 2010). Turning back to the elderly sample who have been diagnosed with chronic illnesses, the two top most frequently reported long term illness are "hypertension" (17 percent) and "other" (~16 percent). Retrospective inquiries revealed that most of the illnesses associated with this unspecified "other" category had elderly who were accident

victims (ibid). Among other widely reported long term illness categories are cataract, diabetes, asthma and heart diseases.

[Figure 5.7 about here]

Figure 5.8 shows distribution of diagnosed long term illnesses among elderly by living arrangement types and disaggregated by gender. Gender differences are not particularly marked, though there exist substantial differences in diagnosed rates between the elderly living independently and the elderly in co-resident family types. More specifically, the elderly living alone or with spouse have higher diagnosed rates as compared to the elderly living with children and others. Since from the previous bivariate analysis, there is evidence that the majority of the elderly living alone are disproportionately concentrated in the lowest wealth quintiles, this finding of higher diagnosed rates is alarming and deserves attention. Relatively lower diagnosed rates among co-resident elderly could be because of substitution of home care and hence lower rates of formal medical care and use.

[Figure 5.8 about here]

In addition, what is not clear from this bivariate association is whether this observed higher diagnosed rates of long term chronic illness among the elderly living alone is one of the reasons why they were unable to move into co-resident arrangements. In other words, the selection problem that arise while exploring living arrangements and elderly health, is accentuated in the case of long term chronic illnesses. Finally, since the data on long term illness is limited to physicians' diagnosis, reporting may be skewed to those who had better access to diagnostic medical care. For example, urban residents are more likely to report higher long term morbidity than rural residents and

those in the south India have higher reported long-term morbidity than those in the central plains (ibid). These factors led to my decision of using short term morbidity (as opposed to long term morbidity) for measuring health outcomes among elderly in my examination of the living arrangement-health link

Disabilities in Activities of Daily Living

The IHDS survey also measured disability by asking if any household member had to cope with any of seven problems (for example, walking one kilometer) that created difficulty for daily activity. If there was some difficulty with a particular activity, respondents were asked whether the person was unable to do that activity or whether the person could do it with some difficulty. Disabilities in activities of daily living are expected to be more common among the elderly than the working-age adults. In particular, of a thousand elderly, 39 have complete disability in one of the seven activities of daily living (namely, walking, toilet, dressing, hearing, speaking, far sight and near sight). This disability rate is almost six times higher the rate for working age adults or for children ages between 8 through 14 (ibid). Figure 5.9 shows the distribution of disabilities in activities of daily living by age. Additionally, Figure 5.10 also presents the bivariate association between living arrangement types and prevalence of disabilities in activities of daily living among the elderly. A quick inspection reveals higher number of elderly with disabilities disproportionately concentrated in households where they either live alone or with their spouses. However the direction of association (that is whether health determines living arrangement decisions or is it the other way round) is unclear at this stage. It is worth

noting that though disability is an important health issue particularly in the case of elderly, but this will not be analyzed in the following chapters while examining the link between living arrangements and health outcomes among the elderly. The reason is the same as stated earlier-the selection bias can be expected to be more severe in such cases as a life course approach cannot be adopted using the IHDS (2004-05) data.

[Figures 5.9 and 5.10 about here]

Expenditures on Medical Care

Indian households spend a surprisingly large proportion of their incomes on medical care (Mahal, et al. 2002; Xu, et al. 2003; Roy & Howard, 2007). The IHDS reports that medical expenses are an important reason why households fall into debt trap in India. In particular, nearly 16 percent of households report that their largest loan in the preceding five years was taken for medical expenses (Desai, et al. 2010). The authors reported that combining expenditures on all household members, on an average, each Indian household spent Rs 190 on minor illnesses during the year and Rs. 1680 on major illnesses during the year (ibid). Furthermore, they also pointed out that the expenses on illnesses varied by household wealth and place of residence (rural/urban). More specifically, affluent households incurred higher medical expenditures than poorer households and the difference was particularly substantial in the case of major illnesses. Again, as pointed out in the previous sections, there is an urban bias in health care outcomes and services in India. The IHDS shows that urban dwellers not only report themselves to be less sick and incapacitated for shorter

periods but they also spend less money on a typical minor illness than villagers (ibid). There also interestingly differences in usage of health care services (public versus private providers) owing to tremendous heterogeneity of the Indian medical sector. A detailed analysis of expenditure on short term morbidity and how it varies by individual and household characteristics of the elderly will be examined in details in a later chapter (Chapter 9).

Living Arrangements and Short-term Illnesses among the Elderly: Evidence from the IHDS data

Table 5.2 displays distribution of the elderly who have been sick with a minor illness in the last one month by selected characteristics and living arrangement types. Table 5.2 indicates that on average, the associations of short term morbidity with all the selected variables (marital status, household wealth, education, place of residence etc.) are stronger for the elderly living independently. Or in other words it can be said that coresidence may act as a buffer against the negative effects such as poverty and widowhood.

Again, elderly women report higher levels of short term morbidity across all living arrangement types as compared to elderly men, though the short term morbidity prevalence rates are higher among both elderly men and women who are living independently than their co-resident types. Additionally, as pointed out in the previous section, widowhood status introduces additional vulnerability among the elderly. The widows/widowers have consistently higher rates of morbidity across all

living arrangement types; the difference (20.5 percentage points) in morbidity rate between married and widow/widowers is particularly marked for the elderly who are living independently.

[Table 5.2 about here]

Again, Table 5.2 shows that the elderly living in highest household wealth quintile have substantially lower short term maladies than those in lowest quintile across all living arrangement types. Apart from the differences across living arrangement types, this result also highlights how socio-economic advantages are associated with health advantages; the elderly in higher household wealth quintiles and with higher levels of education enjoy better health across all living arrangement types than the elderly with no or low levels of education and living in poorer households.

Part of the wealth effect may be due to household amenities in terms of clean household fuel (i.e. LPG as opposed to biomass fuels) and sanitation systems (i.e. piped indoor water and flush toilets as opposed to households that do not have these amenities). The IHDS data indicate that majority of Indian households (62 percent) have none of these amenities and only 7 percent have all three. A cross tabulation (See Figure 5.11) of these amenities by living arrangements shows that in households where the elderly are living independently, prevalence rates of such amenities are lower than in households where the elderly are living either with children or with others. Part of the reason why the elderly in co-resident households have lower rates of short term maladies might be attributed to the presence of such amenities.

To investigate if prevalence rates of morbidity vary by amenities disaggregated by living arrangements, I conducted few bivariate associations (Table 5.3 and Figure 5.12). Table 5.3 demonstrates the difference in short term morbidity rates between the elderly who are living in households that have modern amenities with the elderly who do not. The table clearly shows that household amenities are associated with reduced levels of illness compared with households without such amenities. Furthermore, results from the bivariate analysis also show that among the households that *have* these amenities, the elderly in independent households are still more likely to fall sick with a minor illness than the elderly co-residing with children and other family members (Figure 5.12). This finding is also consistent with the previous observation about the socio-economic effects being larger for those elderly who are living independently. To further test the robustness of this finding, I have included interaction effects (living arrangement types * household amenities) in the multivariate analysis which will be discussed in the next chapter.

[Figures 5.11 and 5.12 about here]

[Table 5.3 about here]

Finally, it is important to note that these amenities may not be only proxies for overall household wealth but may also have direct health benefits. Hence, given these possibilities of direct and indirect effects of household amenities in influencing the relationship between living arrangement and health outcomes, I have incorporated them in the conceptual framework of this dissertation as discussed in Chapter 4.

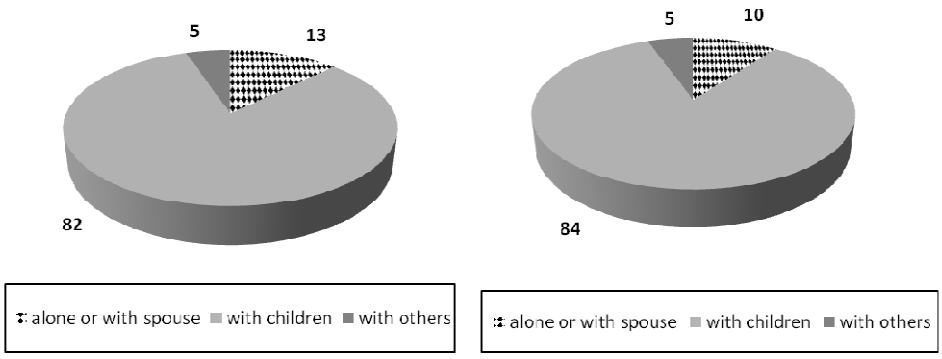
The prevalence of short term morbidity also varies by place of residence. The IHDS Report (Desai, et al. 2010) indicate that metro cities (81 cases per 1000 population) have lower rates of short term morbidity than less developed rural areas (133 cases per 1000 population) highlighting rural-urban differentials in health outcomes. Similar patterns are found while looking at the elderly sample of the IHDS. In Table 5.2, rural-urban differences in prevalence of short term morbidity persists even when they are examined by living arrangement types, though the burden of illness is higher for the elderly who are living independently. Finally, there exists striking regional differences in reported short term morbidity in the country. The context specific differences in short term morbidity rates are discussed in detail in later chapters.

Summary

Drawing data from the IHDS, the above descriptive analysis has been guided by the existing literature on household structure and health outcomes in developing countries. To summarize, bivariate analyses show that the elderly living in extended family settings (i.e. with children or others) are healthier than those living alone or with their spouses (i.e. the elderly have lower prevalence rates for both short term and long term illnesses). Many other factors are also related to health outcomes. There seems to be a consistent urban advantage in health outcomes and health care services in India. Additionally, marriage is also shown to have beneficial association with the health of the elderly in all living arrangement types raising concern for the sick elderly who are widowed and are living independently. There is some evidence to show that co-resident family types are also typically wealthier than the non-coresident

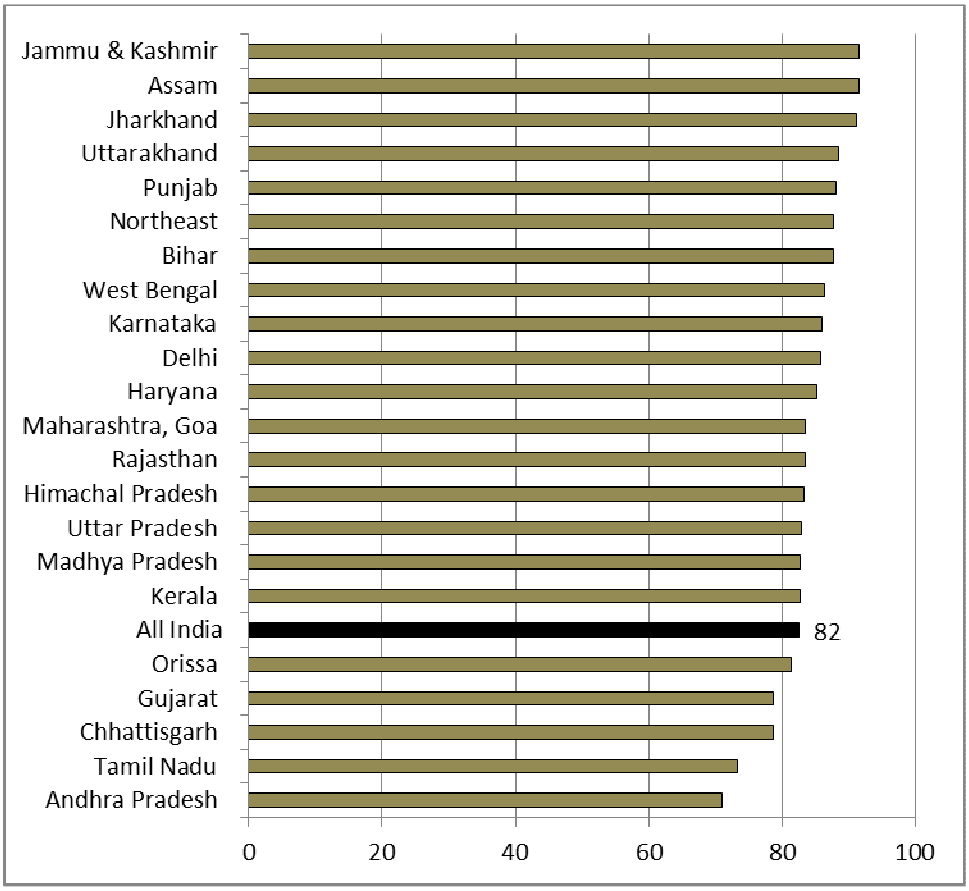
family types. This may explain part of the reason why the elderly living independently fare worse in terms of health outcomes. This observation is consistent with the existing theoretical and empirical literature on the inverse association between SES indicators and health outcomes. When proxy measures of household wealth (here, household amenities such as clean fuel and modern sanitation systems) are studied, bivariate results showed consistently lower rates of short term maladies in households with such amenities as compared to households that do not. Further examination of household amenities by living arrangements also demonstrates higher morbidity rates among elderly living independently as compared to the elderly living in co-resident arrangements. Finally, it remains to be seen whether the associations observed here persist even when other individual, household and contextual covariates are controlled for. This is the motivation for the analyses that follow in the next set of chapters.

Figures 5.1: Living Arrangements of a) (left) Elderly Men and b) (right) Elderly Women (in percent)



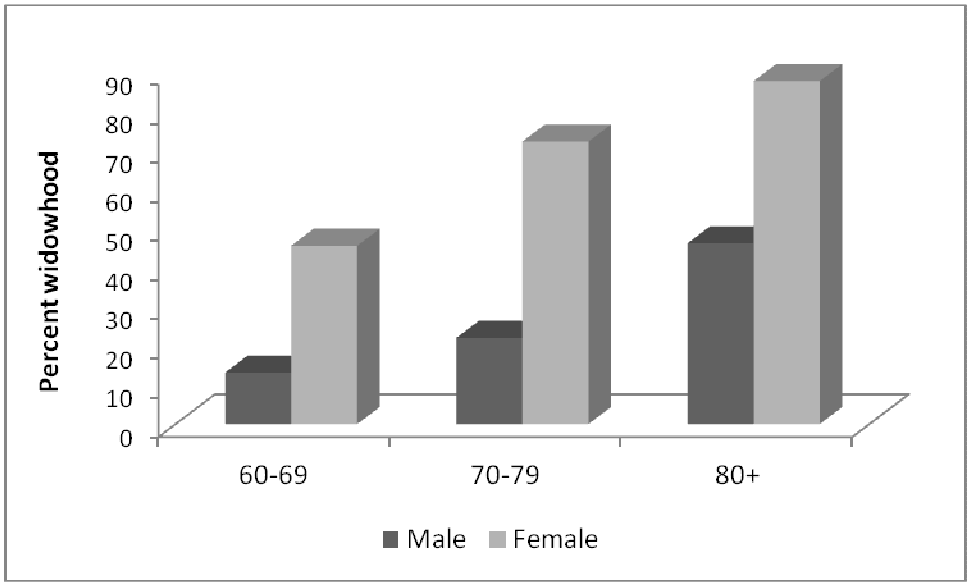
Source: IHDS 2004-05; Elderly Men (N=8949) & Elderly Women (N=8934)

Figure 5.2: % of elderly living with children and others by major states in India



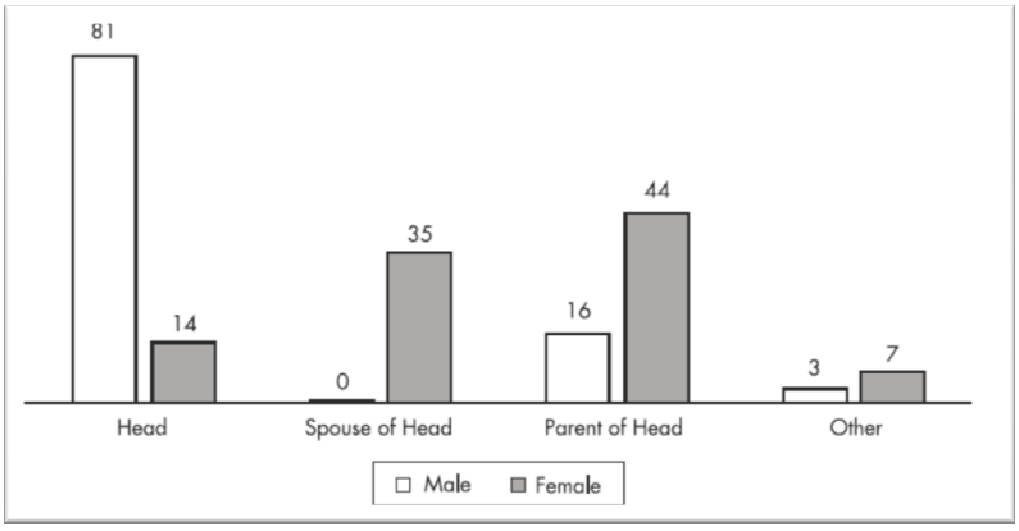
Source: IHDS 2004-05

Figure 5.3: widowhood by age for elderly men and women



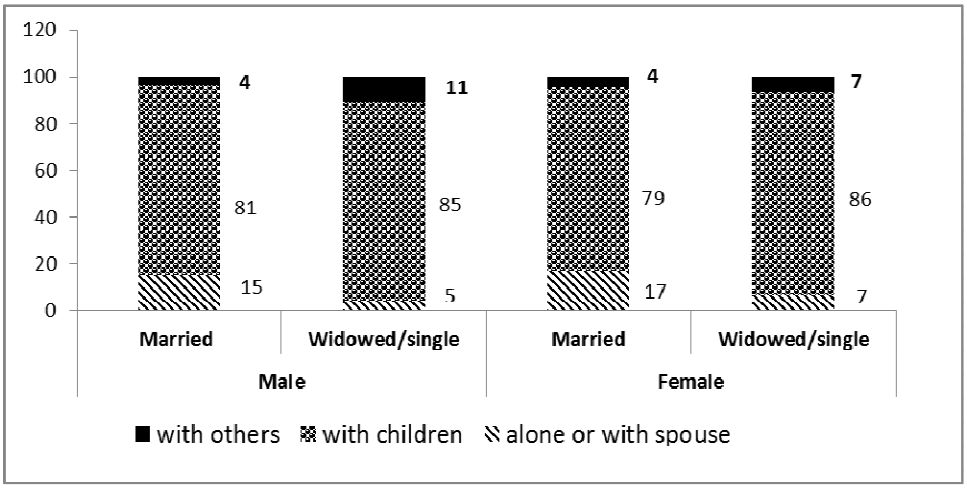
Source: IHDS 2004-05

Figure 5.4: Relationship with household head for elderly men and women (in per cent)



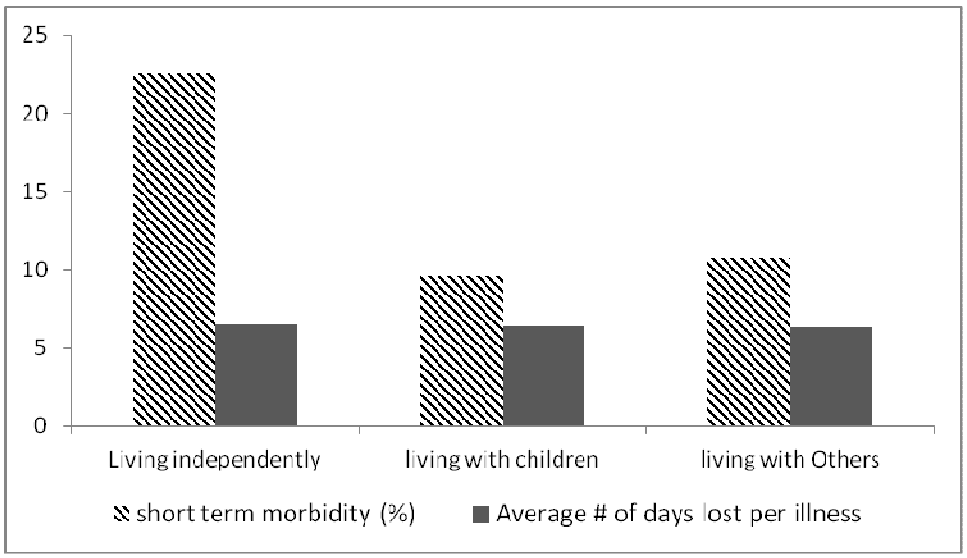
Source: adapted from Desai, et al, 2010. "Well-being of the Older Population", in *Human Development in India: Challenges for a Society in Transition*. OUP.

Figure 5.5: Living arrangements of the elderly by gender and marital status



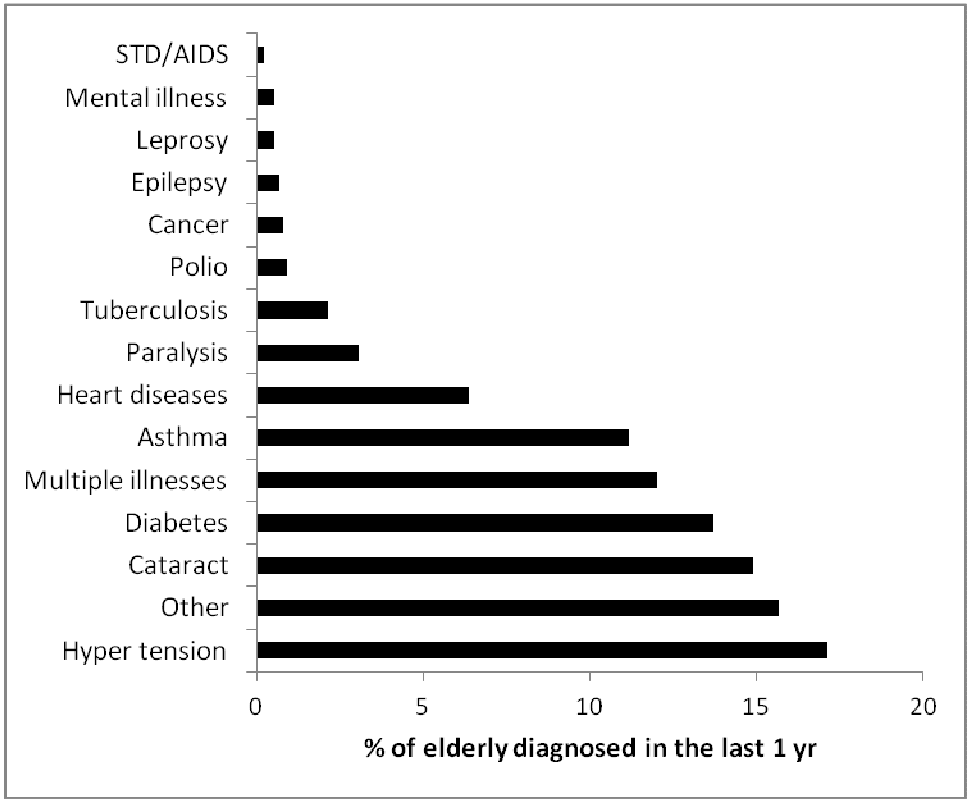
Source: IHDS 2004-05

Figure 5.6: Short term morbidity prevalence (in percent) and No. of days lost due to illness by living arrangements



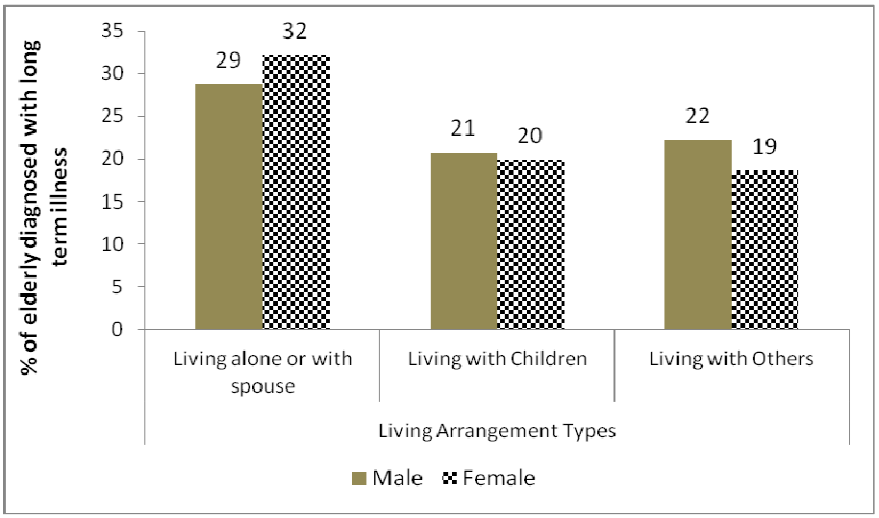
Source: IHDS 2004-05
Note: The "living independently" category consists of the elderly who are living alone or with their spouses.

Figure 5.7: Diagnosed Long term illnesses among elderly (in percent)



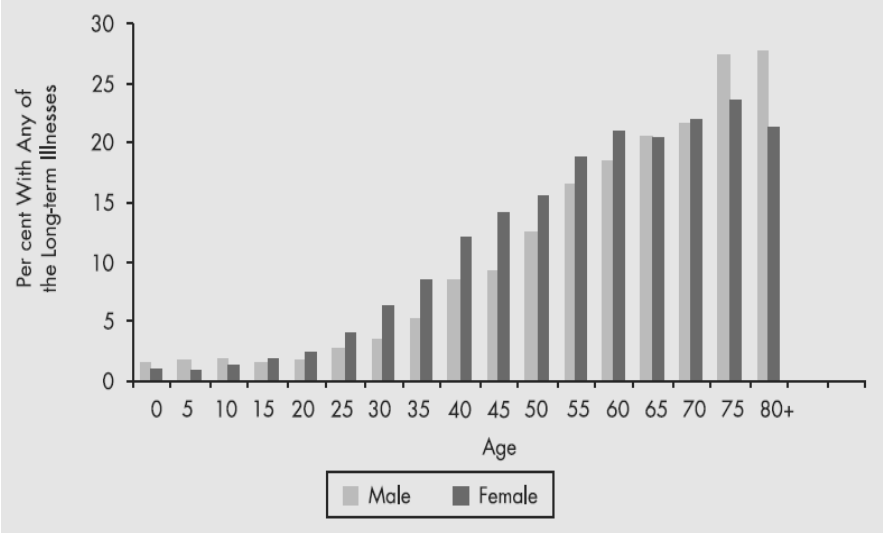
Source: IHDS 2004-05

Figure 5.8: Diagnosed long term morbidity among elderly by living arrangement types



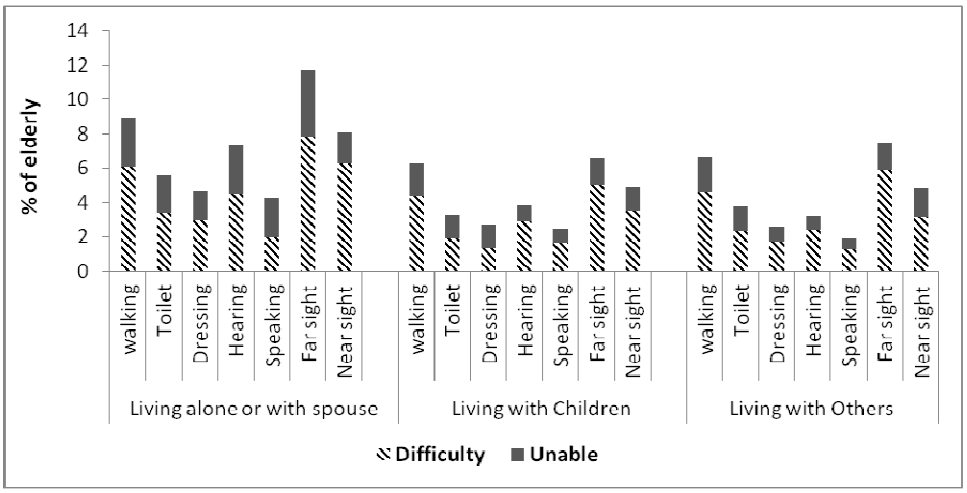
Source: IHDS 2004-05

Figure 5.9: Disabilities in activities of Daily Living by Age



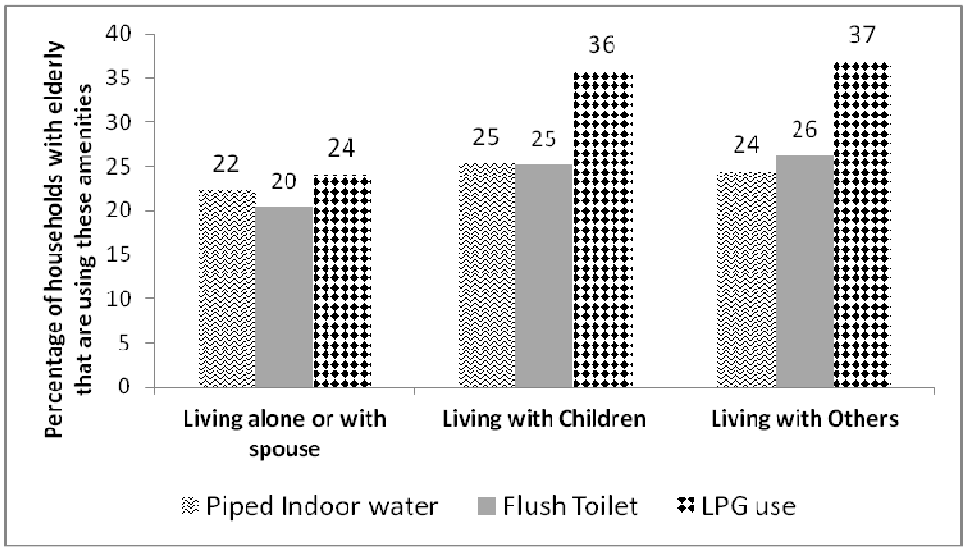
Source: Source: adapted from Desai, et al, 2010. "Health & Medical Care", in *Human Development in India: Challenges for a Society in Transition*. OUP

Figure 5.10: Disabilities in activities of daily living by living arrangement types among the elderly



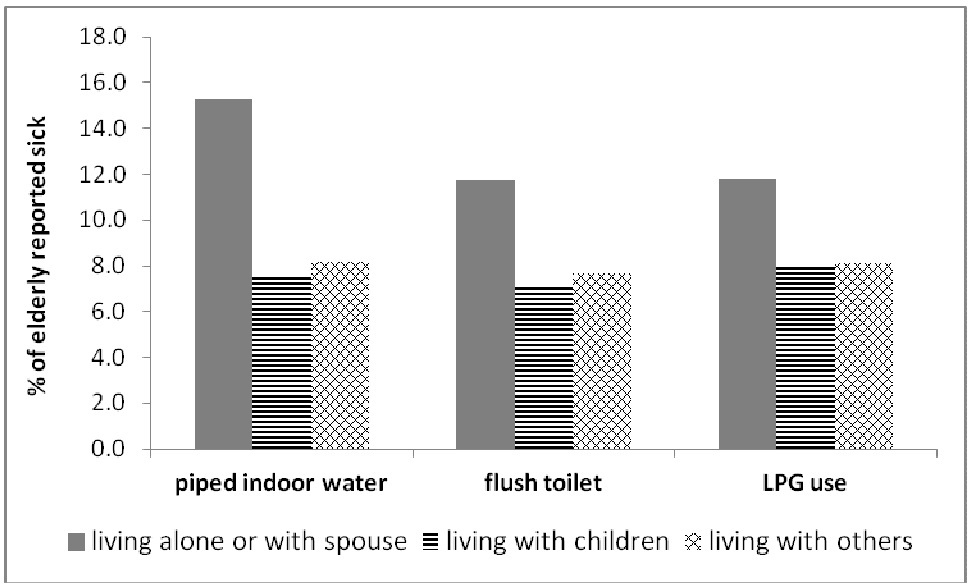
Source: IHDS (2004-05)

Figure 5.11: Households (in percent) with elderly that enjoy modern household amenities by living arrangements



Source: IHDS (2004-05)

Figure 5.12: Percentage of elderly reported sick with short term morbidity by living arrangements and household amenities



Source: IHDS (2004-05)

Table 5.1: Percentages in living arrangement types by selected characteristics of elderly persons (N=17,883)

	Living Arrangement Types		
	Living alone or with spouse	**Living with Children**	**Living with Others**
Age			
60-69	12.5	82.6	4.9
70-79	12.6	82.0	5.3
80+	8.4	82.8	8.8
Marital Status			
Married	15.8	80.3	3.9
Widowed/Single	6.1	86.1	7.8
Education			
Illiterate	33.0	60.4	6.7
Primary School (1-4 std)	20.6	73.2	6.2
Some High School (5-11 std)	6.2	89.2	4.6
Higher secondary & Some college	2.5	91.2	6.3
College Grad	4.0	91.1	4.9
Religion groups			
Hindu	12.4	82.1	5.6
Muslim	10.0	85.5	4.5
Christian	16.2	78.9	4.9
Sikh	8.2	87.4	4.4
Other religion	10.6	86.8	2.6
caste groups			
High Caste Brahmin	9.5	83.3	7.3
Lower castes (OBC, ST, SC)	12.7	82.3	5.0
Other castes	11.5	82.7	5.8
Standard of Living Quintiles			
Poorest	29.8	64.6	5.6
2nd quintile	12.3	82.5	5.2
3rd Quintile	8.2	85.7	6.1
4th Quintile	6.6	89.0	4.5
Affluent	7.4	87.1	5.5
Place of Residence			
Rural	12.7	82.0	5.4
Urban	10.4	84.1	5.5

Source: IHDS 2004-05; (N=17,883)

Table 5.2: Percentages with short term morbidity by selected characteristics of the elderly persons (N=1,987)

	Living Arrangement Types		
	Living alone or with spouse	**Living with Children**	**Living with Others**
Sex			
Male	19.6	8.2	9.6
Female	26.2	10.9	11.9
Age			
60-69	21.0	9.8	11.6
70-79	25.5	8.8	9.6
80+	23.2	10.5	9.5
Marital Status			
Married	18.7	9.0	11.6
Widowed/Single	39.2	10.5	10.0
Standard of Living Quintiles			
Poorest	33.5	13.5	17.3
2nd quintile	24.3	12.0	14.3
3rd Quintile	18.5	10.0	9.3
4th Quintile	11.4	8.9	8.3
Affluent	10.2	6.7	7.0
Place of Residence			
Rural	25.9	10.6	10.9
Urban	13.2	7.1	10.5
Education			
Illiterate	30.27	12.37	15.38
Primary School (1-4 std)	25.22	11.73	23.58
Some High School (5-11 std)	16.41	10.32	10.71
Higher secondary & Some college	1.10	9.04	11.64
College Grad	4.98	6.57	4.86

Source: IHDS 2004-05

Table 5.3: Percentage of elderly reported sick with short term morbidity by household amenities status

	Household Amenities		
	piped indoor water	**flush toilet**	**LPG use**
Yes	8.4	7.6	8.3
No	12.3	12.4	13.2

Source: IHDS, 2004-05

CHAPTER 6: MULTIVARIATE ANALYSIS - THE EFFECT OF LIVING ARRANGEMENTS ON HEALTH OUTCOMES OF THE ELDERLY

In the immediately preceding chapter, the results from the bivariate analysis provide support for some of the hypothesized relationships in this dissertation. In particular, the elderly living with children seem to have lower rates of short term morbidity when compared to the elderly in other living arrangement types (especially, the elderly living independently). Furthermore, bivariate analysis shows that the elderly living with children also seem to live in households that are relatively wealthier which might explain their better health outcomes. Finally, both review of literature and bivariate examination are suggestive of the fact that the elderly who live with their children are the ones who typically spend more on medical expenses when sick.

Gender and marital status seem to introduce additional layers of complexity in the living arrangement-health outcome link. More specifically, bivariate analysis suggest that being a woman and being a widow makes an elderly person particularly vulnerable to illness. A closer look into the condition of widows indicates that they are disproportionately concentrated in the lower wealth quintiles. Surprisingly, health outcomes among the elderly do not seem to vary among different social groups (caste and religion groups) in India. Based on the bivariate analysis, it can be said that differences in health outcomes by social groups do not seem to be associated with living arrangements in any discernable way. Given these findings from the previously

conducted bivariate analyses, it now remains to be seen how each of these individual and household level characteristics influence the living arrangement and health outcome relationship, net of other factors.

In the next sections I restate the overall hypotheses to be tested and also add some secondary hypotheses, drawing from the existing theoretical and empirical literature. Then I discuss the results from the multivariate models and summarize the key findings from the same. In conclusion, I discuss the methodological challenges associated with a logistic regression analytical strategy while looking at the living arrangement-health outcome link and emphasize the need for further examination. This chapter thus sets the stage for the propensity score and the multilevel analyses that I conduct in the remaining chapters of this dissertation.

Hypotheses

The following sets of hypotheses have been examined at the household level. The first two hypotheses examine the broad relationship between co-residence and elderly health while hypotheses 3 and 4 particularly examine the strength of the relationships.

Hypothesis 1:

Co-residence with adult children as opposed to living independently is associated with decreased likelihood of short-term morbidity among the aged, after controlling for SES. In other words, living with children has protective effects on the health of the elderly.

Hypothesis 2:

Co-residence with adult children is associated with wealthier households that decrease the likelihood of short term morbidity among the aged. In other words, household wealth perhaps through better sanitation systems and clean household fuel use play positive intervening roles in the association between co-residence and elderly health outcomes.

Hypothesis 3:

The negative association between co-residence with adult children and lower levels of short term morbidity among the aged is weakened in households where the elderly are enrolled in and have been receiving benefits from pension schemes. In other words, economic independence among the elderly is associated with positive health outcomes irrespective of their living arrangement status.

Hypothesis 4:

The negative association between co-residence with adult children and lesser likelihood of short term illnesses among the aged is strengthened for elderly women (especially widows) as compared to elderly men and widowers. Co-residence with adult child is expected to be more responsive to the health outcomes of elderly women, as aging mothers are more likely to be widowed (given the spousal age difference in marriage) and economically vulnerable (given low levels of schooling and lack of formal employment).

Data, Analytic Strategy and Description of Variables Used in the Multivariate Models

As indicated before (in Chapter 4), I use the India Human Development Survey (2004-05) data (Note: See Chapter 4 for a detailed description of the IHDS data) and focus only on short term illnesses-fever, cough and diarrhea. About 11% of elderly have been sick (i.e. reported any cough, fever or diarrhea).

Based on the primary objective of this empirical exercise, the primary independent variable of interest is the living arrangement variable which captures the co-resident types- living alone or with spouse, with children and with others. The rationale of using these categories for conceptualizing "living arrangement types" and a detailed description of each of these categories have been already provided in Chapter 4. In the regression analysis, each of the living arrangement types will enter as dummy variables into the models with living with children as the reference group.

The choice of the control variables have been shaped by the existing literature (Chapter 3) and the bivariate analyses (Chapter 5). Given the huge body of literature examining the complex association between SES and health, the control variables in the current analysis will include household background characteristics-caste, religion, place of residence (rural/urban), household wealth-(measured using a constructed scale of the number of consumer goods owned from a list of 33 (e.g. chair or table, television, car, credit card, etc)- as well as individual characteristics (gender, education, employment and marital status) of the elderly person. Education enters the

multivariate analyses as a continuous variable and is measured by completed years ranging from 0= no education through 15 years= graduate degree. Marital status is measured as a two category variable, currently married and widowed/single. Other marital status categories-divorced, separated or absent spouse- are ignored for this analysis as they are not theoretically relevant for the Indian context.

Other than wealth, economic standing is also reflected in clean fuel (LPG) use in cooking as opposed to firewood and biomass fuels, presence of flush toilet system as opposed to traditional pit latrine systems or no facility at home and piped indoor water for drinking as opposed to other sources like tube well, canal water or covered well. I believe that these household fuel and sanitation items might play an intervening role in the living arrangement-health outcome relationship. Additional income, like pensions, received by the elderly has been measured by receipt of any government pension including National Old Age Pension (NOAP), disability pension or the widow pension in the last 12 months.

Social group membership is measured in terms of caste and religion groups. This dissertation distinguishes five major caste groups-high caste Brahmin 7.28%, other backward castes (OBC) 40.17%, scheduled castes (SC) 17.65 %, scheduled tribes (ST) 6.30% and other castes (28.30%). In the Indian caste system the OBCs, STs and SCs are considered to be lower order social groups and SCs and STs are typically at the bottom on most of the indicators of well-being (Desai, et al. 2010: 208). Religion has been classified into five major groups-Hindu (81%), Muslim (11%), Christian (3

%), Sikh (3%) and other religion (2%). Both caste and religion groups are included in the multivariate analyses as dummy variables with high caste Brahmins and Hindus serving as the comparison group for caste and religion dummies respectively. Respondents are classified as living in rural (65%) or urban (35%) areas based on the Indian census definition. Diversity in patterns of residential arrangements is so large in India that I control for the place of residence (rural versus urban) in most regression models.

State dummies (22 major states) are also added to control for the context; elderly health outcomes are consequences of not only biology, behavior, socio-economic factors but also of the context and structural antecedents. Adding contextual controls is particularly important in the Indian context where there are marked inter-state differences in health outcomes; the southerners reporting consistently lower levels of short term morbidity and higher levels of health care than elsewhere in the country (Desai, et al in Human Development in India, 2010).

Regression models also control for the elderly respondent's work status operationalized as participation in any sector of work including wage work, work in a business, farm work, or animal care. Additionally, interactional association between living arrangement and marital status and again living arrangement and pension income have been explored in order to test hypotheses 3 and 4. Table 6.1 shows descriptive statistics on selected independent and control variables used in the analysis.

[Table 6.1 about here]

Results from Multivariate Logistic Regression Analyses

I have estimated two sets of logistic regression models. The first set of models examines the overall relationship between living arrangement and health net of a wide range of covariates (Table 6.2a). The first set of models tests the validity of hypotheses 1 through 3. In the second set of regression models I look at the same relationship separately for elderly men and women (Table 6.2 b) and also add gender interactions. The goal is to investigate if the negative impacts of poverty, widowhood, low levels of education, disadvantaged castes, etc. are greater for elderly women than men and also whether these wellbeing indicators differ by the living arrangements of men and women.

Table 6.2a present results from logistic regression models on likelihood of being sick (any of the three types of short term morbidity-cough, fever, diarrhea).Model 1 looks at the total effect of living arrangement on the likelihood of being sick, which essentially is a regression version of the bivariate tables on living arrangements as described in Chapter 5. Model 2 is nested and it includes the non-economic controls such as age, gender, marital status and religion. Model 3 is nested and incorporates economic and household amenities controls, such as standard of living scale, water and sanitation systems and information on household fuel use. Model 3 is estimated primarily to test the hypothesis of wealth as a mediating variable (Hypothesis 2).

Finally, Model 4 is the full model and includes all the state dummies in addition to the above mentioned economic and non-economic controls.

[Table 6.2a about here]

Consistent with the Hypothesis 1, results from all the logistic regression models consistently demonstrate that co-residential living arrangements have positive effect on the health outcome of the elderly. Clearly, the elderly persons living alone or with their spouses fare the worst. However, it does not appear that living with other family members is more disadvantageous than living with your own children. This remains true for each of the models.

The likelihood of being sick for the elderly living with others is not statistically significantly different from the elderly co-residing with children in all the models. In other words, residence in an extended family setting (living with children or living with other family members) has protective effects on the health of the elderly. This finding supports previous studies on health and living arrangement from other developing countries.

More specifically, from Model 2, for an elderly living alone with/without spouse in a nuclear household, his/her odds of being sick is increased by a factor of 2.11 (predicted log odds coefficient =0.749) when compared to their extended family counterparts, after controlling for their non-economic characteristics. Taking all the models together, the increase in odds of being sick for the elderly living on their own ranges from 1.97 to 2.73 when compared to those co-residing with their children.

Consistent with the notion that elderly females and particularly widows are more vulnerable to adverse health conditions given the general neglect and devaluation of women in patriarchal settings, results from Models 2 through 4 seem to suggest higher likelihood of short term morbidity among elderly females and widows (though statistically non-significant). Further examination of the gender differences (if any) is reported and subsequently discussed in the next set of logistic regression models (Table 6.2b)

In addition to the family structure, presence of adults in the household seems to have protective effects on the health of the elderly. This is an important finding. Each of the models shows that presence of adults has positive and significant effect on health. In other words, having another adult member in the household is beneficial, regardless of whether the elderly is married to that adult or whether that other adult is some other relations (e.g. brother, sister-in-law, etc.). This might explain the surprising finding of a statistically non-significant coefficient of the widows in each of the models. These results, however, are consistent with the existing literature on developing countries, where co-residence is common and elderly care is rooted in the normative principles (Chen, 2008; Yount, 2009). From the controls incorporated in Models 2, 3 and 4, the results are fairly consistent with the existing literature on developing countries where health of the elderly is dependent upon host of factors like urban residence, age, education and gender. In particular, the elderly seem more likely to fall ill if they live are located in rural areas, are more aged and have lesser education. These variables are also consistent with the general theory described in

this dissertation (such as frameworks of familism), about the benefits of living with children and others.

From models 3 and 4, it is evident that the elderly poor are much more likely to be sick than those living in more affluent households, even after incorporating the state dummies. Surprisingly, some specific additional household wealth characteristics such as clean fuel and piped indoor water do not seem to play significant intervening roles between living arrangement and likelihood of being sick. So, it is not contaminated water or polluted indoor air that hurt the elderly poor, it is more their general condition of poverty that leads to more illness. The exception here seems to be flush toilets which even independent of overall economic standing reduces illness among the elderly. These results offer partial support to my Hypothesis 2. Health literature on developing countries have shown drinking water, household fuel and sanitation systems to have significant health effects on children and women, but results from the current analysis indicate that these pathways may operate differently for elderly persons.

Additionally, the effect of the economic controls is particularly interesting and the findings corroborate my hypothesis that household wealth has a conditioning effect on the relationship between living arrangement and health outcome among the elderly. It is clear from Models 2 through 4 that education and urban remain significant predictors in influencing the health outcome of the elderly but the strength of their effects are reduced considerably once the economic controls are introduced

into the models. More specifically, for each additional year of education the odds of being sick for an elderly is decreased by factor of 0.96 (log odds coefficient= - 0.0348), holding all other variables constant (Model 2). However this effect not only decreases in size but also loses its statistical significance when economic controls are introduced into the models.

Similarly, for an elderly living in an urban area, the odds of being sick is decreased by a factor of 0.67 (log odds coefficient= - 0.389) compared to an elderly living in a rural area, holding all other variables constant. The effect however reduces from a log odds coefficient of 0.389 (Model 2) to 0.175 (Model 4). These results suggest that the more educated are healthier only because they are better off economically and that the urban elderly are healthier in large part because they are richer. This finding of "urban advantage" will be further substantiated in the multilevel analysis of this dissertation (Chapter 8). Finally, effect of state controls in the Model 4 deserves attention. Interestingly, the log odds coefficient of "living independently" increases from Model 3 (0.682) to Model 4 (0.777). This is probably because living alone is relatively more common in the South (given socioeconomic conditions such as better health infrastructure, higher education and endogamous marriages) and the South is in general healthier (Dyson & Moore, 1983; Navaneetham, 2002; Desai et al, 2010) so that not controlling for region masks the true effect of living alone on health.

Finally, in terms of model fit, Model 3 (which includes the economic controls) seems to be the best model when compared to all the other models, highlighting the

statistical importance of the economic controls in influencing the living arrangement-health relationship. This is reflected by the smallest value for the Bayesian Information Criterion, or BIC reported in Table 6.2a.

Among the social group controls-caste and religion-we have surprising findings. With respect to caste differences, after controlling for all variables, there seems to be no significant difference in the likelihood of being sick. Caste groups- high caste Brahmin, scheduled castes, scheduled tribes and other castes- when compared with the other backward castes, and religion groups-Muslims, Sikhs and Christians-when compared with Hindus, do not seem to stand disadvantaged in terms of their likelihood of short term morbidity. This is an unexpected finding as lower castes and particularly Muslims fare poorly in many other socio-economic outcomes (e.g. education, immunization, mortality, etc.) when compared to high caste Brahmins and Hindus. It is difficult to evaluate these findings of no-differences in caste and religion groups as there is not much literature that looks into the association between social stratification and socio-economic outcomes of elderly in India. Finally, this lack of difference is true before and after economic controls.

Table 6.2b presents logistic regression coefficients predicting likelihood of being sick for men and women separately. This exercise has been motivated by the existing literature on gender differences on health and health care in the developing world. A related goal is to examine whether the causes of ill health are different for older women than for older men. The Table thus includes gender interactions which not

only help to compare any gender related differences across the covariates, but also tests for their statistical significance (Model 3 in Table 6.2b).

[Table 6.2b about here]

Overall, the results from Model 1 and Model 2 of Table 6.2b demonstrate that the effect of living arrangement on likelihood of being sick is almost same (and not strengthened for elderly women as proposed in Hypothesis 4) for both elderly men and women. More specifically, the elderly living alone or with their spouses have worse health when compared to their other living arrangement types. Further, a closer look at the only elderly women model (Model 2 of table 6.2b) demonstrates that though being married is negatively associated to the likelihood of being sick, the effect is not statistically significant (as it is not for elderly men either). Thus findings from these models suggest that while living without children exposes both elderly men and women to several health hazards, the elderly's marital status per se does not necessarily amplify the negative impact of gender, as suggested in my Hypothesis 4. This finding is further corroborated by the female*married interaction coefficient, which is in the expected direction (i.e. negative) but remains statistically non-significant (Model 3).

As shown in Table 6.2b, none of the gender interactions have a statistically significant impact on the likelihood of being sick. Poverty, rural residence, the lack of flush toilets, and the absence of other adults has just as negative effect on older men

as on older women. Thus the more substantive finding is the vulnerability of living without children for both men and women.

Conclusion

In this chapter I examined a set of hypotheses to explore the contours of the relationship between living arrangement and health outcome of the elderly. Based on the logistic regression results I find strong evidence that elderly persons living independently are most vulnerable to the burden of short term morbidity. Part of this "co-resident advantage" can be explained by the fact that such elderly persons also happen to live in households that are relatively wealthier and hence enjoy better sanitation systems. The results from the logistic regression models provide partial support to this explanation. Elderly females seem to have higher likelihoods of falling ill, but a closer examination of male and female elderly show no significant gender differences by living arrangement types. Instead, when living independently both elderly men and women are likely to have worse health outcomes in terms of short term morbidity.

In addition, married status seems to have protective effects on the health of the elderly for both men and women and the beneficial effect is slightly higher for elderly women. However the result is not a statistically significant one. Again the statistical non-significance can probably be explained by the statistical significance of the presence of adults in the household; as indicated earlier, the marriage effect is

probably masked by the presence of adult members in the household. It can be argued that it does not really matter how the elderly is related to the adult member (e.g. spouse, brother, sister-in-law), what *really* matters is the presence of the additional adult member in the household. This finding however is suggestive of some of the observed higher economic and social dependence among elderly widows on family systems typically headed by sons, brother-in-laws or other male members (Chen, 1998). Finally, living in urban areas (as opposed to rural areas) is associated with lower likelihood of short term morbidity among the elderly.

Overall, the results from this analysis thus support previous research on developing countries and confirm that family systems and intergenerational ties are crucial for the well-being of the elderly in settings where institutional support is largely inadequate. Since most of the intervening variables (household cooking fuel and indoor piped water) included in this logistic regression analyses did not significantly contribute to the model, they will be dropped from the analyses in the remaining part of the dissertation.

However at this stage, there could also be potential bias arising from selection issues as it is not immediately clear if the elderly who are more (or less) prone to illness are also the ones who are more (or less) likely to co-reside with children. To adjust for the selection bias and better estimate the average causal effect, I conduct propensity score analyses in the next chapter (See: Chapter 7). In addition, to determine the effect of the context in influencing the relationship between living arrangement and

health, I have used state dummies as control variables in the logistic regression analysis. However for a more nuanced understanding of the contextual effects, I employ hierarchical linear models in a later chapter (See: Chapter 8). There is an important difference between hierarchical models and a logistic regression model that contains state level dummies as controls. A hierarchical model consists of fixed and a random component. Hence, the differences between contexts (e.g. districts, communities, etc.) is also a function of the context-level variables. Additionally, the effect of individual (variables) can also be measured within the contexts as deviations from the context specific average. Hence an analysis of this nature will help to distinguish between individual as well as contextual effects influencing the living arrangement-health link.

Table 6.1: Descriptive statistics on dependent variable and selected independent variables

Variables	Mean	Std Dev	Min	Max
whether ill with any short term morbidity	0.11	0.317	0	1
whether living independently (alone or with spouse)	0.11	0.319	0	1
whether living with children	0.83	0.373	0	1
whether living with others	0.05	0.224	0	1
Age	67.72	7.402	60	116
Female	0.49	0.481	0	1
No. of adults in the household	3.77	1.636	1	18
Married	0.63	0.480	0	1
Education	2.79	4.155	0	15
Caste (brahmin, OBCs, SCs, STs, other)	3.09	1.381	1	5
Religion (hindu, muslim, christian,sikh, other)	1.33	0.834	1	5
Urban (1= urban,0= rural)	0.30	0.458	0	1
Standard of Living	11.90	5.550	0	27
Does any work (including animal care)	0.40	0.490	0	1
Whether receives pension	0.10	0.300	0	1
Has piped indoor water	0.31	0.463	0	1
Has flush toilet	0.28	0.448	0	1
Uses clean fuel/LPG	0.46	0.498	0	1

Source: India Human Development Survey, 2004-05

Table 6.2a: Logistic regression coefficients predicting the likelihood of being sick among elderly (60+) in India

	Model 1 (living arrangement dummies)	**Model 2** (Model 1 + non-economic controls)	**Model 3** (Model 2 + economic and household amenities controls)	**Model 4** (Model 3 + 22 state dummies)
living alone or with spouse[a]	1.005***	0.749***	0.682***	0.777***
	(-16.32)	(-9.6)	(-8.66)	(-9.68)
Living with others	0.13	0.057	0.0244	0.0766
	(-1.16)	(-0.51)	(-0.22)	(-0.67)
Age		0.00215	0.00663	0.00504
		(-0.61)	(-1.81)	(-1.37)
Female (=1, 0=male)		0.197***	0.293***	0.283***
		(-3.42)	(-4.87)	(-4.66)
No. of adults in household		-0.139***	-0.101***	-0.111***
		(-6.57)	(-4.71)	(-5.12)
Married (=1, 0=widowed/single)		-0.0775	-0.0915	-0.0978
		(-1.26)	(-1.47)	(-1.56)
Education		-0.0348***	-0.0104	-0.0155
		(-4.31)	(-1.21)	(-1.75)
High caste Brahmin [b]		0.0858	0.173	-0.0166
		(-0.81)	(-1.63)	(-0.15)
Scheduled Castes		0.0749	0.032	-0.0372
		(-1.08)	(-0.46)	(-0.51)
Scheduled Tribes		-0.147	-0.290*	-0.358**
		(-1.31)	(-2.56)	(-3.04)
Other castes		-0.0253	0.0491	-0.061
		(-0.39)	(-0.75)	(-0.88)
Muslim		-0.00738	-0.0561	-0.153
		(-0.08)	(-0.61)	(-1.58)
Christian		-0.00784	0.121	0.263
		(-0.05)	(-0.84)	(-1.64)
Sikh		-0.085	0.12	0.112
		(-0.58)	(-0.80)	(-0.55)
Other religion		-0.194	-0.194	-0.162
		(-0.92)	(-0.91)	(-0.75)

Urban (=1, 0=rural)		-0.389***	-0.173*	-0.175*
		(-6.08)	(-2.45)	(-2.38)
standard of living index			-0.176***	-0.134***
			(-6.35)	(-4.53)
Any work (yes=1, 0=no)			0.138*	0.102
			(-2.41)	(-1.75)
Receives pension (1=yes, 0=No)			-0.071	-0.008
			(-0.88)	(-0.10)
Piped Indoor water (1=yes, 0=No)			-0.048	-0.004
			(-0.72)	(-0.01)
Flush Toilet (1=yes, 0=No)			-0.140*	-0.151*
			(-1.87)	(-1.93)
Clean Fuel/LPG (1=yes, 0=No)			0.046	-0.005
			(-0.80)	(-0.08)
State dummies				*not shown*
_cons	-2.227***	-1.703***	-1.776***	-1.434***
	(-77.79)	(-6.42)	(-6.21)	(-4.75)
Log likelihood	-5766.9	-5659.4	-5618.3	-5547.2
Chi-squared	236.5	451.5	533.6	675.9
BIC	11562.9	11484.1	11460.3	11522.1
Df	2	16	22	43
N	16689	16689	16689	16689

Source: India Human Development Survey, 2004-05

Note: Coefficients are unstandardized; T-statistics are in parentheses

[a]: *Living with children* is the reference category; [b]: *Other Backward Castes (OBC)* is the reference category; [c]: *Hindu* is the reference category; **p<0.05 **p<0.01 ***p<0.001*

Table 6.2b: Logistic regression coefficients predicting the likelihood of being sick for elderly men and women in India

	Model 1 (elderly males)	Model 2 (elderly females)	Model 3 (gender interactions)
living alone or with spouse [a]	0.792***	0.761***	
	-6.97	-6.65	
Living with others	0.056	0.111	
	-0.32	-0.73	
Age	0.008	0.003	
	-1.39	-0.6	
Female (=1, 0=male)			0.238**
			-4.05
*Female * living alone or with spouse*			-0.013
*Female*Living with others*			0.047
No. of adults in household	-0.100**	-0.120***	
	(-3.18)	(-4.02)	
Married (=1, 0=widowed/single)	-0.0847	-0.12	
	(-0.81)	(-1.47)	
*Female * Married*			-0.029
Education	-0.016	-0.014	
	(-1.42)	(-0.92)	
*Female * Education*			
High caste Brahmin [b]	0.11	-0.123	
	-0.68	(-0.82)	-0.138
*Female * Brahmin*			
Scheduled Castes	0.0616	-0.118	
	-0.57	(-1.20)	
Female Scheduled Castes*			-0.123
Scheduled Tribes	-0.315	-0.395*	
	(-1.83)	(-2.43)	
Female Scheduled Tribes*			-0.046
Other castes	-0.089	-0.041	
	(-0.83)	(-0.43)	
*Female * Other Castes*			0.143
Muslim [c]	-0.0782	-0.218	
	(-0.55)	(-1.62)	
female Muslim*			-0.129
Christian	0.146	0.347	

	-0.59	-1.65	
Female Christian*			0.003
Sikh	-0.149	0.299	
	(-0.43)	-1.17	
*Female * Sikh*			0.593
Other religion	-0.0558	-0.248	
	(-0.18)	(-0.80)	
*Female*Other Religion*			-0.24
Urban (=1, 0=rural)	-0.237*	-0.124	
	(-2.11)	(-1.27)	
Female Urban*			0.078
standard of living index	-0.145**	-0.126**	
	(-3.21)	(-3.21)	
Female Standard of Living Index*			0.027
Any work (yes=1, 0=no)	0.0728	0.135	
	-0.86	-1.67	
Female Any work*			0.11
Receives pension (1=yes, 0=No)	-0.093	0.023	
	(-0.61)	-0.21	
Female Pension*			0.117
Piped Indoor water (1=yes, 0=No)	0.123	-0.099	
	-1.14	(-1.02)	
Female Piped Indoor water*			-0.119
Flush Toilet (1=yes, 0=No)	-0.177	-0.124	
	(-1.49)	(-1.19)	
Female Flush Toilet*			-0.196
Clean Fuel/LPG (1=yes, 0=No)	0.084	-0.074	
	-0.93	(-0.91)	
Female Clean Fuel*			-0.025
State dummies	*not shown*	*not shown*	*not shown*
Female State Dummies*	*not shown*	*not shown*	*not shown*
_cons	-1.683***	-0.948***	-1.431***
	(-3.73)	(-2.45)	(-4.73)
Log likelihood	-2550.2	-2981.3	-5540.5
Chi-squared	302.9	364.9	689.3
N	8440	8249	16689

Source: India Human Development Survey, 2004-05

Note: Coefficients are unstandardized; T-statistics are in parentheses

[a]: *Living with children* is the reference category; [b]: *Other Backward Castes (OBC)* is the reference category; [c]: *Hindu* is the reference category;

: Model 3 includes samples of both elderly men and women. For the sake of parsimony, t-statistics are not reported for the gender interactions model (i.e. Model 3). Also, in Model 3

only the log odds of the interaction terms have been reported while the log odds for all other variables have been suppressed.

$*p<0.05$ $**p<0.01$ $***p<0.001$

CHAPTER 7: LIVING ARRANGEMENTS AND HEALTH OF THE ELDERLY IN INDIA- A PROPENSITY SCORE ANALYSIS

Background: Why use Propensity Score Methods?

Using a logistic regression analysis the previous chapter has demonstrated the importance of family to the well- being of the elderly in India. However, as discussed in the earlier chapters, the IHDS data is cross-sectional and that living arrangement among elderly is predetermined. Hence it is not immediately clear whether living arrangement decisions determine elderly healthisions or the other way round. Additionally, selection bias could be an issue: are the types of people who choose to live alone are also the types of people more (or less) prone to illness?

Given this methodological conundrum as a result of causal interplay between living arrangement decisions and health outcomes, propensity score methods (discussed in the next sections) have been used to estimate counterfactual effects while adjusting for selection bias. However it is important to note that these methods do not totally solve the problem of endogeneity, but they reduce the bias generated by unobservable confounding factors. More specifically, the extent to which the selection bias is reduced depends crucially on the richness and quality of the control variables on which propensity score is estimated. In other words, the bias is totally eliminated if the exposure to treatment can be considered to be purely random among individuals

who have the same value of the propensity score (Becker & Inchino, 2002). Given the fact that the IHDS dataset has a rich set of information on individual and household characteristics, it is reasonable to assume that the propensity score methods will be able to successfully adjust for selection bias in the living arrangement-health relationship.

A central goal of health outcomes research is to estimate the causal effect of a treatment on an outcome of interest. However, in observational studies assignment of subjects to the treatment and control groups is not random, primarily because in most circumstances, random assignment is infeasible for ethical or practical reasons (Hirano & Imbens, 2001). Hence, without randomization, the estimation of the effect of the treatment may be biased by the existence of confounding factors and unmeasured variables problems. However, in some observational studies, it may be reasonable to assume that treatment assignment is unconfounded with potential outcomes conditional on a sufficiently rich set of covariates or pretreatment variables (*ibid*).

Given unconfoundedness or exogeneity (discussed in a later section), various methods have been proposed for estimating causal effects. Earlier studies (e.g. Robins, *et al* 1995) have mostly relied on estimating the conditional regression function of the outcomes given covariates ; recent studies (Hirano & Imbens, 2001; Barth, *et al*, 2006; Brand & Xie, 2007; Crosnoe, 2010; Ham, *et al* 2011) however, are increasingly using propensity score procedures to estimate the effect of the treatment.

A propensity score is defined as the conditional probability of assignment to a particular treatment given a vector of observed covariates (Rosenbaum & Rubin, 1983). When applied appropriately, these models can help solve the problem of selection bias and provide valid estimates of population level mean treatment effects, such as average treatment effects (ATEs) , average treatment effect of the treated (ATTs) and average treatment effect of the untreated (ATUs) (Brand & Halaby; Guo & Fraser, 2010). The concept of treatments effects is discussed in a later section in this chapter while the equation structures of ATT and ATE are described in the Appendix to this chapter.

The remainder of this chapter is organized as follows: I first review the counterfactual framework, on which the estimation of propensity score is based on. Then I describe the logic of propensity score models and their estimation procedures. Three different specifications of propensity score models have been employed in this chapter- *propensity score stratification, propensity score matching and propensity score weighting*; I briefly describe the conceptual frameworks for each of the models/methods while emphasizing the need for these different analytic approaches. I follow this with results and discussion from each of the propensity score models. The last section of this chapter offers a short summary of the results and sets forth my conclusions.

Counterfactuals and the Neyman-Rubin Counterfactual Framework

To study causal effect, we treat one group of people as a *treatment* group and the other as a *control* group. The key conceptual framework to investigate causality in social science research is the counterfactual framework. In statistics, researchers generally credit the development of the counterfactual framework to Neyman (1923) and Rubin (1974, 1978, 1986) and call it the *Neyman-Rubin framework of causality*. A counterfactual is a *potential* outcome or state of affairs that would have happened in the absence of the cause (Shadish, et al 2002). Thus, for a participant in the treatment condition, a counterfactual is the potential outcome under the condition of control; for a participant in the control, condition, a counterfactual is the potential outcome under the condition of treatment (Guo, et al, 2010). Table 7.1 illustrates the counterfactual inference.

[Table 7.1 about here]

Neyman-Rubin's framework emphasizes that individuals selected into either treatment of non-treatment (control) groups have potential outcomes in both states; the one in which they are observed and the one in which they are not observed. Formally, if we assume that each person i under study would have two potential outcomes (Y_{0i}, Y_{1i}) that correspond respectively to the potential outcomes in the untreated and treated states. Let D_i=1 denote the receipt of treatment, D_i=0 non-receipt (control) and Y_i indicate the measured outcome variable. They Neyman-Rubin counterfactual framework can be expressed as the following model:

$$Y_i = D_i Y_{1i} + (1 - D_i) Y_{0i}$$

The central message conveyed in the above equation is that to infer a causal relationship between D_i (the cause) and Y_i (the outcome) the analyst cannot directly link Y_{1i} to D_i under the condition D_i =1; instead the analyst must check the outcome of Y_{0i}, under the condition D_i=0, and then compare Y_{0i} and Y_{1i}.

For example, in our case, we might hypothesize that an elderly person living independently (that is, not co-residing with children or other relatives) has higher levels of short term morbidity. Here the treatment variable D_i=1 if the elderly is living with children; Y_{1i}=1 if the elderly has any of the short term morbidities (fever, cough or diarrhea) and Y_{1i}=0 otherwise. To make a causal statement that living independently (D_i=0) causes short term morbidity (Y_{1i}=1), we should examine the outcome under the state of not living independently (that is, living with children). That is, we need to determine the health outcome of the elderly, $Y_{0i,}$ under the condition of D=0, and ask the question "what would have happened had the elderly not lived with children? However, the critical issue here is that Y_{0i} when D_i =0 is not observed. (Refer Table 1 on "counterfactual inference"). Or in other words, we cannot calculate causal effects at the individual level with the IHDS data. However, Neyman-Rubin's counterfactual framework holds that we can estimate the counterfactual by comparing the **average** outcome of the treatment and control groups. More specifically, if $E(Y_1|D=1)$ denote the mean outcome of all individuals in the treatment group and $E(Y_0|D=0)$ the mean outcome of all individuals who comprise the control group, we can define treatment effect as a mean difference:

$$\tau = E(Y_1 \mid D = 1) - E(Y_0 \mid D = 0)$$

Here τ denotes the treatment effect. The above formula is also called the *standard estimate of the average treatment effect* where both the outcomes (i.e. ($E(Y_1|D=1)$ and $E(Y_0|D=0)$) are observable (Guo, *et al* 2010). It is worth noting that under this framework the evaluation of $E(Y_1|D=1) - E(Y_0|D=0)$ can be understood as an effort that uses $E(Y_0|D=0)$ to estimate the counterfactual $E(Y_0|D=1)$. The central interest of evaluation is not in the $E(Y_0|D=0)$ but in $E(Y_0|D=1)$ (Guo & Fraser, 2010). In summary, The Neyman-Rubin framework offers a practical way to evaluate the counterfactual.

The logic of Propensity Scores

With a conceptual background of the counterfactual framework, this section describes the logic of the propensity score which is based on the counterfactual model of Neyman-Rubin. The propensity score is defined by Rosenbaum and Rubin (1983) as the conditional probability of receiving treatment given observed covariates:

$$p(X) = \Pr(D = 1 \mid X) = E(D \mid X)$$

Where D ={0,1} is the indicator of exposure to treatment and X is the multidimensional vector of observed covariates. Rosenbaum and Rubin (1983) showed that if the exposure to treatment is random within cells defined by X, it is also random within cells defined by the one dimensional variable, *p(X)*. Therefore, given a

population of units defined by *i*, if the propensity score $p(X_i)$ is known then we can the estimate the average treatment effects (ATE or ATT). Formal specifications of ATE and ATT are described in the Appendix to this chapter. In addition, the two important assumptions of propensity score analysis that explains the exogeneity or uncounfoundedness property of this exercise is described in the Appendix.

Estimating the propensity Score

The conditional probability of receiving treatment when there are two treatment conditions (treatment vs control) is estimated using binary logistic regression. As mentioned earlier in the dissertation, the outcome of interest is *stsick* (short term morbidity); the *treatment group* (D=1) comprise of the elderly persons who are either living with adult children or others and *control group* comprise of elderly living independently (i.e. either alone or with spouse) (D=0). The dependent variable is the living arrangement variable which now indicates the binary treatment condition, Y=1 , when the elderly is living with children or others, and Y=0, when the elderly person is living independently. The control variables (covariates) are the age, marital status, education, religion, caste, rural/urban, work status, pension status, standard of living index and state dummies. The ignorability or unconfoundedness assumption depends in part on the extent of observed characteristics available to include in the propensity score specification. The IHDS dataset is particularly helpful in this regard with a large set of individual and household characteristics. The treatment group (elderly living with children or others) contains 15,859 observations and the control group (elderly

living independently) contains 2,045 observations, so the total number of observations is 17,904. Propensity score is estimated using the following specification:

Log odds of (living with children or others)^{treatment}=β_0+ $\beta_1 X_{i1}$ + $\beta_2 X_{i2}$ +...+ $\square_i$

The program **pscore.ado** in STATA estimates the propensity score and tests the balancing hypothesis. The following program runs the algorithm to estimate the propensity score in STATA.

```
pscore livchild female agecat2 agecat3 married illiterate
primary college graduate lowcaste other muslim christian sikh
religother urban dwork pension stdliving st1 st2 st3 st4 st5
st6 st8 st9 st10 st11 st12 st13 st14 st15 st16 st17 st18 st19
st20 st21 st22, pscore(mypscore) blockid(myblock) logit
level(0.001) numblo(5)[1]
```

The predicted probabilities of living with children in the two elderly groups are shown in the Figures 7.1a and 7.1b. There was an absolute difference of 18 % in the average predicted probability of living with children (90 % in the living with children group compared to 72 % among elderly living independently), suggesting moderate differences in the observed characteristics between the two treatment groups. Table 7.2 shows the sample descriptive statistics and the logistic regression estimating the

[1] `Pscore(mypscore)` estimates the propensity score and `mypscore` is the name of the estimated propensity score variable which gets added to the dataset; `blockid(newvar)` allows users to specify the variable name for the block number of the estimated propensity score; `logit` uses a logit model to estimate the propensity score; `level(real)` allows to set the significance level of the tests of the balancing property. I have used 0.001; `numblo(real)` allows to set the number of blocks of equal score range to be used at the beginning of the test of the balancing hypothesis. The default if 5 blocks. (Becker & Ichino for Statacorp. STATA 2011)

propensity score. Bivariate chi-square tests showed that most variables were statistically significant for the overall sample (that is, before matching or stratification) indicating that the covariate distributions were not sufficiently overlapped between the treated and control participants in the original sample. This indicates imbalance on covariates. That is, it is difficult to attribute differences in morbidity outcomes among elderly to living arrangements because the covariates (such as gender, marital status, employment, pension, household wealth, etc.) may also influence the outcome. Propensity score methods (e.g. matching, stratification and weighting) attempt to reduce the confounding effects of the covariates, and so allow differences in outcomes (here, morbidity) to be attributed to differences of treatments (here, living arrangements)

[Figures 7.1a and 7.1b and Table 7.2 about here]

The next sections describe three propensity score models, including propensity score stratification, propensity score matching and propensity score weighting-a new model that has been developed to combine propensity scores and conventional statistical methods. All the three different techniques employ slightly different statistical theories and algorithms, and are sometimes describes as addressing different analytical questions, but all the models originate from Rosenbaum and Rubin's (1983) seminal work that first introduced the concept of a propensity score. In this chapter I provide an overview of the models while discussing the statistical assumptions, theory and finally the limitations associated with each of the methods. For the purpose of the analyses, I have used several user-developed programs

available in STATA including ***psmatch2*** (Leuven & Sianesi, 2003) that has been especially helpful in offering instructions for running the programs. Figure 7.2 summarizes the propensity score analytic process that I have conducted, as either a two-step or a three- step analytic exercise.

[Figure 7.2 about here]

Model 1

Propensity Score-Stratified Analysis

Rosenbaum and Rubin (1983) have shown that stratifying on the propensity score produces treatment groups that are balanced in terms of observed covariates contained in X. Thus under the assumption that treatment assignment is ignorable given X (as discussed in an earlier section), unbiased estimates of the average causal effect can be obtained by comparing elderly with similar values of the propensity score. The treatment effect of the whole sample is the average of the *k* stratum-specific differences of the mean responses in the two treatment conditions, i.e.

$$\hat{\delta} = \sum_{k=1}^{K} \frac{n_k}{N} [\bar{Y}_{0k} - \bar{Y}_{1k}]$$

Where *k* indexes the propensity score stratum, N is the total number of participants, n_k is the number of participants in the *k*th stratum, and $\bar{Y}_{1k}, \bar{Y}_{0k}$ are the mean responses corresponding to the two treatment groups in the *k*th stratum.

To perform a stratified analysis I sorted the sample by estimated propensity scores in an ascending order and then divided the sample of elderly into five strata using the estimated propensity scores**.** Often researchers (Perkins, et al, 2000; Landrum & Ayanian, 2001) have used quintiles of estimated propensity score to create strata but given the distribution of the propensity score in our elderly case, I have tried to create uniform sample sizes for control group (elderly living independently) across the five strata. Table 7.3 provides the number of cases in each stratum separated by living arrangement status. There is overlap within each stratum, i.e. for each propensity score stratum there are elderly with d=1 and d=0. The next section tests for the balancing hypothesis. The balancing hypothesis is satisfied when within each strata the average propensity score and the means of each covariate do not differ significantly between treated and control units.

[Table 7.3 about here]

The balance of covariates between the two treatment groups are presented in the Figures 8.3a and 8.3b. More specifically, I ran a series of regressions-either logistic or OLS-with each of the covariates as the dependent variable and the dichotomous treatment variable (here, *livchild*) as the single independent variable. Depending upon the nature of the covariate, I determined whether to run a logit or an OLS. For example, for the covariate *female*, a dichotomous, variable, I ran a logit with *female* as the dependent variable and *livchild* as the single independent variable. Again, say for the covariate standard of living (*stdliving*), which is a continuous variable, I ran an

OLS with *stdliving* as the dependent variable and *livchild* as the single independent variable. Finally, these analyses were done within each of the five stratum indicated above. The complete list of covariate balance is however, not shown. I have selected only two covariates for explanation purposes.

[Figures 7.3a and 7.3b about here]

There does not seem to be substantial differences between the treatment groups in these two selected covariates (gender, marital status) or in any of the covariates contained in the propensity score model after stratifying elderly into 5 different strata of estimated propensity score. This finding suggests that stratifying the elderly according to their estimated propensity to co-residence removed most of the bias in observed characteristics between the two groups. Figures 7.3a and 7.3b however show that the observed differences in treatment groups are slightly bigger for the highest propensity score strata in both the covariates (gender and marital status), suggesting some residual imbalance. To further reduce the differences in observed characteristics, other methods, e.g. matching or propensity score weighting, could be adopted.

Estimating average causal effect using propensity score stratification method

Propensity score estimates of average causal effect of living arrangement are reported in Table 7.4.

[Table 7.4 about here]

In the first 5 rows, I have reported the short term morbidity likelihood in the two groups-treatment and control and estimated causal effects of living arrangements within groups of elderly stratified according to the five propensity score strata. The estimated causal effect in all the 5 propensity score strata- as captured by the percentage difference in short term morbidity was statistically significant. Among elderly who have the lowest propensity score (strata1: they are *least* likely to live with children), living with children or others is estimated to reduce short term morbidity by 9.7 % (10.68% versus 20.38%). Among elderly who have highest propensity scores (strata 5: they are *most* likely to receive treatment, i.e. live with children), living with children is estimated to reduce likelihood of short term morbidity by only 4.2%. Furthermore, these findings echo the results obtained from the previous logistic regression analyses as the estimated differences in short term morbidity between the two groups of elderly follow a consistent pattern. That is, the elderly living independently (control group) have consistently higher rates of short term morbidity than the elderly living with children and others (treatment group) across all the propensity score strata. Though the magnitude of the estimated difference in morbidity vary from ~4 to ~13 percentage points, it is clear from this stratified propensity score analysis that there exist significant differences in morbidity rates among the elderly by living arrangement status.

Estimates of the overall impact of living with children or others on short term morbidity were obtained by calculating a weighted average of the stratum specific differences (Rosenbaum & Rubin, 1984) and are reported in the last two rows of

Table 7.4. The weighted average of the stratum specific differences estimated short term morbidity to be 12 % lower among elderly who lived with children. Since row 6 reports the weighted average, this estimates the reduction in short term morbidity that we would expect if all elderly represented in the IHDS data were living with children (this is also called the ATE: *average treatment effect*). Weighting the stratum-specific differences by the treated group (that is, number of elderly living with children or others) in each strata estimated a 8 % absolute reduction in short term morbidity among elderly who typically lived with children (this is also called the ATT: *average treatment effect for the treated*). Again, this reduction in the estimated causal effect suggests that elderly who are most likely to benefit from living with children were actually living independently. I also tested the sensitivity of the stratified analysis to the number of strata and found very similar results using 3 or 7 groups. Since all elderly within a stratum have the same propensity score and at least one elderly in the stratum receives each treatment condition (as there is overlap between the treatment groups in each strata)-the expected difference in treatment mean equals the ATE (average treatment effect of the treated) at that value of propensity score the weighted average of such differences is unbiased for the treatment effect,

$\tau = E(Y_1 \mid D = 1) - E(Y_0 \mid D = 0)$ (Rosenbaum & Rubin, 1983: p 46)

However one of the limitations of the Stratification method is that it disregards observations in blocks/stratum where either treated and control units are absent. This observation has led to an alternative way to match treated and control units, which consists of taking each treated unit and searching for the control unit with the closest

propensity score. This method is called the Propensity Score Matching, which is discussed in detail in the next section.

Model 2

Propensity Score- Greedy Matching

The core idea of matching, after obtaining estimated propensity scores, is to create a new sample of cases that share approximately similar likelihoods of being assigned to the treatment condition. The fundamental feature of this method is that it not only balances data through resampling or matching non-treated individuals to treated ones on propensity scores, but also permits follow-up multivariate analysis (e.g. OLS regression, survival modeling, hierarchical linear modeling). Rubin (2008) argued that by reducing the dimensionality of covariates to a one-dimensional score-the propensity-is a substantial contribution that leverages matching. The author describes this process as the design of observational studies to approximate randomized trails. Various algorithms have been developed to match participants with similar propensity scores. These include greedy matching techniques like-Mahalanobis metric distance matching with or without propensity scores, nearest neighbor matching within caliper. However it is important to note that matching typically leads to loss of participants. In the next section, I discuss some of the greedy matching techniques and present results from the matching analyses.

Mahalanobis Metric Matching with and without propensity score

The Mahalanobis metric matching method was invented prior to propensity score matching (Cochran & Rubin, 1973). To apply this method, one should first randomly order the study participants, and then calculate the distances between the first treated participant and all controls, where the distance, *d(i, j),* between a treated participant, *i*, and a nontreated/control participant, *j* is defined by the Mahalanobis distance:

$$d(i, j) = (u - v)^T C^{-1} (u - v)$$

Where u and v are values of the matching variables for the treated participant, *i*, and control participant *j,* and C is the sample covariance matrix of the matching variables from the full set of control participants. The control participant, *j*, with the minimum distance, *d(i, j),* is chosen as the match for treated participant *i*, and both are removed from the pool. This process is repeated until matches are found for all treated participants. In the Mahalanobis with propensity score method, exactly same procedure (as described above) is followed with an additional covariate-the estimated propensity score, $\hat{p(x)}$.

Nearest Neighbor Within Caliper Matching

Let P_i and P_j are the propensity scores for the treated and control participants, respectively, I_0 is the set of control participants and I_1 is the set of treated participants. In this procedure, a neighborhood $C(P_i)$ contains a control participant,(i.e. $j \square I_0$) as a

$$C(P_i) = \min_j \| P_i - P_j \|, \; j \in I_0$$

match for treated participant, I (i.e. $i \in I_1$), if the absolute difference of propensity scores is smallest among all possible pairs of propensity scores between *i* and *j*, as:

Once a *j* is found to match to *i*, *j* is removed from I_0 without replacement. If for each *i* there is only a single *j* found to fall into $C(P_i)$, then the matching is *nearest neighbor pair matching* or more commonly known as the *1-to-1 matching*. Sometimes, to avoid erroneously choosing *j*, an additional restriction is imposed on the distance between P_i and P_j , as long as *j* is a nearest neighbor of *i* in terms of the estimated propensity score. More specifically, one chooses *j* as a match for *i*, only if the absolute distance of propensity scores between the two participants meet the following condition:

$$\| P_i - P_j \| < \varepsilon, \; j \in I_0$$

Where ε is a pre-specified tolerance for matching or a caliper. Rosenbaum and Rubin (1985) suggested using a caliper size of a quarter of a standard deviation of the sample estimated propensity scores (i.e. $\varepsilon \leq 0.25 \, \sigma_p$ where σ_p denotes standard deviation of the estimated propensity scores of the sample). A summary with graphical representation of the matching techniques is presented in the Appendix to this chapter.

Analytic plan for greedy matching

The primary interest of this exercise is to examine whether co-residence with children and others reduces the likelihood of short term morbidity among the elderly. The dependent variable for the post-matching analysis is the short term morbidity variable that take the value of "1" if the elderly have fallen sick and "0" if they remained healthy. As outlined in Figure 7.2, I followed a three- step analytical procedure. At step 1, I estimated the propensity score using exactly the same method as described in the previous section (Model 1: propensity Score Method using Stratification). At step 2, I used both nearest- neighbor matching within caliper and Mahalanobis metric matching to create various matched samples (Note: the matching algorithms and results are discussed in the next sections). At step 3, I conduct a logistic regression based on the matched sample generated by using the 1-to-1 match within caliper.

The 1-to-1 match for this analysis was a "one by two by two" design. That is, I used *a single* logistic regression to predict the propensity scores of receiving treatment, *two* matching algorithms (i.e. nearest neighbor within caliper and Mahalanobis), and *two* matching specifications (i.e. for nearest neighbor I used two different specifications on caliper size and for Mahalanobis I used one with and one without the propensity score as a covariate to calculate the Mahalanobis metric distances). Hence I tested a total of 4 matching schemes. The design using multiple matching schemes was directly motivated by the need to compare results among varying methods. I have defined the logit or $\log[(1-\hat{p}(x))/\hat{p}(x)]$,

rather than the predicted probability $\hat{p}(x)$ as propensity score, because logit is approximately normally distributed (Guo & Fraser, 2010).Table 7.5 summarizes the different matching schemes used in this analysis. The Appendix to this chapter exhibits the STATA syntax and output of the matching procedures.

[Table 7.5 about here]

Figure 7.4 shows the overlap between the propensity scores generated by the logistic model for the treatment (living with children or others) and the control (living independently) groups. The post matching sample as shown in Figure 7.4 is obtained by using 1-to-1 nearest neighbor matching within caliper. As expected, post-matching, the distribution of the treated group is closer to the non-treated/control group, indicating correction of confoundedness. The final sample after using the 1-to-1 nearest neighbor matching within caliper contains 1943 cases-evenly matched between treatment and control. Finally, the average propensity score for the matched treatment group was 0.64 and for the control group was 0.73. The difference in scores between the two groups has been reduced by 12 percentage points after matching. Finally, Table 7.6 presents sample descriptive statistics before and after matching which essentially tests for covariate balance. Bivariate chi-square tests showed most variables to be statistically significant ($p<.05$) *before* matching. This is an indication of covariate imbalance or in terms of graphical representation, it can be said that the covariate distributions were not overlapping between the treated and control groups of elderly in the original sample. Hence analyses of outcomes based on the original

sample would violate the fundamental assumption of "ignorable treatment assignment" and generate biased results. However, after matching no significant differences remained between treated and control groups on most variables. In other words, the propensity score matching has reduced the confounding effects of the covariates.

[Figure 7.4 and Table 7.6 about here]

Results from multivariate analysis after matching

After matching on the estimated propensity scores, the matched sample is balanced on observed covariates (between treated and control participants) and therefore we can perform multivariate analyses and undertake covariate adjustment for the matched sample as is done in randomized experiments (Guo & Fraser, 2010). In theory any regression type models can be used at this stage to estimate the average causal effect (*ibid*). For the purpose of this study, I have conducted a logistic regression based on the matched sample and have presented results comparing log odds from the overall (pre-matched) sample and the matched sample. The matched sample reported in Table 7.7 is generated using the nearest neighbor matching within caliper and without replacement. As mentioned before, I used a caliper size one quarter of the standard deviation of the propensity scores. Both the pre-matched and matched analyses look at the effect of living arrangement on the likelihood of being sick after controlling for key demographic and socioeconomic characteristics of the elderly. State dummies have been omitted from the final analyses as the focus is on

examining the effects of individual and household characteristics on the health outcome of the elderly. In the matched analysis several variables were significantly associated with the likelihood of being sick with short term morbidity-most notable is the living arrangement variable that still continues to explain health outcome of the elderly (log odds=(-)0.8460, p<.001). In other words, in the unmatched sample, results indicate that elderly living with children or others are 0.56 times ($e^{-0.815}$=~0.44) *less likely than* elderly living independently, holding all other variables constant. After adjusting for selection bias (i.e. after matching) the protective health effects of co-residency still holds. That is, the elderly living with children or others are 0.57 times ($e^{-0.846}$=~0.43) *less likely than* elderly living independently, holding all other variables constant. Furthermore, this finding is consistent with the previous analysis using the propensity score stratification method. Finally, gender, marital status, place of residence (rural/urban) and standard of living continue to be significant factors mediating the living arrangement-health outcome relationship, even after propensity score procedures have been used to minimize selection bias.

[Table 7.7 about here]

Model 3

Propensity Score Weighting

Propensity score models are also used in two-step analytic process as shown in Figure 7.2. One of such methods is conducting multivariate analysis using propensity score as sampling weights. This analytical model share the same first step of estimating the

propensity scores as the above two models-Stratification & Matching. However this method does not involve matching or resampling, hence it avoids undesirable loss of participants. Owing to this unique feature, several studies (Morgan & Harding, 2006; Hirano & Imbens, 2001) have claimed the propensity score weighting method to be more efficient that the three -step models discussed before. The use of propensity scores as weights is analogous to the reweighting procedures used in survey sampling, where adjustments are made for observations on the basis of the probabilities for inclusion in a sample (Guo & Fraser, 2010; McCaffery, *et al* 2004). Another bonus of propensity score weighting method is that it not only overcomes the problem of loss of sample participants but also offers two kinds of estimates for treatment effects:-ATT and ATE-that will be discussed in the next section.

The crucial element of this analysis is that the propensity score must be transformed into a modeling weight. Different types of weights could be used depending upon whether an average treatment effect (ATE) or the average treatment effect for the treated (ATT) is desired. Following Rosenbaum (1987) and Hirano & Imbens (2001), I define the following weights

For estimating ATE, $$\omega(W, x) = \frac{W}{\hat{p}(x)} + \frac{1-W}{1-\hat{p}(x)}$$

By this definition, when W=1 (i.e. a treated participant), the above equation becomes $\omega(W,x) = 1/\hat{p}(x)$; and when W=0 (i.e. a control participant), the above equation becomes $\omega(W,x) = \hat{p}(x)/(1-\hat{p}(x))$.

For estimating ATT, $$\omega(W,x) = W + (1-W)\,\hat{p}(x) \Big/ 1-\hat{p}(x)$$

By this definition, when W=1 (i.e. a treated participant), the above equation becomes, $\omega(W,x) = 1$ and when W=0, the above equation becomes $\omega(W,x) = \hat{p}(x)/(1-\hat{p}(x))$. However since the propensity score weighting does not use the matching process, one should use a different method to check covariate imbalance, that is, an alternative technique that is suitable to weighted analysis. The approach that is typically used is a weighted simple regression or weighted logistic regression depending upon the nature of the covariates-dichotomous or continuous. Table 7.8 presents the results of imbalance checking based on this method.

[Table 7.8 about here]

Table 8.8 demonstrates that most covariates for ATT weight (other than marital status variable, one education dummy and a religion dummy) were imbalanced to a not statistically significant degree between the treated participants and controls. This finding suggests that for this data set propensity score weighting may remove

covariate imbalance and therefore it suitable for a weighted analysis. Finally, propensity score weighting analyses are presented in Table 7.9 for both ATT and ATE weights. I present odds ratios for short term morbidity among elderly comparing the unweighted and weighted analyses.

[Table 7.9 about here]

From the perspective of *average treatment effect (ATE)* (i.e. what is the effect if we consider all elderly persons), elderly living with children or others are on an average are 0.44 times as likely (or the odds of being ill is decreased by 56%) as elderly living independently to fall sick ($P<0.001$), holding all other variables constant. From the perspective of *treatment effects of the treated* (ATT) (i.e. what is the effect if we consider only those elderly persons who are or would be assigned to the treatment condition?), we find that elderly living with children or others are 0.45 times (or the odds of being ill is decreased by 55%) as likely as elderly living with independently to fall sick with short term morbidity, holding other variables constant ($p<0.001$). Compared to ATT, ATE odds ratios for all variables decrease in size only slightly but not in level of significance. When these results are compared to the un-weighted (i.e. without incorporating propensity score weights) analysis, it is interesting to see that the results remain consistent. The magnitude and significance of the odds ratios for the living arrangement variable and other covariates remain consistent across all the models.

Summary and Conclusion

This chapter investigated the living arrangement and health outcome link among the elderly and took a methodological step forward by incorporating propensity score methods. Given the nature of the research question and the associated issues of endogeneity and selection bias, propensity score methods have been used to adjust for the selection bias and reduce the confounding effects of the covariates. Three different propensity score methods have been used to estimate treatment effects: propensity score stratification, matching and weighting. The basic goal of using propensity scores and then creating matched pairs or strata is to balance the observed covariates between the two groups-elderly living with children or others and elderly living independently. The resulting matched or stratified sets are heterogeneous in the covariates, but the covariates tend to have similar distributions in treated and control groups making the groups as a whole appear comparable (Joffe & Rosenbaum, 1999).

The findings from all the three methods highlight the protective role of the extended/joint family on the wellbeing of the elderly. In particular, both the propensity score matching and the weighting methods indicate that on average the odds of being ill for the elderly living with children is decreased by 55% when compared to the elderly living independently (that is either alone or with their spouses), holding all other variables constant. From the propensity score stratified analysis, it is clear that significant differences in morbidity rates exist across all the five propensity score strata between the treatment and the control groups.

Specifically, elderly living independently have higher rates of morbidity across all the propensity score strata as compared to the co-residing elderly.

As suggested in the previous logistic regression analyses, gender, marital status, place of residence and household wealth are significant factors influencing the living arrangement and health link, even after adjusting for selection bias. Specifically, while being an elderly woman increases the likelihood of morbidity, the married status can decrease the likelihood of short term illness, holding other variables constant. Furthermore, as expected, the elderly who live in wealthier households and who are located in urban areas appear to have less likelihood to fall sick with cough, fever or diarrhea than the elderly from poorer households and those residing in rural areas. Among other controls, after adjusting for selection bias, education seems to be a marginally significant factor in influencing the living arrangement and health outcome relationship, in contrast to its important role in the earlier logistic regression analysis. In summary, the consistency of these results with those of the previously conducted logistic regression analyses, offer additional validation to research questions examined in this dissertation. It can now be ascertained with reasonable confidence that the observed differences in morbidity among the elderly by living arrangement types is not due to selection effects.

Finally, since the propensity score procedures also allow for estimation of average causal effects, this analysis is particularly useful for health outcomes research such as the current study. From the estimation of average causal effects analyses, results

suggest that for those elderly who have the *least* likelihood to co-reside with children, living with children will have a *significant reduction* in their morbidity levels. This finding has important policy implication in the Indian context where institutional support for the elderly is scant and care/support for the elderly is commonly expected to be shouldered by extended/joint members. However, based on this finding along with the previous finding that majority of the elderly who live independently belong to poorer households, a targeted intervention from the government in the form of both economic and medical support is warranted.

These results establish the fact that individual characteristics (e.g. gender, marital status) and household characteristics (such as living arrangements, household wealth) have important implication for health outcomes of the elderly, even when selection biases have been adjusted for. As a next analytical step, I will investigate if morbidity outcomes among elderly are explained not only by compositional factors (household and individual characteristics) but are also likely to depend on contextual differences. A multilevel exercise is particularly relevant for the Indian context, given the huge context-specific differences in socioeconomic and health outcomes as demonstrated by existing studies. Additionally, it may also help in understanding the role of compositional factors (e.g. household wealth, which consistently stands out to be an important control in all the multivariate analyses) interact with context-level factors to influence the living arrangement-health outcome link. In the next chapter I investigate these issues by employing a hierarchical linear modeling framework.

Table 7.1: Counterfactual Inference

Group	Y^1	Y^0
Treatment (D=1)	Observable	(counterfactual)
Control (D=0)	(counterfactual)	Observable

Notes: Y_i^1 : potential outcome for individual I resulting from exposure to the treatment group
Y_i^0: potential outcome for individual I resulting from exposure to the control group
So, theoretically, Causal Effect: $Y_i^1 - Y_i^0$

Table 7.2: Sample Description and Logistic Regression Model predicting Propensity Score

Variable	N	%	% treated elderly (living with children or others)	Bivariate Chi-square Test	Log odds
Gender (male)					
Male	8949	50.04	89.81	<.0001	
Female	8934	49.96	87.37		-0.111*
Marital Status (single/widow)					
Married	11240	62.85	85.23	<.0001	-1.518***
Single/widow	6643	37.15	94.28		
Age categories (age60-69)					
Age 60-69	10902	60.96	88.17	<.0001	
Age 70-79	595	29.05	87.97		-0.168**
Age 80+	1786	9.99	93		0.207
Education (high school)					
No education	3334	18.64	68.81	<.0001	-2.153***
Primary	1287	7.2	78.17		-1.504***
high school	7831	43.79	93.6		
College	2078	11.62	96.97		0.878***
Graduate	3353	18.75	95.38		0.522***
Caste (Brahmin)					
Brahmin	1301	7.28	88.47		
OBC, SC, ST	11467	64.12	88.24		1.205***
Other castes	5115	28.6	89.42		0.567***
Religion (Hindu)					
Hindu	14621	81.76	88.28	<.0001	

Muslim	1757	9.82	91.8		0.713***
Christian	592	3.31	83.28		-0.622***
Sikh	606	3.39	92.41		-0.219
Other religion	307	1.72	87.62		-0.067
Place of Residence (rural)					
Urban	5255	29.39	89.72	0.002	-0.734***
Rural	12628	70.61	88.12		
Work status (no work)					
No work	10796	60.37	90.46	<0.0001	
Any work (including animal care)	7087	39.63	85.75		-0.051
Pension status (no pension)					
Does not get pension	16071	89.87	88.96	<0.0001	
Receive pension	1812	10.13	85.32		-0.366***
Standard of living index (mean)					0.051***
state dummies					*output omitted*

Note: reference group is shown in the parentheses
*p<.05, **p<.01, ***p<.001

Table 7.3: Frequency Counts per Propensity Score Stratum

Pscore	**d=0 (control group: living independently)**	**d=1 (treatment group: living with children)**
[.00, 0.5)	319	234
[0.5, 0.75)	688	1361
[0.75,0.875)	466	1807
[0.875,0.9375)	328	3239
[0.9375,1.00)	244	9218

Source: IHDS 2004-05

Table 7.4: Propensity score estimates of average causal effect

	Treatment Group (elderly living with children)		Control Group (elderly living independently)		Average Causal Effect	
	N	% falling ill with short term morbidity	N	short term morbidity (%)	Difference in short term morbidity (%)	Standard Error
Stratified Analysis						
Strata 1 (lowest propensity score)	234	10.68	319	20.38	-9.7	(0.03)[$]
Strata 2	1361	12.49	688	25.15	-12.66	(0.02)[$]
Strata 3	1807	10.63	466	25.54	-14.91	(0.02)[$]
Strata 4	3239	8.8	328	21.65	-12.85	(0.02)[$]
Strata 5 (highest propensity score)	9218	9.32	244	13.52	-4.2	(0.02)[$]
Overall effect (weighted average)		9.66		22.55	-12.89	(.007)[$]
Overall effect (weighted to treatment group)		9.50		17.65	-8.00	(.455)[$]

Source: IHDS 2004-05

Notes: Estimated difference in short term morbidity between elderly who are living with children compared to those elderly who are living independently using propensity score methods; [$] standard errors are from two-sample t tests

Table 7.5: Description of Matching Schemes and Resample Sizes

Scheme	Description of Matching Method	N of the New Sample	
		Treated	Nontreated
Nearest Neighbor	Propensity scores predicted by logistic regression (logit 1), nearest 1-to-1 using caliper = 2.46 (.25* SD)	1,943	1,943
Nearest Neighbor	Propensity scores predicted by logistic regression, nearest 1-to-1 using caliper = .1	1,942	1,942
Mahalanobis without pscore	Covariates used in the calculation of the Mahalanobis distances same as used in logistic regression (logit 1)	15,843	15,843
Mahalanobis with pscore	Mahalnobis with propensity score added; pscores predicted by logistic regression (logit 1)	15,843	15,843

Source: IHDS 2004-05

Table 7.6: Covariate Balance Testing- Elderly by treatment conditions for overall and matched samples (%)

Variable	Overall control (n=2045)	Overall treated (n=15,859)	matched control (n=1943)	matched treated (n=1943)
Gender				
Female	44.61	50.65	44.57	41.22
Marital Status				
Married	81.37	60.47	80.44	87.55
Age categories				
Age 60-69	63.24	60.67	63.56	65.41
Age 70-79	30.64	28.85	30.16	29.03
Age 80+	6.13	10.48	6.28	5.56
Education				

No education	50.98	14.48	49.05	69.84
Primary	13.77	6.35	13.95	19.81
high school	24.56	46.27	25.78	8.54
College	3.09	12.72	3.24	0.31
Graduate	7.6	20.19	7.98	1.49
Caste				
Brahmin	7.35	7.27	7.15	4.89
low caste	66.13	63.86	66.2	72.1
Other castes	26.52	28.87	26.25	23.01
Religion				
Hindu	83.97	81.47	84.05	83.38
Muslim	7.06	10.18	7.31	7.93
Christian	4.85	3.11	4.58	5.25
Sikh	2.25	3.53	2.32	2.11
Other religion	1.86	1.7	1.75	1.34
Place of Residence				
Urban	26.47	29.76	26.51	22.75
Work status				
Respondent works (yes=1)	49.51	38.36	49	53.83
Pension status				
Receive pension (yes=1)	13.04	9.76	12.51	12.87
Standard of living index (mean)	9.69	13.1	8.21	9.8

Source: IHDS 2004-05

Notes:

Pre-matched sample differences (bivariate χ^2 tests) have been conducted.; For the *standard of living* variable, difference of means t-test has been conducted

Pre-matching: Sample differences for most variables (except one age and one education dummies) are statistically significant ($p<0.05$)

Post-matching: Sample differences are *no*t statistically significant ($p<0.05$). The exceptions are marital status and the education dummies.

Table 7.7: Logistic Regression on the likelihood of being sick among elderly *before* and *after* matching

Variable	Unmatched sample (2045 control participants vs. 15,859 treatment participants)	Matched sample (1943 control participants vs. 1943 treatment participants)
living with children (living independently)	-0.815***	-0.846***
female (male)	0.286***	0.211*
age categories (age 60-69)		
age 70-79	-0.028	0.124
age 80-89	0.093	0.170
married (single/widow)	-0.154**	-0.539***
education (high school)		
no education	0.199**	0.115
Primary	0.093	0.007
college	0.025	-2.279*
Graduate	-0.053	-0.708*
Caste categories (Brahmin)		
SC, ST, OBC	-0.213*	-0.14
other castes	-0.141	0.034
Religion categories (Hindu)		
Muslim	-0.072	-0.014
Christian	0.093	0.5164**
Sikh	0.154	-0.0561
other	-0.376	-0.204
Urban (rural)	-0.166*	-0.251*
Any work (no work)	0.146**	0.193*
Receive Pension (no pension)	-0.086	-0.231
standard of living	-0.043***	-0.055***
Constant	-0.819***	-0.41
Log Likelihood	-5976.9775	-1663.7472
LR chi2 (19)	522.37	251.51

Reference group is shown in parentheses
*p<.05, **p<.01, ***p<.001

Table 7.8: Covariate (selected) Imbalance after Propensity Score Weighting

	p value of regression coefficient of living alone
Covariate (used as dependent variable in regression)	ATT
Female (=1; 0=male)	0.500
Married (=1; 0= single/widow)	0.000***
Age categories (reference: age60-69)	
Age 70-79	0.986
Age 80+	0.302
Education (reference: high school)	
Illiterate	0.000***
Primary	0.864
College	0.723
Graduate	0.132
Caste (reference :Brahmin)	
low caste	0.140
Other castes	0.085
Religion (reference: Hindu)	
Muslim	0.027**
Christian	0.944
Other religion	0.090
urban (=1; 0=rural)	0.872
Any work (=1; 0= no work)	0.597
Receive pension (=1; 0= no pension)	0.204
Standard of living index (0-30)	0.159

Source: IHDS 2004-05
NOTES: The balance check used simple regression for continuous dependent variable and logistic regression for dichotomous dependent variable
ATT= average treatment effect for the treated where weight for a treated case is 1 and for a control if pscore/(1-pscore)

Table 7.9: Logistic Regression Analysis on the likelihood of being sick among elderly with propensity score weighting (and compared with the un-weighted analysis)

Predictor variable	odds ratios (un-weighted)	Odds ratios (weighted) ATE	ATT
living with children (living independently)	0.443***	0.442***	0.451***
female (male)	1.331***	1.339**	1.353**
age categories (age 60-69)			
age 70-79	0.972	1.153	1.162
age 80-89	1.097	1.228	1.265
married (single/widow)	0.857	0.637**	0.661**
education (high school)			
no education	1.220**	1.383**	1.476**
Primary	1.097	1.158	1.19
college	1.025	0.413***	0.406***
Graduate	0.948	0.75	0.733
Caste categories (Brahmin)			
SC, ST, OBC	0.808*	0.571**	0.539**
other castes	0.868	0.75	0.731
Religion categories (Hindu)			
Muslim	0.931	1.041	1.034
Christian	1.097	1.398	1.408
Sikh	1.166	1.038	1.03
other	0.687	0.801	0.816
Urban (rural)	0.847*	0.93	0.963
Any work (no work)	1.157**	1.291**	1.302*
Receive Pension (no pension)	0.918	0.775**	0.758**
standard of living	0.958***	0.953***	0.953***
Log pseudolikelihood	-5976.9775	-6595.3516	-6479.9372
Wald chi2 (19)	456.82	394.76	362.91
No. of observations	17883	17883	17883

NOTE: ATE= average treatment effect where the weight for a treated case is *1/pscore*, for a control case is *1/(1-pscore)*; ATT= average treatment effect for the treated where the weight for a treated case is 1 and for a control case is *pscore/(1-pscore)*.
*P<.05, **p<.01, ***p<.001

Figure 7.1a: Boxplots of estimated propensity scores

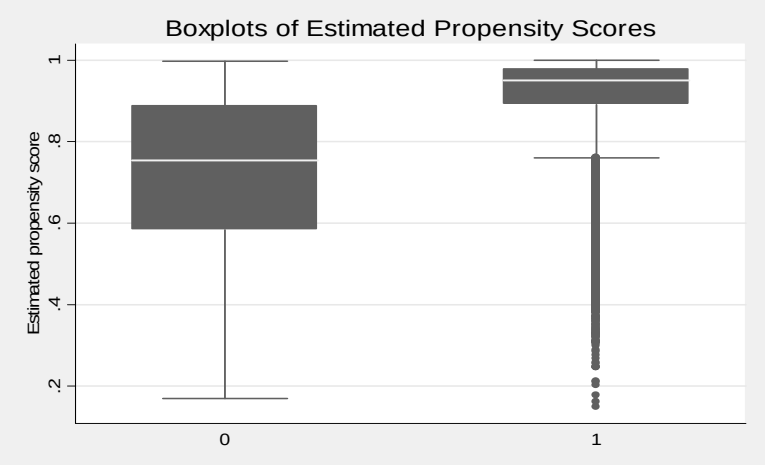
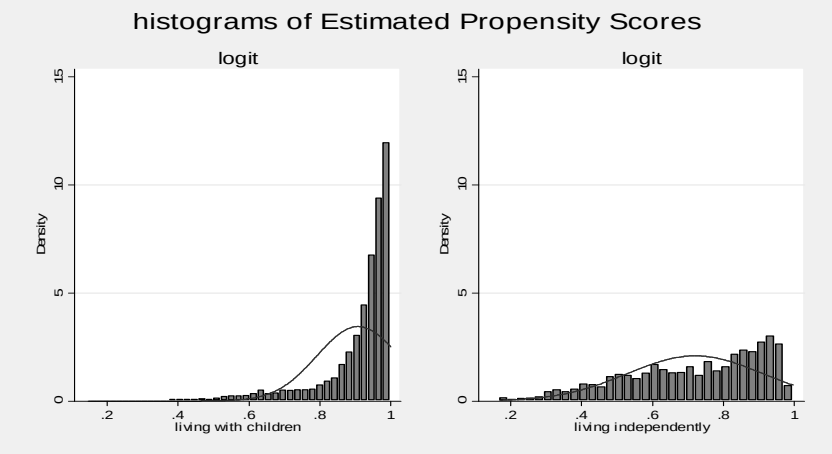


Figure 7.1b: Histograms of estimated propensity scores



Source: *India Human Development Survey, 2004-05*

Figure 7.2: Propensity Score models used in this dissertation

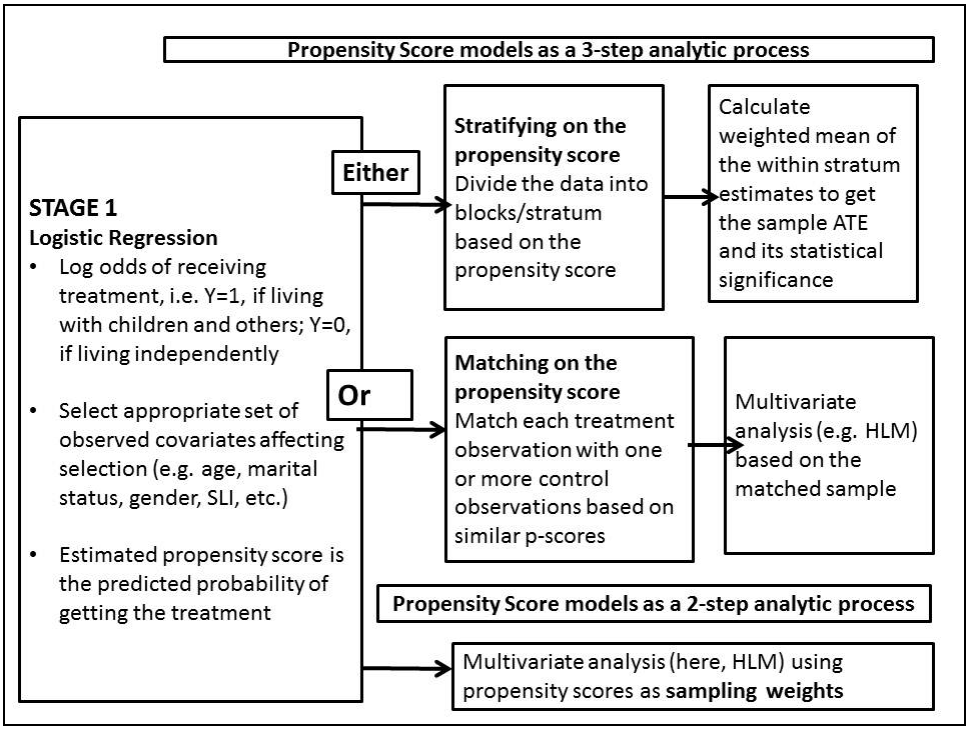


Figure 7.3a: Balance of covariate *FEMALE* after being stratified by estimated propensity score and observed treatment

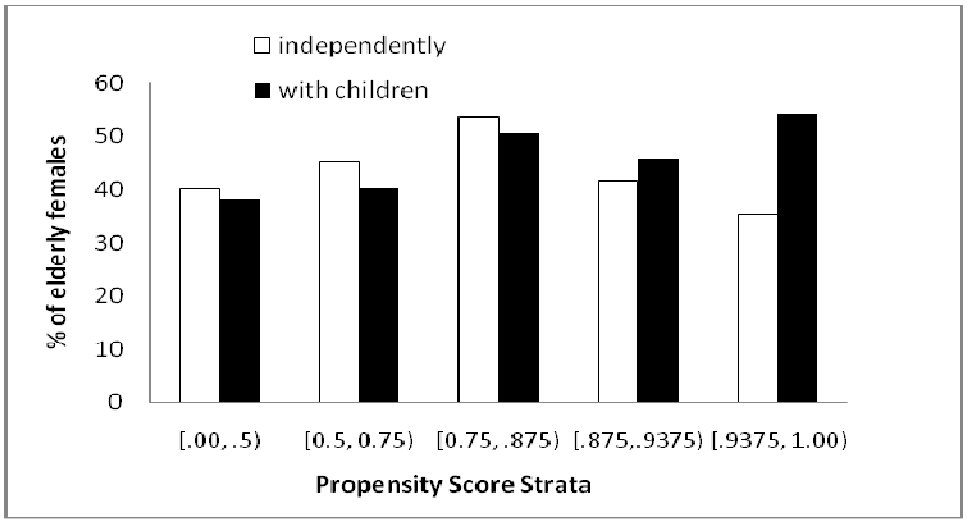
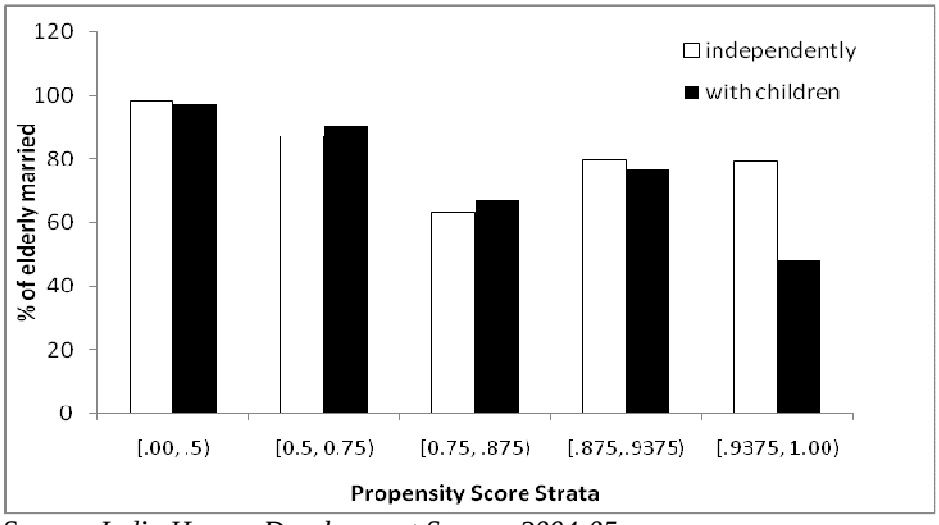
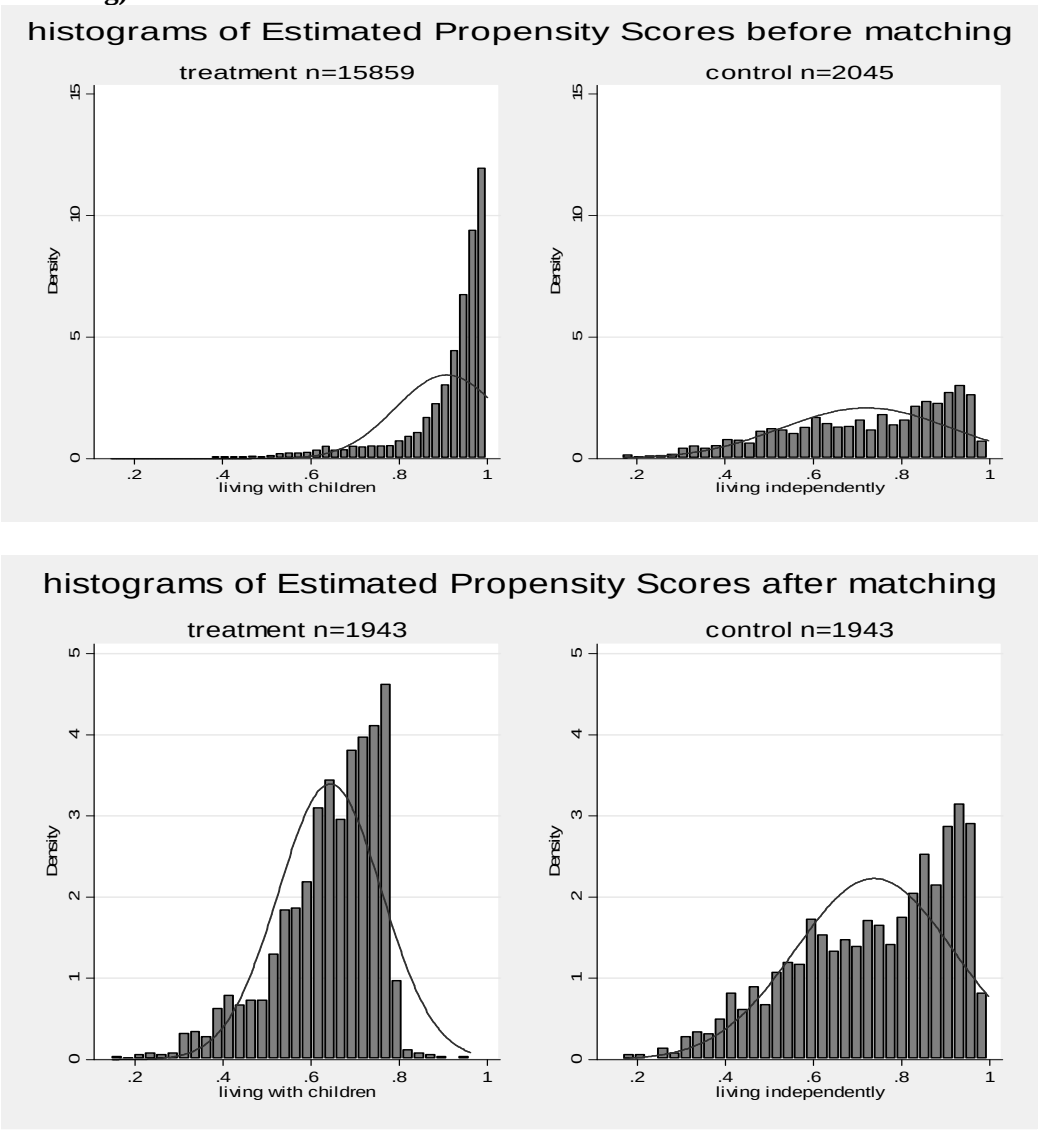


Figure 7.3b: Balance of covariate *MARRIED* after being stratified by estimated propensity score and observed treatment



Source: *India Human Development Survey, 2004-05*

Figure 7.4: Distribution of the probability of receiving treatment (before and after matching)



Source: *India Human Development Survey, 2004-05*

CHAPTER 8: LIVING ARRANGEMENTS AND HEALTH OF THE ELDERLY: A CONTEXTUAL ANALYSIS

Background: why look at contextual differences?

As indicated in the previous chapter, in addition to the logistic regression and propensity score analyses, I also conduct several multilevel models using hierarchical linear modeling. Hierarchical linear models will help us understand whether differences in short term morbidity rates among the elderly are due to variations in their individuals and households characteristics (compositional factors) or if they are also a function of the area (or district) where they reside (contextual factors) such as the availability of elderly friendly institutional and medical facilities. If contextual (district-level) characteristics influence the likelihood of short term morbidity, it is likely that even elderly persons living independently in an area/district with overall high levels of elderly support services will have lesser likelihood of falling ill with minor illnesses, while the co-resident elderly living in an area/district with low levels of institutional support will have higher rates of morbidity. Given the huge regional and rural-urban differences in socioeconomic and health outcomes in India, this analysis will be useful to critically evaluate the dominant role of the family in older adult care-giving in diverse contexts while highlighting the possibility of substitutability of informal family care by institutional support. This analysis thus has important implications for the newly emerging aging policies in India.

Literature on Health and Context

Empirical studies examining health trajectories over the life course (Chen. *et al*. 2010; Sellstrom, et al. 2006; Seeman & Crimmins, 2001; Martin, 1989) have consistently shown that variation in individual level outcomes are not always sufficiently explained by differences in household characteristics, but are also likely to depend on variation in community contexts as characterized by urban or rural residence, level of infrastructure development and state of residence (Desai, *et al*. 2010). However, most of the demographic literature on this issue has been motivated by exploring fertility dynamics in developing countries. Mason & Smith (2000) showed the impact of gender context on desires for additional children and use of contraception among married women and their husbands in selected communities in five Asian countries. Similarly, using data from Demographic and Health Surveys for 22 countries in Sub-Saharan Africa, Kravdal (2002) demonstrated that the average educational level in a village or a community has a significant depressing effect on a woman's birth rates, net of urbanization and her own education. Finally, similar results have been established in the Indian context, where studies (Moursund & Kravdal, 2003) show that the average educational level of other women in the community has an effect on a woman's contraceptive use over and beyond that of her own education. Surprisingly, a systematic examination of the role of context in explaining morbidity outcomes has been missing from the demographic literature on developing countries. The current analysis aims to fill this research gap.

As indicated at the outset, the issue of linking context with morbidity outcomes is particularly important in the Indian context where there are huge interstate differences in almost all human development indicators-education, health and income. This is especially marked in the case of health and medical care. The southerners reporting consistently lower levels of short term morbidity (cough, fever or diarrhea) and higher levels of health care than elsewhere in the country (Desai, *et al*. 2010). More specifically, studies have shown southern states to have lower infant and child mortality (Jain, 1985) and greater rates of vaccination than the central plains (Gaudin, *et al*. 2006; Parashar, 2005; Pande, *et al* 2003). Furthermore, the south outperforms the rest of the country on every indicator of maternal medical care (Navaneetham, 2002 ; Bloom, *et al*. 2001; Dyson & Moore, 1983). Better medical care and relatively easy accessibility have contributed to the south's health advantage (Desai, *et al*. 2010). As indicated earlier in this dissertation the incidence of short term morbidity levels also vary markedly among elderly in the country. Most states indicate short term morbidity levels ranging from 7 to 18 percent (IHDS, 2004-05) among the elderly (Figure 1). Again, southern states (e.g. Karnataka, Kerala &Tamil Nadu) seem to report relatively lower rates of minor illnesses as compared to the eastern (e.g. West Bengal and Bihar) and northern states (e.g. Uttarakhand and Uttar Pradesh) among the older population.

[Figures 8.1 & 8.2 about here]

The state differences in the use of health services when sick with minor illnesses are also substantial- the northern hill states of Himachal and Kashmir show a higher usage of public/government services while the southern states of Kerala, Tamil Nadu and Karnataka show lower rates (Figure 8.2), probably because there are more private health care facilities/services unlike in hill states (Desai, *et al*. 2010).

Urbanization and local availability of services affect where the sick go for treatment. Typically, while urban residents generally have a choice of government and private providers, rural residents face far fewer choices. Desai et al. (2010) concluded from their nation-wide household survey that in general, individuals living in the south and cities report lower morbidity and have better medical care; urban residents also pay somewhat less money on a typical minor illness than a villager (Table 8.1). These regional and urban-rural differences warrant further contextual analysis to examine factors affecting health outcomes and differential use of health services among the elderly.

[Table 8.1 about here]

From the previous chapters, it is clear that individual and household characteristics (more specifically, living arrangements) have important implication for the health of the elderly. However it can be argued that not only individual and household characteristics but contextual characteristics like social networks, urbanization and institutional care facilities (e.g. old age homes, geriatric clinics, etc.) for the elderly are important in affecting health outcomes. For the purpose of this analysis, I

conceptualize “context” in terms of districts. Demographic literature on India has always indicated an urban advantage in terms of health and socioeconomic outcomes. In general, Indians living in urban areas have higher household incomes, enjoy high quality of schooling and medical care, have greater degree of household sanitation (e.g. flush toilet) and have lower morbidity rates (Desai, *et al*. 2011). Hence I chose urban area as one of the contextual variables for this analysis. Additionally, it can be expected that districts that provide institutional support (such as old age homes, special clinics for the elderly, presence of civil societies/NGOs working on elderly issues, etc.) may result in generating positive health outcomes among the elderly, regardless of their household structure. However data on institutional facilities for the elderly still remains inadequate and unstructured in India. The only available resources are the rapid surveys across some Indian cities conducted by the HelpAge-India, to provide an estimate of the institutional facilities available for the elderly (Available at: http://www.helpageindia.org/relief-old-age-homes.php) and the Central Statistical Organization’s (of the Ministry of Statistics & Program Implementation, Government of India) list of old age homes in different states that are supported by the Ministry of Social Justice (See: *Elderly In India: Profile & Programs*, 2006. Accessed at: www.mospi.gov.in).

However none of these published data are adequate to perform a multilevel analysis. Thus, given the data unavailability, I chose to use a proxy measure to examine the contextual effects (if any) influencing the living arrangement-elderly health outcome association. I constructed a “percentage of elderly persons in a district” variable, or in

other words, proportion of elderly persons in an area/community. It is perhaps reasonable to assume that higher number of elderly persons in a district or state may in turn lead to higher availability of elderly friendly services that can improve individual health outcomes. While explaining the importance of context, Huckfeldt (1986) describes contextual effects as "instances in which individual behavior is affected by the presence of a social property in a population regardless of whether the individual possesses the property in question" (p. 13). Hence existence of a large number of a particular population group (here, elderly) may generate supply, leading to an environment conducive for better health care for the elderly. However it should be noted that such supply side efforts can only be successful when the particular population group actively demands, rather than passively accepting the existing situation (Bonu, Rani & Baker, 2003). Nevertheless, the importance of context cannot be understated. I would have preferred more nuanced variables for measuring context, and I recognize that this measure might not be fully successful at tapping the underlying context and health outcome link. Hence I use these variables despite their potential weaknesses and interpret the results with caution.

Thus, using the contextual variables, one of the goals of this chapter is to test how much of the area (district level and urban-rural) differences is due to compositional (household) factors and how much are contextual. For the purpose of this investigation, I employ hierarchical linear modeling techniques and I use stepwise models to examine the role of the context in the household structure and elderly

health outcome relationship. The model design, data and results are discussed in the next sections.

Analytic Strategy

Hypotheses

Though there has been a fair amount of literature focusing on determinants of living arrangements, intergenerational ties and elderly health, far less research has incorporated the effect of context while analyzing these issues. This may be due to problems in transporting contextual effects into individual-level models or choosing the appropriate units and levels of analysis. Even when such effects are included in single-level equations, the results can be misleading due to aggregation bias, misestimated standard errors and heterogeneity of regression (Raudenbusch & Bryk, 2002). Hierarchical linear modeling (Smith 1973) which is a type of multilevel linear modeling permits simultaneous estimation of micro and macro level models and hence helps correct these methodological issues. By using maximum likelihood estimation (MLE), it provides relevant tools for modeling within and between area differences in social phenomena, thus allowing for the direct representation of the influence of higher-level factors on structural relations within areas (Raudenbush & Bryk, 2002). Since the goal of this chapter is to examine how the likelihood of being sick with minor illnesses among the elderly is influenced both by the household characteristics (particularly, living arrangements) as well as characteristics of the district and community where the elderly resides, the HLM technique will be useful

to answer the questions posed here. More specifically, I test the following set of hypotheses to distinguish between compositional and contextual effects.

Hypothesis 1

The elderly in urban areas will have *lesser likelihood* to fall sick with minor illnesses than the elderly in rural areas. This hypothesis draws from the existing studies (Desai & Rastogi, 2006) demonstrating rural-urban differences in socioeconomic and health outcomes. Among other things, urban residents typically have better transportation facilities and easier access to health care services than their rural counterparts. As a corollary to this hypothesis, I examine a related hypothesis:

- Hypothesis 1a: Much of the urban/rural differences is due to the fact that urban households (as opposed to rural households) are also wealthier, are better educated and have better sanitation facilities, thereby lowering the chances of being sick with a minor illness. In other words, the district level effect can be explained away by compositional factors (individual and household)

Hypothesis 2

The positive relationship between co-residence with adult children and elderly well-being is likely to *weaker*, where contextual (district level) effects are stronger (i.e. higher percentage of urbanization and higher percentage of elderly persons). I argue

that in districts that enjoy more urban facilities (such as accessible health care, transportation, etc.) and have higher proportion of elderly persons to the total population, co-residence of the elderly persons with children and others (and hence higher care-receiving possibilities) will not be as beneficial to their health outcomes. This hypothesis will involve modeling the slope coefficients of the living arrangement variables in level 2.

For the purpose of his exercise, I develop a basic two level multilevel model using level-1(individual) intercept (residual elderly morbidity) as function of level-2 (district and urban/rural) characteristics. Additionally, by using the two-level model, I can also test cross-level effects (i.e. how district level variables affect household level relations such as living arrangements-morbidity link). The HLM statistical software (version 6) developed by Raudenbush, *et al*. (2000) has been used to conduct the multilevel analysis. Descriptive analysis of the individual and district-level data such as checking frequencies, distributions and correlations were performed in STATA. Finally, individual and district-level datasets were then read into HLM.

Data

Two levels of data are utilized. Level 1 (individual level) data is drawn from the same nationally representative and multi-topic dataset of 41,554 households- *India Human Development Survey (2004-05)* -that the current dissertation has employed for all its previous analyses. 17743 elderly persons were included in the level-1 analysis. Level-

2 (district-level) data is from the 2001 Census of India which provides detailed information regarding employment, literacy rates, wealth, level of urbanization and other demographic characteristics for 496 districts, separately by urban-rural location. Unique state-district identifier codes were created to merge individual data from IHDS with the district level data from Census. Table 8.2 provides descriptive statistics of the dependent and independent variables at both levels 1 and 2.

[Table 8.2 about here]

Description of dependent, independent and control variables used at both levels

The *dependent variable* for the analysis is the same as in the previous chapters: the likelihood of being sick with a minor illness (cough, diarrhea or fever) which is a categorical variable that takes the value of "1" if they have been sick and "0" if they remained healthy. About 11% of elderly have been sick in the last month with a standard error of 0.31.

The *macro-level independent variable* used in this exercise is the percentage of elderly in a district (*PELDERLY*). This variable is expected to be negatively associated with the likelihood of being sick for an elderly residing in that district. As indicated earlier, the rationale behind this expectation is that more number of elderly persons in a district will lead to better health awareness among the elderly and may generate higher supply for elderly medical/non-medical services which in turn will lower the chances of being sick. Although there may not be direct linkages between

elderly presence in a district and health outcomes, but indirect mechanisms may be involved in creating a larger context for favorable health outcomes.

An urbanization variable (a 0/1 variable; the variable takes a value 1 in the case of urban areas in a district, and 0 if rural) was added as a *macro-level control variable*. As mentioned earlier, like many other developing countries, one of the salient characteristics of India is its rural-urban divide in terms of socio-demographic, economic and health outcomes. City and town dwellers more often perceive themselves as more healthy, less often report suffering from minor illnesses and are incapacitated for shorter periods when ill (Desai, *et al*. 2010). Hence the urbanization variable *(URBAN*) is expected to act as a proxy for economic development in that district; more specifically, proximity to urban areas may imply better communication systems and availability of medical facilities.

Individual level control variables include the same set used in previous chapters: (1) socio-demographic characteristics: age, gender, marital status (currently married or divorced/single), caste (Brahmin, lower castes-scheduled tribes & scheduled castes-& other castes), religion (Hindu, Muslim, Sikh, Jain, Christian & Other religion), education (0=no education through 15 year=graduate degree), whether receives pension and work status (participation in any work including wage work, business, farm or animal care) ; (2) household characteristics: a 3-category living arrangement variable-living independently (alone or with spouse), living with children and living

with others; and (3) overall standard of living index: measured using a constructed scale of the number of consumer goods owned from a list of 27 items (e.g. chair/table, television, car, credit card, etc.).

Estimation Method

Since the outcome of interest (likelihood of being sick takes on a value of either zero or unity; follows a Bernoulli distribution) is binary in nature, this study utilizes a two-level hierarchical generalized linear model (HGLM) that offers a coherent modeling framework for multilevel data with nonlinear structural model and non-normally distributed errors (Raudenbush & Byrk, 2000).

The level-1 model becomes:

$$\eta_{ij} = \log\left(\frac{\varphi_{ij}}{1-\varphi_{ij}}\right) = \beta_{0j} + \sum \beta_{kj}(X_{ijk} - X...{}_k) \qquad (8.1)$$

Where,

η_{ij} is the logit link function or the predicted log odds of being sick for an elderly person *i* in district *j*.

The predicted log odds can also be converted into an odds by taking the exp (η_{ij}) or into a predicted probability by computing $\varphi_{ij} = \frac{1}{1+\exp\{-\eta_{ij}\}}$

β_{0j} is the intercept or the log odds of being sick for an elderly *i* in district *j*

β_{kj} is the slopes for *k* individual-level variables X_{ikj} that are fixed across districts

$(X_{ijk} - X...k)$) are individual level variables that are grand mean centered

I model β_{0j} as a function of the level-2 predictors. In this analysis, all the other level-1 coefficients, $\beta_{kj}, k > 0$, are fixed. Hence the level-2 (district level) model becomes:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (PELDERLY) + \gamma_{02} * (URBAN) + \mu_{0j} \qquad (8.2)$$

$$\beta_{kj} = \gamma_{k0} \text{ for } k>0 \qquad (8.3)$$

Here,

γ_{00} is the intercept for the log odds of being sick for an elderly person in a district with average levels of urbanization and elderly presence and a random effect of zero

μ_{0j} is the error term for the district level random effect on the intercept

γ_{k0} is the constant coefficients β_{kj} across all districts

Model Results

I estimate five models-one unconditional or null model and four conditional models. In the above analytic strategy, all independent variables included in level 1 lead to level 2 equations where each coefficient at level 1 could be potentially modeled as an outcome variable at level 2. However, for the purpose of this analysis, I model both the intercept and the coefficients of the living arrangement variable. A variable that is "fixed" does not allow for variance between districts for that particular parameter. In all the models (except the last model), individual variables are grand mean centered,

with effects fixed across all districts. The reason for grand centering is that it models the intercept as a measure of the likelihood of illness for an "average" household; that is, one with the grand means on education, standard of living, age, etc. Without grand mean centering, the intercept is the likelihood of illness for a household that is zero on all individual characteristics (age, education, etc.) and hence is not meaningful. Finally, all multilevel models use sampling weights to minimize bias in parameter and standard error estimates.[2]

The first model (MODEL 1) is the null or unconditional model that has no predictors at either level. Given a Bernoulli sampling distribution and a logit link function, the level-1 model is simply

$$\eta_{ij} = \beta_{0j}$$

and where level-2 model is

$$\beta_{0j} = \gamma_{00} + \mu_{0j} \quad , \quad \mu_{0j} \sim N(0, \tau_{00})$$

Here, γ_{00} is the average log-odds of being sick across all districts, while τ_{00} is the variance among/across districts in district-average log odds of being sick. Table 8.3 shows that the estimated results are $\hat{\gamma}_{00}$ =-2.14 (se=0.038) which is interpreted as the average value of the dependent variable across all districts. In other words, for a district with a "typical" short term morbidity likelihood, that is, a district with a random effect μ_{0j} =0 , the expected log odds of being sick is -2.14, corresponding to

[2] Similar HLM analyses have been conducted using propensity score weights (See Chapter on Propensity Score Methods). Since multilevel analyses using sampling weights and propensity score weights generated similar results, I have reported only the results using sampling weights.

an odds of exp{-2.14}=.117. This corresponds to a probability of 1/{1+exp(2.14)}=0.105. Within the framework of a standard two-level hierarchical model, the interclass correlation (ratio of level 2 variance to the total variation) obtained from the null model is usually an useful index (Luke, 2004). However this measure cannot be used in this nonlinear link logit model, as level 1 variance is heteroscedastic (Raudenbush & Byrk, 2000).

Next I consider the three conditional models. The goal of estimating these conditional models is to test for the "contextual effect ; i.e. whether urban location and elderly prevalence will predict lower rates of short term morbidity. Models 2 through 4 follow equation structures specified in 1.1, 1.2 and 1.3.

[Table 8.3 about here]

I build Model 2 with level-2 predictors (PELDERLY & URBAN) only. Model 3 includes socio-demographic predictors in level 1 and retains the same level-2 predictors. In Model 4, I include living arrangement variables in addition to the socio-demographic variables in level-1 and retain the same predictor variables in level-2. Model 2 through 4 are all "intercept" models whose basic goal is to assess the extent to which the district wise variability of short term morbidity is influenced by urbanization and presence of elderly. Finally, Model 5 captures the "slopes" model which will test not only whether urban area and percent elderly influence short term morbidity in a district, but also whether it *interacts* with the level-1 (individual level) predictors. Thus γ_{11} and γ_{12} will serve as indications of cross level interactions

where a district level characteristic (URBAN and PELDERLY) may influence an individual level relationship (See Table 8.4).

[Table 8.4 about here]

Results from Model 2 highlight the negative relationship between the likelihood of an elderly person to fall sick with a minor illness with urbanization and elderly prevalence in a district. Districts with a larger proportion of elderly do have better health outcomes among elderly; the coefficient for percent elderly is negative as hypothesized but not statistically significant. Although the *effect* of urbanization on elderly health outcomes confirms my hypothesis that urbanization is associated with lower levels of morbidity. Without any control variables (Model 2), one standard deviation (0.31) increase in urbanization a district reduces the log odds of an elderly being sick by a factor of 0.81{exp(γ_{02}=-0.668*0.31)=0.81}. The intercept (γ_{00}) indicates that the conditional odds of being sick for an elderly residing in a district with average levels or urbanization and elderly prevalence is-2.18 (and a random effect of zero).

Model 3 retains the same district level controls but adds socio-demographic and compositional controls-gender, age, marital status, education, caste, religion, wealth and employment status. The negative relationships between likelihood of short term morbidity and the two contextual variables (PELDERLY & URBAN) from Model 2 persist. However there is a substantial reduction in the URBAN coefficient (from -0.668 to -0.225). The difference in magnitude of the urban coefficient highlights the

fact that elderly in the urban households are wealthier and better educated. Therefore the difference between Model 2 and Model 3 captures the compositional effect. These results also support my first hypothesis about the role of household wealth in influencing the household structure-health outcome link.

The log odds of being sick reduces by a factor of 0.90{exp(γ_{02}=-0.225*0.49)=0.90} for one standard deviation (0.49) increase in percent urbanization in a district. Model 3 also underscores the significant negative association between likelihood of being sick and the household wealth index (SLI) $\hat{\gamma}_{190}$ =-.179, holding constant the other predictors in the model and the random district effect, μ_{0j}. The log odds of an elderly being sick reduces with one standard deviation (1.38) increase in the standard of living {exp(γ_{190}=-0.179*1.38)=0.78} In addition, it also highlights that elderly females are particularly disadvantaged experiencing higher likelihoods of being sick. More specifically, increase in proportion of females in a district is associated with an increase in log odds by a factor of 1.33 {exp(γ_{30}=0.290)=1.33}, holding other variables constant.

Model 4 adds the living arrangement controls and examines the robustness of the contextual effects. The significant negative (-0.342) relationship between urbanization and short term morbidity likelihood still persists (and in fact is somewhat larger) even after controlling for compositional factors. The elderly are more likely to live independently in urban areas and so would be expected to be

healthy as a result; thus the independent living arrangements of the urban elderly somewhat masks the better health of urban areas.

Finally, in Model 5, cross level effects are examined to test whether the living arrangement effects vary across district. Table 8.4 compares models 4 and 5 to highlight the difference in results when cross level effects are examined. The coefficients of the living arrangement variables are marginally significant in Model 5 (Note: living independently is the reference category here). More specifically, the direction and statistical significance of the living with children variable demonstrates that living with children is no longer associated with lower likelihood of falling ill, when contextual factors are taken into consideration. In particular, holding all other variables constant, for the elderly who are living with children, the odds of being sick with a minor illness is increased by a factor of 1.04 (=exp(0.044)) in a district that has high proportion of elderly and is increased by a factor of 1.20 (=exp(0.188)) in a district that is more urban, when compared to the elderly living independently. That is, in districts that enjoy urban facilities and have higher percentage of elderly, the protective health effects of co-residence on elderly health outcome are marginally washed away. This finding supports my hypothesis 2 about the direction and magnitude of the co-residence-health outcome link, when contextual variables are factored in. Comparison of Models 4 and 5 shows that the effects of other compositional factors remain consistent across both models.

Since the outcome variable (likelihood of being sick: 1, if yes, 0, if remained health) is binary in nature, estimation and interpretation of the variance components (See Table 8.3) is not as straightforward as for continuous variables (Guo & Zhao, 2000). In other words, since the outcome can only assume two values, 0 or 1, it is not normally distributed. In the multilevel framework, the estimation of variance components for binary outcomes requires special adaptation of estimating procedures to approximate to maximum likelihood. The key is that variance components are calculated on the log-odds scale, or metric, but should be transformed to a probability metric for ease of interpretation (Goldstein & Rasbash, 1996).

Conclusion

In this chapter, I used generalized hierarchical linear models with a binary outcome to examine two related questions: (1) how much of the area (district level and rural-urban) differences are due to compositional factors and how much are contextual, and (2) if the strength and direction of the living arrangement-health relationship is altered in districts where contextual factors are more prominent. The goal of combining the micro level logit models (examined in previous chapters) and the hierarchical models examined in this chapter was to test if the living arrangement-health outcome linkages persist when district level factors are taken into consideration.

In summary, taking all the five models together, it can be said that *half* of the living arrangement-health link is explained by contextual factors, i.e. level of urbanization

and proportion of elderly in a district. Consistent with the logistic regression models (Chapter 6), living with children or others as opposed to living independently reduces the odds of being sick with a minor illness, even when contextual variables are factored in. These findings support previous studies on developing countries that demonstrate rural-urban differences in health outcomes and health care utilization- Desai, *et al*.2010 in case of India, Gilson & Molyneux (2007) in the context of Kenya and Shaikh & Hatcher (2005) in Pakistan.

However the finding that the elderly in the urban areas fare better in terms of health when compared to the elderly residing in rural areas, is primarily driven by the fact that these elderly also happen to come from households that are wealthier and better educated.

Finally, examination of cross level effects suggested that in districts that enjoy urban facilities and have higher proportion of elderly, the protective health effects of co-residency are diminished substantially. This finding highlights the role of context (district level factors) in affecting the living arrangement-health outcome link among elderly above and beyond the elderly persons' individual and household characteristics.

Furthermore, at the individual level, gender and marital status remain important predictors. In particular, being female increases an elderly person's odds of being sick relative to being a male, while being married has protective effects on health

outcomes of the elderly which may be indicative of the disadvantages faced by elderly widows. Other individual level controls such as education and social groups do not have significant effects on the living arrangement and health outcome link when district level factors were incorporated in the models. Finally, lack of appropriate contextual data (on elderly medical infrastructure and old age homes) limits the analyses in elucidating the complex mechanisms between contextual factors and elderly health outcomes. The exploration of these mechanisms is left to future studies.

Table 8.1: Utilization of medical care and expenditure for minor illnesses by place of residence

Minor illnesses: Cough, Fever, Diarrhoea				
Place of Residence	Treated in Government center (%)	Treated outside local rea (%)	Median Expenses if sick (Rs)	No treatment (%)
Metro	15	13	100	3
Other urban	18	27	110	6
More developed village	21	41	130	9
Less developed village	15	53	110	12

Source: IHDS, 2004-05. Adapted from Desai, et al. 2010. "Health & Medical Care", in Desai, et al. (eds). *Human Development in India: Challenges for a Society in Transition*. Oxford University Press, New Delhi.

Table 8.2: Descriptive Statistics of All Variables in the Analyses

Individual level Descriptive Statistics (n=17,743)			*District level Descriptive Statistics (n=496)*		
variables	**Mean**	**SD**	**Variables**	**mean**	**SD**
likelihood of being sick (*Dependent variable*)	0.11	0.31	PELDERLY	7.4	1.73
living independently	0.11	0.32	URBAN	0.43	0.49
living with children	1.67	0.75			
living with Others	0.16	0.67			
female (male)	0.5	0.5			
age 60-69	0.61	0.49			
age 70-79	0.29	0.45			
age 80-89	0.1	0.3			
married (single/widow)	0.63	0.48			
no education	0.19	0.39			
Primary	0.07	0.26			
Highschool	0.44	0.5			
college	0.12	0.32			
Graduate	0.18	0.39			
Brahmin	0.07	0.26			
SC, ST, OBC	0.64	0.48			
other castes	0.28	0.45			
Hindu	0.82	0.39			
Muslim	0.1	0.3			
Christian	0.03	0.18			
Sikh	0.03	0.18			
other	0.02	0.13			
Any work (no work)	0.4	0.49			
Receive Pension (no pension)	0.1	0.3			
standard of living	3.28	1.38			

Source: *IHDS 2004-05; Census of India, 2001*

Table 8.3: Hierarchical linear model results for household and contextual effects on likelihood of being sick

		Model 1 (null model)		*Model 2 (ONLY level-2 predictors)*		*Model 3 (socio-demographic controls in level 1)*		*Model 4 (Model 3 + living arrangement controls)*	
	Fixed Effects	Coef	SE	Coef	SE	Coef	SE	Coef	SE
For Intercept, β_{0j}	Intercept, γ_{00}	-2.144***	0.03	-2.181***	0.05	-2.223***	0.05	-2.258***	0.05
	PELDERLY γ_{01}			-0.038	0.03	-0.015	0.03	-0.041	0.03
	URBAN γ_{02}			-0.668***	0.11	-0.225*	0.12	-0.342**	0.12
Living Arrangement (ref: living independently)									
Living with children	Intercept, γ_{10}							-0.484***	0.04
Living with Others	Intercept, γ_{20}							-0.266***	0.05
FEMALE (*ref: male*)	Intercept, γ_{30}					0.290***	0.08	0.274***	0.08
MARRIED (*ref: single/divorced*)	Intercept, γ_{40}					0.030	0.08	-0.109**	0.08
Age Categories (ref:60-69)									
AGE 70-79	Intercept, γ_{50}					-0.041	0.07	-0.067	0.07
AGE 80-89	Intercept, γ_{60}					-0.176	0.11	-0.194	0.12
Castes (ref: Brahmin)									
LOW CASTES (SC, ST, OBC)	Intercept, γ_{70}					-0.353	0.16	-0.252	0.16
OTHER CASTES	Intercept, γ_{80}					-0.268	0.15	-0.236	0.15
Religion (ref: Hindu)									
MUSLIM	Intercept, γ_{90}					-0.139	0.14	-0.111	0.14
CHRISTIAN	Intercept, γ_{100}					0.112	0.23	0.061	0.22
SIKH	Intercept, γ_{110}					0.444*	0.23	0.448*	0.23
OTHER RELIGION	Intercept, γ_{120}					-0.568	0.25	-0.544	0.24
Education (ref: primary)									
NO EDUCATION	Intercept, γ_{130}					0.172	0.13	0.048	0.12
HIGH SCHOOL	Intercept, γ_{140}					-0.257	0.12	-0.093	0.12
COLLEGE	Intercept, γ_{150}					-0.404*	0.16	-0.207	0.16
GRADUATE	Intercept, γ_{160}					-0.59**	0.16	-0.409*	0.16
GET PENSION (*ref: yes*)	Intercept, γ_{170}					0.161	0.11	0.085	0.11
ANY WORK *(ref: yes)*	Intercept, γ_{180}					0.164	0.09	0.154	0.09

STANDARD OF LIVING	Intercept, β_{190}					-0.179***	0.03	-0.13***	0.03
Random Effects Variance Component									
Intercept		0.332***		0.337**		0.340***		0.366***	
Likelihood function		-24466.76		-24361.67		-24420.41		-24417.92	

*p<.05, **p<.01, ***p<.001; N (level 1)=17743, N (level 2)=496

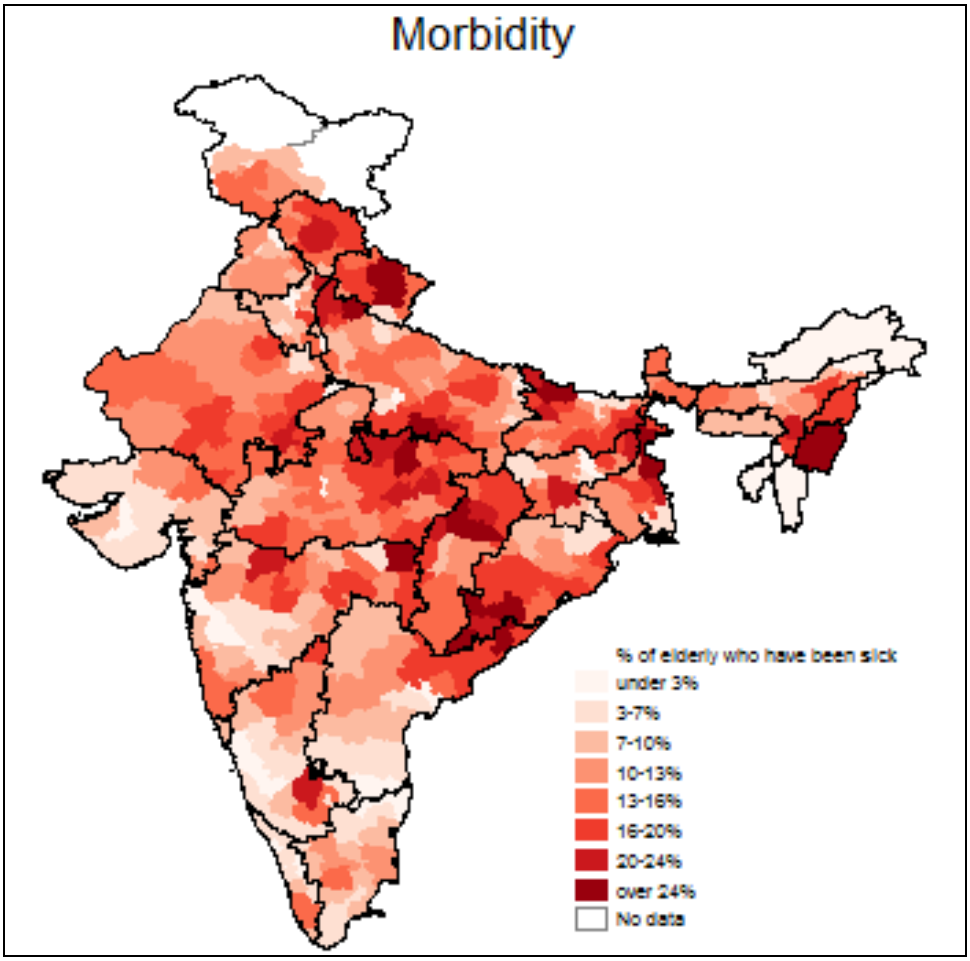
Table 8.4: Hierarchical linear model results for household and contextual effects on likelihood of being sick *(modeling the intercept and the slope)*

		Model 4		***Model 5*** *(cross level effects)*	
	Fixed	**Coef**	**SE**	**Coef**	**SE**
For Intercept	Intercept	-2.258***	0.05	-0.380	0.42
	Pelderly	-0.041	0.03	-0.106**	0.05
	Urban	-0.342**	0.12	-0.672***	0.20
Living Arrangement (ref: living independently)					
Living with children	Intercept	-0.484***	0.04	-0.864***	0.21
	Pelderly			0.044	0.02
	Urban			0.188*	0.09
Living with Others	Intercept	-0.266***	0.05	-0.237***	0.25
	Pelderly			-0.010	0.03
	Urban			0.184	0.11
FEMALE (*ref: male*), slope	Intercept	0.274***	0.08	0.269***	0.08
MARRIED (*ref: single/divorced*), slope	Intercept	-0.109**	0.08	-0.111	0.08
Age Categories (ref:60-69)					
AGE 70-79 slope	Intercept	-0.067	0.07	-0.071	0.07
AGE 80-89, slope	Intercept	-0.194	0.12	-0.198	0.12
Castes (ref: Brahmin)					
LOW CASTES (SC, ST, OBC), slope	Intercept	-0.252	0.16	-0.258	0.16
OTHER CASTES, slope	Intercept	-0.236	0.15	-0.242	0.15
Religion (ref: Hindu)					
MUSLIM, slope	Intercept	-0.111	0.14	-0.117	0.14
CHRISTIAN, slope	Intercept	0.061	0.22	0.058	0.22
SIKH, slope	Intercept	0.448*	0.23	0.431*	0.23

OTHER RELIGION, slope	Intercept	-0.544	0.24	-0.530*	0.24
Education (ref: primary)					
NO EDU, slope	Intercept	0.048	0.12	0.048	0.12
HIGH SCH, slope	Intercept	-0.093	0.12	-0.091	0.12
COLLEGE, slope	Intercept	-0.207	0.16	-0.21	0.16
GRADUATE, slope	Intercept	-0.409*	0.16	-0.415*	0.16
RECEIVE PENSION, slope	Intercept	0.085	0.11	0.085	0.11
ANY WORK, slope	Intercept	0.154	0.09	0.145	0.09
STANDARD OF LIVING, slope	Intercept	-0.13***	0.03	-0.135***	0.03

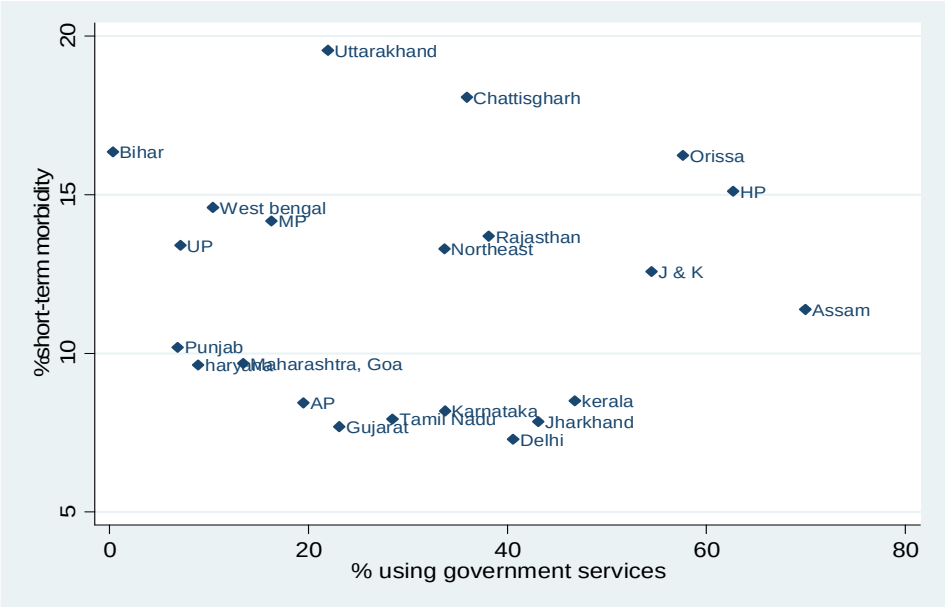
*p<.05, **p<.01, ***p<.001; N (level 1)=17743, N (level 2)=496

Figure 8.1: Short term morbidity rates among elderly in India



Source: IHDS, 2004-05

Figure 8.2: State-wise short term morbidity rates and use of government health services



Source: IHDS, 2004-05

CHAPTER 9: LIVING ARRANGEMENTS AND HEALTH EXPENDITURES AMONG THE ELDERLY IN INDIA

Introduction: Why look at health expenditures?

The preceding chapters have clearly demonstrated the importance of multigenerational family to the well-being of elderly in India, even after adjusting for selection bias. Findings from multivariate analyses (both logistic regressions and propensity score methods) have indicated that in addition to the household structure, the health of the elderly is also dependent on gender, education and household wealth. Furthermore, results from 2-level hierarchical linear modeling have emphasized the importance of place of residence in influencing health outcomes of the elderly. Given this big-picture view of what drives positive health outcomes among elderly, the goal of this chapter is to formally model the role of health expenditures within households in determining health of the elderly. The primary motivation to look at health expenditures is that it serves an indirect evidence of intra-household allocation of resources between family members; i.e. whether the elderly really benefit from being part of the extended family settings. The argument so far has been the co-resident elderly are healthier because they have a more supportive living arrangement. If that argument is true, then we would expect more spent on co-resident elderly when they do get sick.

This analysis draws from one of the theoretical frameworks of family behaviors- the rational choice framework (Becker, 1974, 1991)-as discussed in the earlier chapters. Such an analysis has important implications for policy decisions in developing countries where support and care for the elderly are almost exclusively provided for by the intergenerational households.

In the next few sections, I discuss the theoretical and empirical literature around the intra-household resource allocation debate while highlighting the need for such an analysis for the Indian context. Then I describe the data and methods used to examine expenditure on medical care services for the elderly by living arrangement types. The last section of this chapter presents the results from the OLS regression models and sets forth my conclusions.

Existing literature and the Indian context

As mentioned earlier, early economists (Becker 1974; Schwatrz, et al, 1984; Wolf, 1991) had developed the rational choice framework (incorporating concepts of "exchange" and "reciprocity") which has motivated much of the literature on intergenerational transfer behavior and living arrangements in developing countries. From this perspective, variations in children's willingness to "supply" co-residence are incorporated into the framework and can be viewed as operating through household production and/or division of household output. Elderly parents can "buy"

the care and attention of their adult children with promises to provide the latter with bequests or other transfers (Bernheim, et al 1985). Thus caring and co-residing with elderly parents, for example, could be given in response to resources received long ago, perhaps in return to parental investment in schooling, caring for a young grandchild, help with buying a home or land or in response to expected future compensation, as with a bequest. Population and development theorists (Cain, 1983; Nugent, 1985) have used similar hypothesis, namely the old age security hypothesis, to rationalize fertility motives in developing countries. These studies highlight the values of children as insurance against risk of income insufficiency in parents' old age.

Furthermore, absence of any publicly provided social or health insurance in most of the developing countries is based on a widespread belief that the elderly are well provided for by the intergenerational households, where the vast majority of them live with their adult children (Dharmalingam, 1994; Vlassoff & Vlassoff, 1980). However among the handful of empirical studies that have examined the living conditions of the elderly within intergenerational households, the findings are often inconclusive. For example, Caldwell, et al. (1988) in their study on demographic behavior in South India concluded that extended family structure "has proved remarkably capable of caring for the great majority of the elderly", so that "India-at least rural South India-has little in the way of crisis arising from aging" (p. 193). Several United Nations (1987) reports of elderly echo similar findings, arguing aging to be a "satisfactory

state of life" in Asian economies, with the elderly commanding the respect of the young and enjoying a position of "high status". Later studies (Rajan & Kumar, 2003 in India; Knodel & Chayovan, 1997 in Thailand and Anh, et al, 1997 in Vietnam), however, have pointed out to the gradual erosion of the elderly's "high status" as decision makers in extended family settings, but it is not immediately clear if such changes in cultural prescriptions have negative implications on the living conditions of the elderly.

Surprisingly, the literature on living arrangements and living conditions of elderly remains very scant. Among the few studies that have examined the living conditions of elderly, Sen & Noon (2007) in their examination of factors affecting treatment and health expenditure of elderly in India found that elderly living with children are likely to have higher medical expenditures than their non-coresident counterparts.

However there are studies that argue otherwise. Dharmalingam's (1994) study on South Indian villages and Vlassoff & Vlassoff's (1980) study on rural India, show that while intergenerational households adequately provide the daily food, household and clothing requirements of the elderly, they fall short in providing them with adequate medical expenditure. Specifically, Vlassoff & Vlassoff showed that 42% of the co-resident elderly in their sample financed their own medical expenditures. Dharmalingam's study reported that sons financed medical costs for only 34% of the elderly men in his sample, while the remaining medical costs were borne by wives and unmarried children. Similar observations are made in later studies by Kochar (1999) in her examination of familial support for medical expenditure of the elderly

in rural Pakistan. Using an intra-household resource allocation framework, the author concludes that there seem to be a significant negative correlation between individual contribution of older males to the households and the amount spent on medical expenditure. Since individual contributions decline with age and disability, medical expenditures also seem to reduce, despite greater need for medication. Pal (2004) echoed similar observations in her study on India where she empirically demonstrated that while majority of co-resident elderly men and women enjoy higher per capita household expenditure, elderly parents with morbidity and physical disability are unlikely to obtain adequate medical care from their co-resident children, thereby reducing the older parents' likelihood of co-residence. Similar results have also been reported in developed settings. Pezzin & Schone (1997) examined health care utilization of elderly parents in intergenerational households in the U.S and concluded that allocation decisions in such households are best modeled as outcomes of a bargaining process. Lau & Kirby (2009) in their examination of the relationship between living arrangements and preventive care services among older adults in the U.S, show that elderly living with adult children are less likely to obtain preventive care services when compared to the ones living with their spouses.

Although literature has analyzed number of factors that can potentially influence health expenditures of the elderly, it is not clear to what extent these disparate findings can be explained by living arrangements per se. A counter argument can be that living with children and others may reduce (or delay) the need for formal health care services because of the substitution of home care; evidence of home care

substituting medical care has been found in studies of Van Houtven & Norton (2001) and Cutler & Sheiner (1998).

Another related issue that has been widely discussed in the living arrangements literature on developing countries is the gender differences in the aging experience. Though literature is sparse with respect to disparities in treatment and access to health services among older adults, but all studies seem to agree that women in general experience greater continuity of roles (ongoing contributions to domestic chores and kin-keeping activities) as they age as compared to men who experience role disruption (Yount, 2009).

Furthermore, gender might interact with household wealth which in turn has important implications for access to resources. A study (Iyer, 2005) of health care access in rural Karnataka (India) shows that although the households that earned regular wages were better off in terms of access to health care than those that subsisted on casual wages or self- employment, women's access to health care did not particularly change. That is, women had poorer access to healthcare in casual wages household than in households earning regular income. On the other hand, income made little difference to men who enjoyed uniformly high levels of access in any type of household (ibid).

Marital status introduces an additional dimension into the gender disparity and access to resources debate. Widows in particular are a very disadvantaged group in terms of economic and health resources and hence their access to resources is much more dependent on living arrangements than widowers (Rahman, 2000; Agarwal, 1998;

Rahman & Menken, 1990). Given this evidence from South Asia and elsewhere, it is no surprise why Chen & Drez (1992) concluded based on their village study of widows that "the notion that the joint (extended) family provides protection to widows in rural India is little more than a myth" (p 87).

As suggested by Kochar (1999), empirical tests of intra household allocation of resources (here, spending on health services for the elderly) have been often hampered by lack of data on income, or expected income of household members in developing economies. This is the motivation behind using household wealth index as an indicator of income/wealth for the purpose of current analysis. Again, much of the disparate results might stem from a lack of good data on morbidity and health care access for measuring health spending of the elderly in intra-household settings. While there seems to be some degree of consensus in the literature about health behaviors and outcomes (e.g. reproductive health and mortality) of children and young adults, very few studies have examined morbidities among older adults in developing countries. This problem becomes more acute in the case of women, who in many cultures believe that suffering is their lot and hence do not report their illnesses (Papanek, 1990). Furthermore, even if there are studies on morbidity, they are more focused on several degenerative diseases associated with the aging process and are primarily based on developed countries. In recent years, several studies/surveys (INDEPTH-WHO SAGE study: see Suzman, 2010; RAND-Longitudinal Aging Study in India) have been underway that are attempting to chart the demographic and epidemiological transitions of low income countries (including India) by measuring

disease/morbidity patterns, disability and socioeconomic conditions of the elderly. Preliminary descriptive findings from one such study on India (Hirve, et al, 2010) indicate elderly women (especially widows) reporting poorer health status and greater disability across all key domains of health. Surprisingly, the study also demonstrated that self-reports on quality of life were not significantly different across SES quintiles. This finding led them to conclude that traditional joint family structures in India have protective effects on elderly, who are most often "considered social if not financial assets for their children" (ibid).

Thus, based on the above discussion which clearly indicates not only empirical inconclusiveness but also reveals the very low priority placed on the provision of health care for the elderly in the demographic and policy debates of developing countries, this chapter analyzes two related questions:

1. Is there a difference in the amount spent on medical expenses based on living arrangements? More specifically, based on the earlier findings of the importance of family to the well-being of the elderly, I hypothesize that the co-resident elderly (when sick) will be likely to spend more on medical treatment than the non-coresident elderly.

2. Second, there is likely to be a household wealth effect that mediates the relationship between co-resident elderly and their higher likelihoods of health spending. That is, wealthier households spend more on medical treatment of the elderly sick, and partly because co-resident elderly live in wealthier households, more is spent on their medical treatment.

Data & Method

Data and Analytic Strategy

Since very few studies have tried to examine living conditions of older adults in multigenerational households, I believe that the universal nature of short term morbidity is a good starting point to test how health care spending of the elderly differ by living arrangements, after controlling for other significant factors. Moreover, expenditure on short term illnesses is important because, if healthcare services are not sought, minor illnesses may become a symptom of something more serious leading to chronic morbidities. Since co-residency is a social convention in India, expenditure on short term morbidity can be taken as an indicator of wellbeing among the elderly (in the absence of institutional care). For the purpose of this analysis I use data from the India Human Development Survey (2004-05), where a series of questions were asked to identify if someone in the household had suffered from any of the three minor illnesses-coughs, fever or diarrhea. The recall period was one month. Data were then collected on the nature of the illness, type of the health provider and expenses on health services. These questions were generally answered by an adult female member in the household; most often that was the spouse of the household head in extended family types.

I use OLS regression to examine the two questions on expenditure on short term morbidity. As mentioned previously in the "Data" chapter of this dissertation, the reference period for short term illnesses (cough, cold, fever and diarrhea) was 30 days. So, respondents were first asked if anyone in the household had fallen ill with any of these illnesses in the last month. For household members who had been sick, further questions were asked about the illness-specific medical costs which include doctors' fees, medical tests, medicine and other associated expenses (e.g. travel and lodging while seeking treatment). In addition there were questions to account for time lost from usual activities, including both outside and domestic work, due to short term morbidity. The IHDS data indicate, on average, the elderly lose 10 days per year in short term illness (Desai, et al, 2010). This number is higher than any other age group (5.5 days per year for working adults and 7 days per year for children) and hence I treat this as a control variable in all my models.

The dependent variable is a logged variable on medical expenditures that includes not only the doctor's fee, but the cost of medication and any travel that was exclusively undertaken for the treatment. On average, respondents reported that they spent 16% of the total expenses as doctors' fees, 76% of the total expenses on medicines and tests and 7% of the total expenses on other treatment related expenses such as travel, lodging and tips. Descriptive statistics of the dependent and all the independent variables are presented in Table 9.1.

[Table 9.1 about here]

Independent Variables and Some Descriptive Statistics

The primary variable of interest is the living arrangement variable which is measured by three distinct groups of elderly: living alone or with spouse (11.4%), with children (83.2%) and with others (5.3%) (Detailed description of this variable has been provided in previous chapters). Table 9.2 presents bivariate results of expenditure on short term morbidity by living arrangement types. It is interesting to find that though in general, the elderly living independently spend more on medical care (Rs. 71) as compared to Rs.42 and Rs.30 for those living with children and others respectively , but when ill, those elderly living with children and others have higher medical expenditures than those living independently. This difference in medical expenses reflects the difference in the sample-all elderly (N=17,883) versus elderly who have been sick (N=1987). Hence for the remainder of the chapter, I will only analyze expenditure per illness since the previous chapters have already focused on overall morbidity. This distinction in samples also ties back to the motivation and purpose of this exercise which is to look more closely at a restricted sample of elderly who have already experienced short term morbidity as opposed to the elderly who are at risk of illness. In the preceding chapters, the focus has been on all elderly who are at risk; narrowing down the focus of analysis on the elderly who have had episodes of short term morbidity and examine how their expenditure patterns differ by living arrangements will further our understanding of family support in elderly care.

[Table 9.2 about here]

More amounts are spent per illness episode on elderly men as compared to elderly women (Figure 9.1) across all the household wealth quintiles. This finding has been consistently substantiated in earlier studies on women's health and health seeking behavior in India (See NCAER, 1992; Madhiwala, et al, 1998; Sen & Sharma, 2006). The gender disparity in medical expenditure however narrows in wealthier households, which highlights the role of wealth in shaping socio-economic behavior (this simple bivariate result is consistent with previous finding on the role of household wealth, from propensity score analyses and multi-level models in the preceding chapters). Specifically, results from the previous chapters demonstrate that there is wealth effect on the likelihood of being sick. The elderly from wealthier households are less likely to fall sick than those in poorer households, even after controlling for selection bias.

Finally, as indicated in the existing literature, marital status, also influence health care expenditure. Figure 9.2 presents the disparity in average health expenditure by marital status and gender stratification. This is consistent with previous studies that have shown women to have poorer access to health care (Mason, 1986; Iyer, 2005; Young, 2006) and subsequently lower health care utilization. Authors have argued that widowed, unmarried and separated women's relatively poor bargaining power within the household have resulted in their lower rates of health care treatment and utilization (ibid). The higher average expenditure on short term morbidity among elderly widows contrary to the usual finding of higher rates of medical expenditure among males, might reflect the fact that morbidity questions were typically answered

by the elderly women in the households. However, to verify whether these observed differences in expenditure patterns hold after controlling for socioeconomic differences, I conduct the multivariate analysis, described in the next section.

[Figures 9.1 & 9.2 about here]

I estimate three models. The first model looks at the total effect of living arrangement on health expenditures, after controlling for key demographic characteristics (age, gender, marital and educational status). The second one is nested and includes an additional indicator of household wealth (research question # 2). The final model (full model) is nested and includes state dummies.

All the regression models include controls of age, gender, marital status, work status, educational attainment, area of residence, pension status, caste and religion dummies. I use dummy variables to identify whether or not the elderly is married. I also control for the respondent's work status operationalized as participation in any work including wage work, work in business, farm work or animal care. The work status control is important for this analysis, as very little is known in the existing literature on the determinants of labor supply of older adults in the developing world. Though there are descriptive accounts and statistics on average hours worked by older adults (Cain 1991; Adlakha & Rudolph, 1994), the literature assessing the relationship between older adult labor supply and living arrangement is very scant. Exceptions include Kochar (1999) who examined in Pakistan and Cameron & Clark (2008) who formally modeled labor supply in old age while taking into account co-residency and transfers from children in Indonesia. I also use three age dummies (age 60-69, age 70-

79 and age 80 & above) as given the literature on living arrangements and financial transfers, it is important to examine if the elderly parent's expenditure on health differs by his/her age, which can act as a proxy for old age economic activity and financial (in)dependence.

I use dummies for the gender (male/female) and marital status (married/widowed or single) variables. As mentioned before, household wealth is measured using a constructed scale of the number of goods owned from a list of 30 items (e.g. television, chair or car). The Cronbach's alpha reliability of the index is 0.88. This index is again rescaled into five approximately equal quintiles. Additional income, like pensions, received by the elderly has been measured by receipt of any government pension including National Old Age Pension (NOAP), disability pension or the widow pension in the last 12 months. I believe these indirect indicators of economic standing/resources will also provide preliminary understanding of any substitutability that may exist between co-residency and wealth for old age security among the elderly in India.

Education is measured by five dummy variables: no education, primary (1-4 years of schooling), high school (5-11 years of schooling), some college (also includes higher secondary schooling) and college graduate. In general, studies on India (Pal, 2004) have shown that level of literacy is an important determinant for co-residency and financial dependence among elderly men but no so much for elderly women. Other than household wealth, cognitive capacities (or education) are important to assess

health care needs. Furthermore, education might interact with gender to influence health care expenditures among the elderly. As mentioned before, elderly women in particular might accept minor illnesses to be “normal” with no expectation of any health care spending for treatment.

Social group membership is measured using caste and religion variables. I distinguish three caste groups-high caste Brahmin (6%), lower castes (66%-including scheduled castes, scheduled tribes and backward castes) and other castes (26%) - and five major religion groups-Hindu (81%), Muslim (11%), Christian (3 %), Sikh (3%) and other religion (2%). Both caste and religion groups are included in the OLS models as dummy variables with high caste Brahmins and Hindus serving as the comparison group for caste and religion dummies respectively. I also control for number of days the respondent was unable to do usual activities due to their illnesses in the last 30 days, as I believe this will serve as a proxy for the severity of the illness which in turn will affect their medical expenditures. Respondents are classified as living in rural (65%) or urban (35%) areas based on the Indian census definition. Finally, 22 state dummies are added in the full model to control for region effects.

OLS Results and Discussion

The OLS regression coefficients on logged medical expenditures for short term morbidity (cough, fever or diarrhea) is presented in Table 9.3

[Table 9.3 about here]

I begin the analysis by examining the total effect of living arrangements on logged medical expenditure (Model 1). As anticipated, the elderly living with children are likely to have higher medical expenditures than those living independently and living with others. In particular, it can be said that expenditure on short term morbidity will be 22% (exp(0.203)=1.22) lower for the elderly living independently than for the elderly living with children, and 10% (exp(0.098)=1.10) lower for the elderly living with others when compared to the elderly living with children.

After incorporating the household wealth control into the model (Model 2), the strength of the living arrangement coefficients is reduced (though still, statistically significant) highlighting the wealth dimension in the living arrangement and health outcome relationship. In particular, elderly in wealthy households are likely to have higher medical expenditures than those who belong to poorer households. This finding persists even when all socio-demographic, economic and region controls are introduced in the final model (Model 3). More specifically, from Model 3 (which includes all socio-demographic controls and state dummies) it can be said that for one quintile increase in the standard of living quintile variable, we expect to see a 23.3% (exp(0.210)=1.2336) increase in the medical expenditure. Thus, the multivariate analyses from the previous chapters and the current analysis drive home the vulnerability of the non-coresident, poor elderly in India-they are more likely to fall sick with minor illnesses and are likely to spend less on medical expenditures.

Elderly females seem to spend less on medical expenditures as compared to elderly males. This is consistent with the previous studies that indicate general neglect of

women's health in patriarchal societies. Though studies on elderly women are rare, but studies focusing on girls and young women have consistently demonstrated that lower levels of health care spending on these groups, reflecting their structurally marginal social status as well as their lack of decision making power (Dasgupta, 1987; Sen 1990; Sen & Sharma, 2006). Also most often men control the cash, making it difficult for women to pay for health care or for transportation costs if facilities are far away. Additionally, these financial constraints are further worsened in contexts where social and cultural prescriptions restrict women's mobility in public spaces without permission (Jejeebhoy, 1995; World Bank, 2005).

Among other controls, education does not seem to have any significant effect on the likelihood of healthcare spending. The coefficients for caste and religion groups are interesting. Surprisingly, elderly from backward castes seem to have comparable health care spending as high caste Brahmins. Again, elderly who belong to Muslim households have lower medical expenditures than any other religious groups. This is consistent with previous studies that show Muslims in India to be disadvantaged in terms of many socioeconomic and health outcomes.

As expected, there is a significant positive association between number of adults in the household and medical expenditures. It is reasonable to assume that higher number of adults in a particular household may lead to higher economic contribution to total household wealth, thereby increasing the proportion of medical spending for the elderly. This finding also makes a case for further assessment of economic

contribution of individual household members to understand the dynamics of intra-household allocation.

Elderly located in urban areas have significantly higher medical expenditures when sick as compared to the rural elderly. This finding indirectly also supports our previous finding from the contextual analysis about the disparities in health outcomes between urban and rural elderly. In other words, it can be argued that in situations where families spend more per illness (e.g. urban areas), the result is less illness.

Finally, as expected, higher number of days lost per illness is associated with higher expenditures on short term morbidity and this result remains consistently and statistically significant across all the models.

Conclusion

Research on health care access and health expenditures for the elderly is rare in the living arrangements literature on developing countries because (1) of the common belief that they are well provided for by their children, with whom overwhelming majority of the elderly reside, and (2) lack of good quality data to examine such questions. The current analysis is a step towards bridging this research gap in the existing literature.

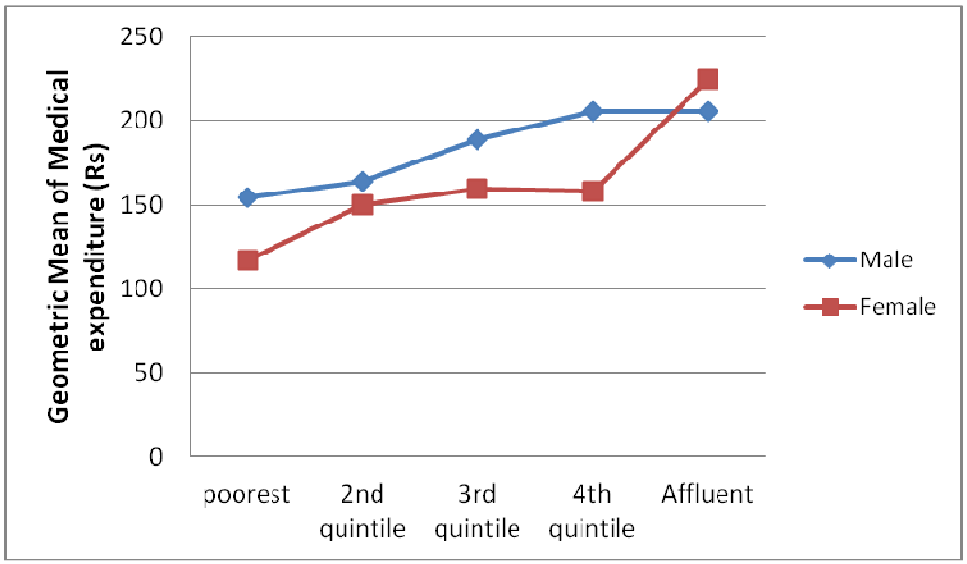
In summary, this analysis indicates that co-resident elderly have higher medical expenditures when sick, supporting the earlier finding that multigenerational family still plays a positive role for older adult health outcomes. This analysis also highlights the importance of household wealth in affecting the above mentioned positive

relationship between co-residence and elderly health outcomes. The results that flow from the current analysis on medical expenditures are remarkably consistent with findings from previous chapters; that is, the same set of household variables that predict better elderly health (wealth, urbanization, adults, gender) also predict higher medical expenditures.

Based on this finding, it is perhaps no surprise why the Indian government has rolled out programs and policies reinforcing the existing family support system (e.g. the previously discussed Maintenance & Welfare of Senior Citizens Act, 2007 of the Government of India). However, these findings also raise concerns for those non-coresident elderly persons who lack both health and wealth. Bivariate analysis (see Table 9.2) and multivariate results from this chapter demonstrate that the non-coresident elderly actually spend *more* per month on medical care (because they are more often sick) out of their lower budgets (given lower household wealth). However the non-coresident elderly get *less* spent on each individual illness leading to a downward cycle of more illness. Thus in absence of extra-familial welfare institutions, there is an urgent need for the state to come forward with alternative social security programs for the elderly. Furthermore, from the future research perspective, surveys focusing on economic contribution of individual household members (i.e. data on income or expected income and self- employment) might be useful to examine intra-household allocation of resources. Specifically, it might be useful to compare expenditures on morbidity of children, adults and elderly in households where the sick elderly are and what affects the adult/elderly differential in

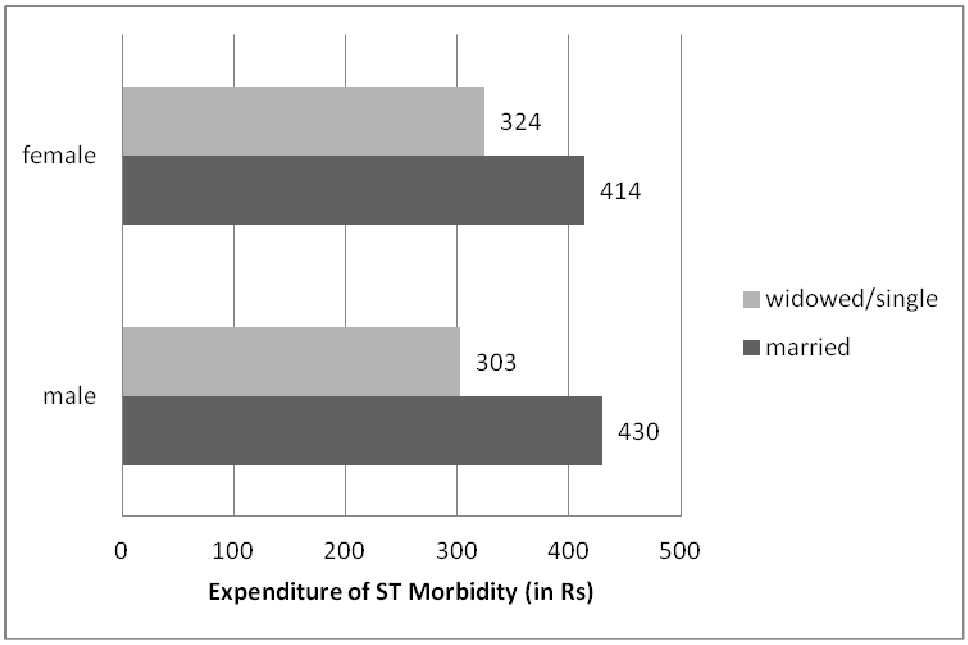
medical expenditures. This can guide future research to not only assess if consumption allocations of the elderly depend on their contributions to household income but can also clarify adult children's motivations underlying the support (e.g. traditional role versus bequest or inheritance motives).

Figure 9.1: Expenditure on medical expenditure by gender and household wealth quintiles (for the elderly who reported sick in the last month)



Source: India Human Development Survey, 2004-05

Figure 9.2: Expenditure on short term morbidity by gender and marital status (for the elderly who reported sick in the last month)



Source: India Human Development Survey, 2004-05

Table 9.1: Descriptive Statistics for Dependent and Independent variables (N=1987)

Dependent variable	Mean	SD	Min	Max
Logged Medical Expenditures	4.68	1.96	0	9.95
Independent Variables				
Living Arrangement Types				
Living independently	0.23	0.42	0	1
Living with children	0.83	0.37	0	1
Living with Others	0.05	0.22	0	1
Age categories				
age 60-69	0.61	0.49	0	1
age 70-79	0.28	0.45	0	1
age 80-89	0.10	0.30	0	1
Female	0.56	0.50	0	1
No. of adults in the household	3.26	1.69	1	18
No. of days unable to do usual activities	6.44	7.02	0	30
Married	0.59	0.49	0	1
Education categories				
No education	0.30	0.46	0	1
Primary	0.07	0.26	0	1
High School	0.40	0.49	0	1
College degree	0.09	0.29	0	1
Graduate	0.12	0.32	0	1
Caste categories				
High caste Brahmin	0.07	0.26	0	1
lowcaste (SC, ST, OBC)	0.68	0.47	0	1
Other castes	0.26	0.44	0	1
Religion categories				
Hindu	0.82	0.39	0	1
Muslim	0.09	0.29	0	1
Christian	0.03	0.18	0	1
Sikh	0.03	0.17	0	1
Other religion	0.01	0.12	0	1
Urban	0.21	0.41	0	1
Standard of Living Quintiles	2.81	1.41	1	5
Respondent works	0.44	0.50	0	1
Respodent recieves	0.12	0.32	0	1

pension	
state dummies	*not shown*

Source: India Human Development Survey, 2004-05

Table 9.2: Expenditure (in Rupees) on Short Term Morbidity by Living Arrangement Types

	mean expenditure (in Rupees) by **all** elderly (N=17,883)	mean expenditure (in Rupees) by elderly **reported sick** (N=1987)
Living independently	71	293
with children	42	426
with others	30	245

Source*: India Human Development Survey, 2004-05*

Table 9.3: OLS Regression models on logged medical expenditure for short term morbidity among the aged in India

	Model 1	Model 2 (Model 1 + household wealth variable added)	Model 3 (full model)
Living alone *(ref: living with children)*	-0.203	-0.167	-0.178
	(0.13)	(0.13)	(0.13)
Living with others	-0.098	-0.092	-0.190
	(0.13)	(0.19)	(0.19)
age 70-79 *(ref: age 60-69)*	0.136	0.111	0.096
	(0.10)	(0.10)	(0.10)
age 80-89	0.097	0.033	-0.090
	(0.15)	(0.16)	(0.15)
Female *(=1, if yes*)	-0.133	-0.158	-0.185*
	(0.15)	(0.15)	(0.15)
# of Adults in the household	0.081*	0.067*	0.073*
	(0.03)	(0.03)	(0.03)
married (*ref: widow/single)*	0.139	0.145	0.175
	(0.10)	(0.10)	(0.10)
No education *(ref: primary education)*	0.103	0.183	0.160
	(0.16)	(0.17)	(0.16)
High school (5-11 years)	0.261	0.109	0.041
	(0.16)	(0.17)	(0.16)
College (includes high secondary)	0.249	-0.031	-0.105
	(0.21)	(0.21)	(0.21)
Graduate degree	0.515*	0.162	0.188
	(0.21)	(0.22)	(0.21)
SC, ST, OBC *(ref: High caste Brahmin)*	0.075	0.195	0.184
	(0.18)	(0.18)	(0.18)
Other castes	0.156	0.159	0.216
	(0.19)	(0.19)	(0.19)
Muslim *(ref: Hindu)*	-0.066	-0.058	-0.079
	(0.15)	(0.15)	(0.15)
Christian	0.205	0.036	0.054
	(0.25)	(0.25)	(0.26)
Sikh	0.165	-0.052	0.589
	(0.22)	(0.22)	(0.33)
Other religion	-0.875*	-0.830*	-0.594*
	(0.36)	(0.36)	(0.35)

Urban	-0.264*	-0.448***	-0.240*
	(0.11)	(0.12)	(0.12)
No. of days unable to do usual activities	0.085***	0.087***	0.083***
	(0.01)	(0.01)	(0.01)
Household wealth (quintiles)		0.215***	0.210***
		(0.05)	(0.05)
Respondent works *(=1 if yes)*		-0.101	-0.141
		(0.10)	(0.10)
Receives pension *(=1, if yes)*		0.020	-0.068
		(0.14)	(0.14)
state dummies			*not shown*
_cons	3.622***	3.180***	3.289***
	(0.27)	(0.30)	(0.31)
Degrees of Freedom	19	22	43
R^2	0.128	0.140	0.222
N	1940	1940	1940

Note: **p<0.05, **p<0.01, ***p<0.001; Standard errors in parentheses.*

Source: *India Human Development Survey, 2004-05*

CHAPTER 10: CONCLUSION

Overview of the Dissertation

I began this dissertation by highlighting the changing demographic profile of the world population. The world population is graying. While the populations of more developed countries have been aging for well over a century, this process began recently in the less developed world and it is being compressed into a few decades. By 2050, nearly 1.2 billion of the expected 1.5 billion people aged 65 or older will reside in today's less developed regions (UN, 2002). While population aging may be seen as a human success story-the triumph of public health, medical advancements and economic developments over diseases and epidemics that had limited human life expectancy for millennia (Kinsella & Phillips,2005), the same aging process is also perceived as a "problem" in many developing nations. While the population is graying rapidly, poorly developed social security systems and inadequate formal systems of care are still the mainstay in most developing countries. Additionally, modernization-urbanization, migration and growth of secular education-have not only led to breakdown of multigenerational families but have also lowered the prestige of the aged and have reduced their control over resources (The World Bank, 1994).

These developments have led to concerns surrounding the importance of household structure in influencing elderly health care. Hence a concerted focus on household

structure (conceptualized here in terms of living arrangements) has been the central theme running through all the chapters in this dissertation. In the process, this dissertation has not only reviewed mounting evidence on coresidence leading to better health outcomes among the elderly in other developing countries but has specifically addressed several overarching questions and related dimensions of household structure, intergenerational relationships and health. More generally, some of the questions that this dissertation answers are: How does the health of the elderly differ by household structure (or living arrangements)? Are extended families still important in providing economic and instrumental support for the elderly? If so, what are the micro (individual and household characteristics) and macro (urbanization and institutional support) level factors that influence the relationship between household structure and elderly wellbeing? Given the recent socioeconomic changes, whether the elderly *really* benefit from being part of the extended family settings?

A quick review of the plan of this dissertation is provided to understand how I approached the issue and the steps involved in answering the above mentioned questions. After describing the background (Chapter 2) and reviewing the existing literature (Chapter 3), this dissertation outlined the conceptual framework and the analytical strategy (Chapter 4). The relevance of using the India Human Development Survey (IHDS 2004-05) dataset has been discussed to examine the hypotheses that motivated this dissertation project. Methodological issues such as endogeneity and selection bias have been considered and ways how this dissertation has addressed those issues have also been outlined. In Chapter 5, this dissertation conducted an

exploratory exercise in which it analyzed descriptive statistics and bivariate associations for most of the determinants relating to household structure and health. The goal of Chapter 5 was twofold; first to identify important relationships which would sharpen the hypotheses, and second, to set the stage for a multivariate analyses.

In Chapter 6, after describing the dependent, independent and control variables, several sets of logistic regression models have been estimated to study the relationship between living arrangement and health of the elderly. This chapter also discussed the methodological challenges in using a logistic regression analyses to examine the aforementioned association. In other words, Chapter 6 discussed the motivation for adopting a more advanced statistical technique (i.e. propensity score analysis) to resolve the issue of endogeneity and selection bias. In the earlier sections of Chapter 7, this dissertation explained the rationale behind using the propensity score methods and elucidated the different specifications of this technique. Summary of results following from each of the propensity score methods were discussed in the later sections of Chapter 7.

Chapter 8 presented results from multilevel models using hierarchical linear modeling. Drawing from the theoretical and empirical literature on the role of context in affecting health behaviors, the goal of this chapter was to examine the distinctive roles of compositional as well as contextual factors in influencing the living arrangement-health link. Finally, in Chapter 9, a multivariate analysis of how expenditure on medical care for the sick elderly differs by living arrangement has

been examined. By limiting the sample to only the sick elderly, this chapter teases out the different household level dynamics that influence the expenditure-health outcome link.

The contribution of this dissertation is both empirical and methodological. It not only extends current knowledge on aging and health in developing countries but also introduces a unique methodological technique which has remained unexploited in the study of aging and demographic behavior.

From a policy perspective, the contribution of this dissertation is important as it has addressed questions surrounding intergenerational relationships and has examined interactions of the role of families and health outcomes of the elderly simultaneously. By doing so, this dissertation has emphasized the need to recognize that policies on aging must address families, society and people of all ages and that aging needs to be integrated into the broader process of development.

Summary of results

From the bivariate analyses it was clear that the elderly living alone or just with their spouses have higher prevalence rates for short term morbidity. Many other factors were also related to health. Some of the notable ones were marital status and household wealth. Marriage was shown to have beneficial association with the health

of the elderly in all living arrangement types. Additionally, there was evidence from the bivariate analyses that co-resident family arrangements (that is living with either children or others) were also typically wealthier than the non-coresident family types (that is, where the elderly either lived alone or with their spouses). This finding was particularly suggestive of the fact why the elderly fared better in terms of health in households where they lived with children or other adult family members. A few other measures of household wealth (here, household amenities such as clean fuel and modern sanitation facilities) were also shown to be positively associated with lower morbidity rates among the elderly.

In the multivariate logistic regression models, the link between living arrangement and health was examined net of other covariates. The most substantive and consistent finding from all the logistic regression models is that living with children (as opposed to living alone or with their spouses) have protective effects on the health of the elderly persons. This finding is consistent with previous studies on living arrangement and health in other developing countries. As suggested in the bivariate analyses, results from the multivariate models demonstrated that health of the elderly is also dependent on host of factors such as urban residence, age, education and gender.

Household wealth control (measured by a standard of living index) emerged as a crucial factor influencing the living arrangement-health link. This accords with the earlier observation from bivariate analyses that suggested that part of the reason why the elderly living with children and others were better off in terms of health as

compared to their living independently counterparts, was that these elderly also happen to live in households that are wealthier. However contrary to expectations, additional household wealth characteristics (except flush toilet) were not significant factors influencing the living arrangement-health link. Finally, a closer examination of elderly men and women revealed that there is a gender difference in morbidity rates; elderly women are more often sick, holding constant other characteristics. However living arrangements affect the health of both elderly men and women in similar ways, that is both elderly men and women are the most vulnerable when they are living independently. With the growing number of elderly living independently owing to urbanization, migration and changing cultural scripts surrounding extended family living, this finding merits further attention.

Results from the multivariate propensity score analyses further confirm the robustness of these findings. Specifically, results from all the propensity score methods support all of the substantive findings from the logistic regression analyses, suggesting that the results of this dissertation holds even after adjusting for endogeneity/selection bias. The “coresident advantage” and “urban advantage” remain fairly consistent across all models. Specifically from the propensity score stratification, matching and weightings methods, it is clear that on average the odds of being ill for the elderly living with children is decreased substantially (more than 50 per cent) when compared to the elderly who are either living on their own or with their spouses.

Additionally, since the propensity score methods are based on the assumption of unconfoundedness or ignorability (detailed discussion in the Appendix) these methods also facilitate estimation of causal effects in terms of average treatment effect (ATE) and treatment effects of the treated (ATT). The ATT and ATE estimation in all the methods further suggest the significant difference in morbidity rates among the elderly by living arrangement status, highlighting the importance of extended/multigenerational families to the wellbeing of the elderly. This is another unique contribution of this dissertation to the field of demography of aging in developing countries where most studies are based on cross-sectional, observational data owing to a lacuna of longitudinal research design and datasets in such countries. Hence estimation of causal effects from observation data becomes a critical methodological step in health research in these countries. This dissertation is a step towards that direction.

The multilevel analyses of this dissertation support previous studies on rural-urban differences in socio-demographic outcomes in India. Additionally, the multilevel analyses corroborated the "urban advantage" finding that was observed consistently across all multivariate models in this dissertation. In particular, the multilevel analysis demonstrates how higher levels of urbanization and higher proportion of elderly within a community are important factors in influencing the household structure and elderly health outcome relationship. On the other hand, the effect of household wealth in influencing this relationship cannot be downplayed. These results have important indirect implications for development policy in a country that is experiencing a

growing bulge in the older age groups (policy implications are discussed in the next section). In conclusion, it can be said that likelihood for being sick among elderly is affected not only by compositional factors but is also influenced by the larger context created by urbanization.

Finally, in order to extend existing knowledge on health care and health expenditures research in developing countries, this dissertation closely examined expenditure patterns on health care for the elderly who have reported themselves sick in the past one month. Results from the OLS regression analyses revealed that when sick, coresident families have higher medical expenditures when the elderly get sick as compared to the household where the elderly live on their own or just with their spouses. Consistent with the previous finding of the role of household wealth, results from the expenditure models suggested that household wealth does play an important conditioning role in the living arrangement-health expenditure link.

Policy Implications and Recommendations

The inexorable momentum of population aging in the developing world is one of the most significant demographic processes of the current century. This continuing shifts in population age structure calls for new social sensitivities and innovative policy responses in part of the policy makers in such countries (Kinsella & Phillips, 2005). Results from this dissertation supports previous research on developing countries and confirm that family systems and intergenerational ties are crucial for the well-being of

the elderly in settings where institutional support is largely inadequate. These findings corroborate the concern over potential erosion of multigenerational family systems and make a powerful case for policy interventions.

But these findings do not necessarily mean mandating blanket legislation on parental responsibility (e.g. *Maintenance Act, 2007* described earlier). Instead, more research on elderly is warranted to suggest effective policies that support co-operative efforts between the family, community and the State. For example, what is it about urban areas that lead to better health for the elderly?

In this connection, the suggestions provided by the World Bank report (1994) are particularly useful. This report recommends policies that extend the lives of the informal systems of care in countries such as India, where formal systems of care (1) cannot be achieved overnight and (2) when implemented may have limited capabilities to do the full job given the cultural norms/constraints surrounding caregiving. The report suggests that the most obvious way to bolster family based care is to avoid policy biases against traditional agriculture (such as protective tariffs and electricity that typically favor the industrial & service sectors), in which family pooling of risk and resources works best (p 68).

Findings from this dissertation clearly indicate that extended families facilitate healthy aging among the elderly and one possible explanation for this could be that such families are capable of pooling work, risk and economic resources better as

compared to households where the elderly live on their own. Hence, in a predominantly rural country like India, avoiding policy biases against agriculture will help in preserving long term residential stability that underpin the family support system.

Contrary to expectations, results from this dissertation also demonstrated that there are no significant gender differences in the way how living arrangements affect the health of both elderly men and women. Both elderly men and women who are living independently (that is either living alone or just with their spouses) are equally disadvantaged in terms of both health and household wealth when compared to their co-resident counterparts. Hence encouraging the elderly persons living alone (owing to their single status or loss of spouse) to remarry or live together outside marriage could be alternative options to ensure care and economic support. Despite strong and pervasive cultural norms, China apparently has had favorable experience with these policies (ibid). Hence it is likely that such policies will hold promise for India as well.

Finally, based on the substantive finding of this dissertation that highlights the fact that families provide a safety net that compensates for the limitations of the public support system, it can argued that the general principle in establishing government supported formal systems of care should be to complement and not totally substitute family based sources of support. To accomplish this, reviewing cross-national policy histories and learning lessons from other countries can be a useful starting point. For instance, Singapore gives preferred housing assignments to families that are willing to

take care of an older parent/relative; community clinics and outpatient health facilities for older people are available in Angola, Hong Kong and Thailand; in Malaysia, a small stipend goes to adult children who live with their parents (Kendig, Hashimoto & Coppard, 1992; Treas & Cohen, 2006). Though HelpAge India (an NGO that works for elderly rights) has worked with several state governments to implement some of these initiatives locally, a concerted effort to carry out these policies on national scale is warranted to prepare the Indian society of the impending socioeconomic transformations.

Furthermore, most health outcomes research on India is based on different waves of cross-sectional data such as the IHDS, National Family Health survey (NFHS) and National Sample Survey Organization (NSSO). Given the difficulty of basing policy decisions on the analysis of cross-sectional data, a strategy of employing variety of methods with careful assessment of the conceptual frameworks underlying each method, may lead to optimal solutions. For example, the propensity score stratification analyses in this dissertation estimated that for those elderly who have the least likelihood to co-reside with children, living with children will have a significant reduction in their morbidity levels (See Chapter 7; estimation of average causal effects). Though it may be ethically and economically unfeasible to promote coresidency among this group of elderly persons, a targeted intervention to increase support (medical and economic) among this group of elderly who are currently least likely to receive family care may substantially improve their outcomes. The results from this dissertation provide a compelling case to take first steps in approaching that

goal. If the basic results of this study hold across future studies employing other analytical strategies with newer or better data, that will confirm the robustness of the methodological conclusions and policy recommendations that follow from this study.

Results from the multilevel HLM analyses have important policy implications as well. In particular, it can be argued that access to better health care services (chances of which can be increased either by living in areas that have urban facilities or/and having higher household wealth) emerge as effective strategy to reduce disease burdens among elderly irrespective of their living arrangement status. This also makes a case for increasing the pension amount to help the elderly (especially, the poor elderly) to adjust to the many transformations that are underway in household/family structures.

Finally, the results from the analysis of expenditure on short term morbidity for the elderly also highlight the need to prioritize payments on minor illnesses in health-policy debates in the country. It is perhaps no mystery in understanding that expenses on repeated short term illnesses can lead to impoverishment and this can be especially problematic for poorer households (typically, these are also the households where the elderly live independently) who are less able to cope with any given level of health expenditure than richer households. Prepayment mechanisms, such as health insurance for the elderly can be helpful to reduce the financial burden on the elderly as well as for other family caregivers. Also targeting social assistance programs to people without adequate income or without family members capable of supporting

them will be a meaningful step in this direction. In this connection, an innovative program in the Indian state of Kerala is particularly noteworthy. The Kerala government provides means-tested pension scheme for poor agricultural workers. Further the pension is also credited with enabling relatives to take care of the elderly by subsidizing the cost of home care and thereby encouraging family based care. Similar innovative programs that complement traditional informal support need to be designed as given limited taxing and administrative capacities in developing countries such as India, ambitious formal programs might not be successful (World Bank, 1994).

Limitations of the current study

Certain limitations of the analysis merit attention. First, as indicated in the Data and Methods chapter, the responses to the morbidity questions were not always self-reported. The dataset did not have questions to evaluate subjective wellbeing, which might have been a more powerful measure for this analysis as the problem of endogeneity could have been reduced further. Although physically weaker older persons may have needs that lead to living arrangements, it is not immediately clear if individual happiness drives differences in living arrangements (Chen & Short, 2008).

Second, this dissertation uses a relatively unconventional technique (propensity score methods) to study the association between living arrangements and health. It has been

well established that unlike traditional multivariate models the propensity score methods is a powerful tool to control for confounding thus making it an attractive technique in health research. However it is important to point out that, even though propensity score methods (either by stratifying or matching) can balance observed covariates between control and treatment groups, they cannot balance unmeasured characteristics and confounders (Shadish, et al. 2002; Wolfgang & Kurth, 2004; Guo & Fraser, 2010). Hence, as with all cross-sectional observational studies and unlike randomized controlled trails, the propensity score analyses may still have the limitation that some remaining unmeasured confounding may be present.

A related concern is about using cross-sectional data that provides information at only one point in time. Since aging is a dynamic process longitudinal data (even if only in the form of limited panels) would have been useful to study processes related to aging. It would have also provided a framework to assess the direction of causality or in other words, to determine if wellbeing is endogenous. Since patterns of living arrangements across age and marital status may capture lifecycle stages and differences across age-cohorts, results from the multivariate analyses using these controls should be interpreted with caution (Yount, 2009).

Finally, the variables used to measure context (i.e. percentage urban and proportion of elderly in a district) are conservative. Accordingly, the contextual effects of urbanization and proportion of elderly demonstrated in the HLM analysis have probably underestimated the role of context in influencing the living arrangement and

health relationship. Nevertheless, the results shed light on the interaction between compositional and contextual factors in influencing the relationship between living arrangements and health.

Future Research

The literature on living arrangements in developing countries suffers from a lack of longitudinal data. Most demographic studies on this topic suggest collecting and employing longitudinal data as that can greatly influence the quality of the research. Palloni (2002) contends that the reason to plea for greater availability of longitudinal data is "an enhanced ability to assess the influence, however transient, of changes in individual or social conditions on co-residential arrangements" (p: 50). In this connection, the author particularly uses the health-living arrangement association to explain the importance of longitudinal datasets. He argues that with longitudinal datasets, it will be possible to estimate multistate hazard models which in turn will shed light on the plasticity of living arrangements. It will help us to understand under what conditions associated with individual characteristics and their social context co-residence occurs, and under which ones co-residence is less likely to materialize. Finally longitudinal datasets can also support projection of future living arrangements as a function of the health status of the elderly (ibid).

Though the current dissertation has drawn data from a cross sectional survey, for future comparative analyses of changes over time of elderly levels of wellbeing according to living arrangements, there will be several datasets available. Conceptually comparable and internationally harmonized survey instruments/datasets such as the Longitudinal Study of Aging in India (LASI) led by Harvard School of Public Health and the RAND Corporation and the World Health Organization study on global ageing and adult health (SAGE-INDEPTH) will facilitate measurement of health -and its determinants and consequences-over later portions of life cycle. In view of these future research possibilities, the current dissertation has provided a solid foundation for panel analyses for changes in health outcomes as well as living arrangements.

Furthermore, a related line of analysis that could be considered in future research agenda is incorporating spatial demographic techniques in aging research. Among other developing countries, India offers a particularly interesting context to perform spatial demographic analysis, given its tremendous socio-demographic heterogeneity including regions at very different stages of demographic transition in terms of population growth, fertility and mortality. Though there has been a fair amount of literature focusing on spatial differences in fertility, mortality and sex-ratio no study on India has used spatial data (obtained from maps and Geographical Information Systems (GIS) readings) to examine the implications of spatial autocorrelation for health behavior and health outcomes of the aged. Spatial demography is a relatively new endeavor which can significantly advance this field of research.

Another useful extension of this current work would be to focus on the role of the spouse (usually the wife) in providing informal support and hence influencing health outcomes among the elderly in the developing countries. Given the increasing joint survivorship at older ages coupled with the growing popularity of nuclear families and inadequate formal systems of care in these countries, the role of the spouse as the primary informal caregiver is perhaps instrumental for the elderly who are living only with their spouses. An examination of socioeconomic (especially health) outcomes of the single or widowed elderly living alone versus the elderly living only with their spouses can be useful. The small number of cases for these aforementioned groups in the current data set limited such an analysis, but may be conducted for other developing countries such as China. It can be expected that the interplay of marital status and living arrangement status might affect older men and women differently, as it is well established in existing literature that older widowed men often have poorer mental health outcomes owing to their lack of social support network while older widowed women often experience significant declines in their living standards owing to the loss of their spouses. Again, methodologically, these examinations make a good case for the need to longitudinal data as part of future research agenda on aging in developing countries.

Finally, demographic aging has implications for a wide range of human behavior and researchers increasingly recognize the need for multidisciplinary approaches to study the aging process. The next steps thus lie in understanding the aging phenomenon

from a multidisciplinary perspective which involves further integration of scientific inquiry, combining ideas and methods from biodemography, genomics, psychology and economics.

APPENDIX A: Propensity Score Analysis-Assumptions and Causal Effect Estimation

ATT and ATE: Concepts and Estimation

Formally, *Average Treatment Effect* or average causal effect (ATE):

$E(Y_1 \mid D = 1) - E(Y_0 \mid D = 0)$

Formally, the *Average treatment effect for the treated* (ATT) can be expressed as: $E[(Y_1 - Y_0) \mid X, D = 1]$. Authors (Heckman, 1992; 2005) have argued that the treatment effect of the treated is of substantive interest especially for policy research. The goal of research based on the counterfactual framework, is not whether on average the treatment is beneficial for all individuals but whether it is beneficial for those individuals who are assigned or would assign themselves to the treatment.

Assumptions of PSM

The propensity score analysis is based to two assumptions as described by Rosenbaum and Rubin (1983):

Assumption 1: balancing of observed covariates given the propensity score

$$D \perp X \mid p(X)$$

Assumption 2: Unconfoundedness given the propensity score. That is, if the assignment to treatment is unconfounded;

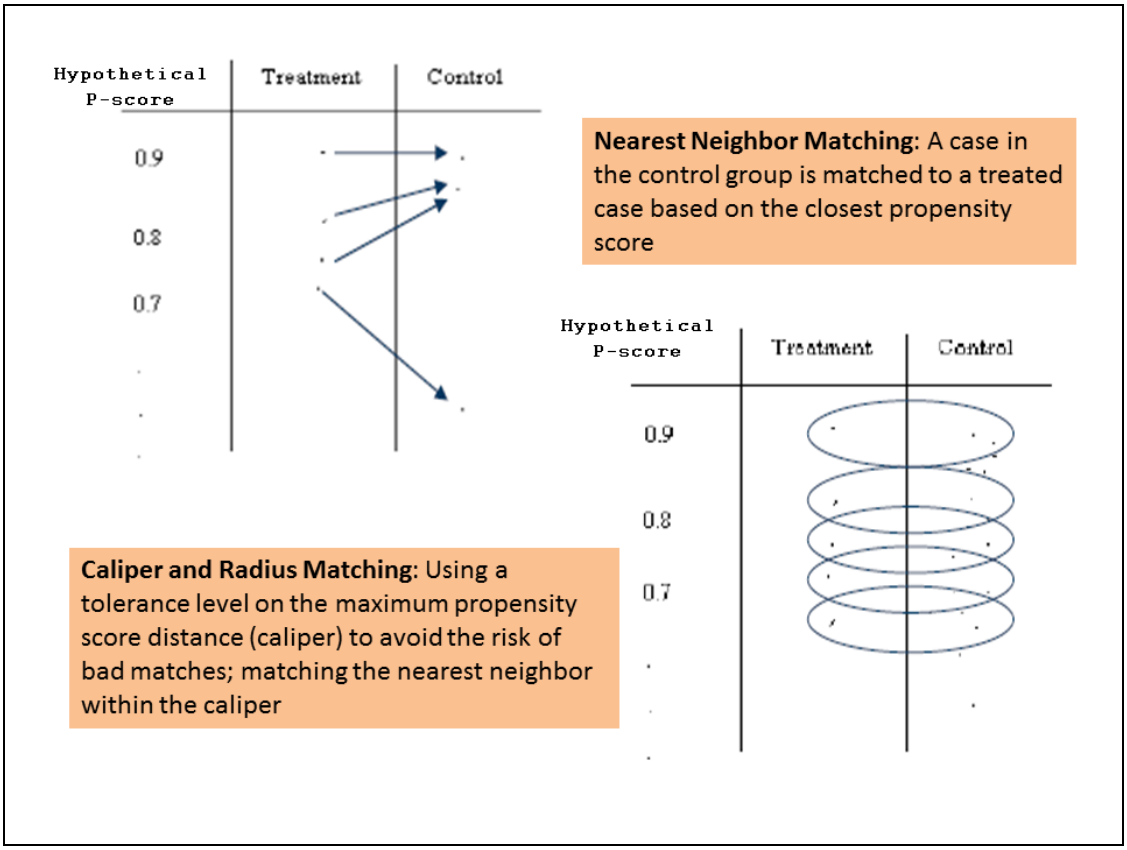
$$Y_1 Y_0 \perp D \mid X$$

Then assignment to treatment is also uncounfounded given the propensity score

$$Y_1 Y_0 \perp D \mid p(X)$$

Assumption 2 implies that, if the balancing property is satisfied, observations with the same propensity score must have the same distributions of observable (and unobservable) characteristics independently of treatment status. In other words, for a given propensity score, exposure to treatment is random and therefore treatment and control groups should on an average be observationally identical (Becker & Ichino, 2002). Assumption 2 is the fundamental assumption of the propensity score and it is also known by different names in the literature, such as “ignorable treatment assignment”, “conditional independence” and “exogeneity”.

APPENDIX B: Illustrative Summary Of Matching Methods Used In Chapter 7



Source: Adapted from Chen, V.W & K. Zeiser. 2008. *Implementing Propensity Score Matching Causal Analysis with Stata***,** Population Research Institute, Penn State University

APPENDIX C: Exhibit Of Stata ***Psmatch2*** Syntax And Output

Running Greedy Matching And Mahalanobis Metric Distance

```
//Estimating propensity score
pscore livalone female agecat2 agecat3 married illiterate///
    primary college graduate lowcaste other muslim ///
    christian sikh religother urban dwork pension ///
    stdliving st1 st2 st3 st4 st5 st6 st8 st9 st10 st11 ///
    st12 st13 st14 st15 st16 st17 st18 st19 st20 st21 ///
    st22, pscore(mypscore) blockid(myblock) logit ///
    level(0.001) numblo(5)
predict p1

summarize mypscore

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
    mypscore |     17883    .8859252    .1400083   .1481883   .9994769


drop if p1==.
gen logit1=log((1-p1)/p1)

. summarize logit1

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
      logit1 |     17883    -2.71455    1.388694  -7.555347   1.748881


SCHEME 1: NEAREST NEIGHBOR WITHIN CALIPER (.25 *SD)
generate x=uniform()
sort x
psmatch2 livchild, pscore(logit1) caliper (2.4680665) noreplacement
descending
sort _id

. g match=unipersonid_n[_n1]
(15940 missing values generated)

. g treat=unipersonid_n if _nn==1
(15940 missing values generated)

keep if _weight==1
(14018 observations deleted)


. Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
       match |      1943    2.07e+10    9.78e+09   1.03e+09   3.40e+10
```

```
       treat |      1943    2.04e+10    9.68e+09   1.12e+09   3.40e+10

list match treat in 1944/1953

      +---------------------+
      |    match      treat |
      |---------------------|
1944. | 3.32e+10   3.31e+10 |
1945. | 3.32e+10   3.33e+10 |
1946. | 3.31e+10   3.33e+10 |
1947. | 3.21e+10   3.33e+10 |
1948. | 2.41e+10   3.31e+10 |
      |---------------------|
1949. | 3.31e+10   3.31e+10 |
1950. | 3.21e+10   3.32e+10 |
1951. | 3.21e+10   3.31e+10 |
1952. | 3.31e+10   3.40e+10 |
1953. | 3.32e+10   3.31e+10 |
      +---------------------+
```

SCHEME 2: Nearest neighbor within caliper .1

```
use "C:\PSMunique.dta", clear
generate x=uniform()
sort x
psmatch2 livchild, pscore(logit1) caliper (.1) noreplacement descending
sort _id
g match=unipersonid_n[_n1]
g treat=unipersonid_n if _nn==1
keep if _weight==1
sum treat match
```

(output)

```
sum treat match

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
       treat |      1942    2.05e+10    9.96e+09   1.02e+09   3.40e+10
       match |      1942    2.07e+10    9.78e+09   1.03e+09   3.40e+10

. list match treat in 1944/1953
      +---------------------+
      |    match      treat |
      |---------------------|
1944. | 3.32e+10   3.33e+10 |
1945. | 3.21e+10   3.33e+10 |
1946. | 2.41e+10   3.31e+10 |
1947. | 3.31e+10   3.31e+10 |
1948. | 3.21e+10   3.32e+10 |
      |---------------------|
1949. | 3.21e+10   3.31e+10 |
1950. | 3.31e+10   3.40e+10 |
1951. | 3.32e+10   3.31e+10 |
```

```
1952. | 3.31e+10   1.01e+10 |
1953. | 3.31e+10   3.40e+10 |
      +---------------------+
```

SCHEME 3: Mahalanobis without propensity score

```
use "C:\ PSMunique.dta", clear
set seed 1000
generate x=uniform()
sort x
psmatch2 livchild, mahal(female married agecat2 agecat3 illiterate ///
         primary college graduate lowcaste other muslim Christian ///
         sikh religother urban dwork pension stdliving ///
         st1 st2 st3 st4 st5 st6 st8 st9 st10 st11 st12 ///
         st13 st14 st15 st16 st17 st18 st19 st20 st21 st22)
sort _id
generate match=unipersonid_n[_n1]
generate treat=unipersonid_n if _n1 !=.
keep if _weight==1
sum treat match
list match treat in 1944/1953
```

(output)

```
. sum treat match

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
       treat |     15843    1.87e+10    1.02e+10   1.02e+09   3.40e+10
       match |     15843    1.87e+10    1.02e+10   1.03e+09   3.40e+10

.list match treat in 1944/1953

      +---------------------+
      |    match      treat |
      |---------------------|
1944. | 9.48e+09   9.33e+09 |
1945. | 2.82e+10   2.81e+10 |
1946. | 2.42e+10   2.41e+10 |
1947. | 3.31e+10   3.32e+10 |
1948. | 2.92e+10   2.92e+10 |
      |---------------------|
1949. | 1.03e+10   1.03e+10 |
1950. | 2.42e+10   2.41e+10 |
1951. | 8.12e+09   8.09e+09 |
1952. | 2.11e+10   2.10e+10 |
1953. | 3.09e+09   3.02e+09 |
      +---------------------+
```

SCHEME 4: Mahalanobis with propensity score

```
use "C:\UMD coursework\Dissertation stuff\PSM\PSMunique.dta", clear
set seed 1000
generate x=uniform()
sort x
psmatch2 livchild, mahal(female agecat2 agecat3  married illiterate ///
```

```
         primary college graduate lowcaste other muslim Christian ///
         sikh religother urban dwork pension stdliving st1 st2 st3 ///
         st4 st5 st6 st8 st9 st10 st11 st12 st13 st14 st15 st16 ///
         st17 st18 st19 st20 st21 st22) pscore(logit1)
sort _id
generate match=unipersonid_n[_n1]
generate treat=idhh if _n1 !=.
keep if _weight==1
sum treat match
list match treat in 1944/1953
```

(output)

```
. sum treat match

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
       treat |     15843    1.87e+08    1.02e+08   1.02e+07   3.40e+08
       match |     15843    1.87e+10    1.02e+10   1.03e+09   3.40e+10


. list match treat in 1944/1953

      +----------------------+
      |    match      treat |
      |----------------------|
1944. | 1.13e+09   1.13e+07 |
1945. | 9.15e+09   9.15e+07 |
1946. | 2.92e+10   2.92e+08 |
1947. | 2.31e+10   2.34e+08 |
1948. | 8.15e+09   9.07e+07 |
      |----------------------|
1949. | 2.01e+09   2.04e+07 |
1950. | 8.15e+09   8.10e+07 |
1951. | 2.93e+10   2.92e+08 |
1952. | 9.68e+09   9.02e+07 |
1953. | 2.71e+10   2.73e+08 |
   +-------------------+
```

Bibliography

Adlakha A and D. Rudolph .1994. "Aging Trends: Indonesia", *Journal of Cross Cultural Gerontology* 9: 99-108

Agarwal, Bina. 1998. "Widows versus Daughters or Widows as Daughters? Property, land and Economic Security in Rural India", *Modern Asian Studies*, Vol 32, No. 1

Anh, S T. et al. 1997. "Living arrangements, patrilineality and sources of support among elderly Vietnamese", *Asia Pacific Population Journal*, 12 (4).

Antonucci, Toni C. 1990. "Social supports and social relationships", in *Handbook of Aging and the Social Sciences*. 3rd ed. Binstock & George (eds). (205-206). New York. Academic Press Inc.

Balarajan, Y, S Selvaraj & SV Subramanian. 2011. "India: Towards universal health coverage 4- Health care and equity in India", *The Lancet*, Volume 377 (February 5).

Barth, RP, C. Gibbons and S Guo.2006 "Substance Abuse Treatment and the Recurrence of maltreatment among Caregivers with children living at home: A Propensity Score Analysis", *Journal of Substance Abuse Treatment*, (30): 93-104

Basu, Alaka M & Sajeda Amin. 2000. "Conditioning factors for fertility decline in Bengal: History, language identity and openness to innovations", *Population and Development Review*, 26(4): 761-794

Becker, Gary. 1981. *A Treatise On The Family*. Cambridge, MA: Harvard University Press.

Becker, S O & A. Ichino. 2002. "Estimation of Average Treatment Effects Based on Propensity Scores", *The STATA Journal*, 2, Number 4: 358-377.

Bengtson, V and Robert E.L Roberts. 1991. "Intergenerational Solidarity in Aging Families: An Example of Formal Theory Construction", *Journal of Marriage & Family*, Vol 53, No. 4.

Bengtson, V, R. Giarrusso, Beth Mabry, Merril Silverstein. 2002. "Solidarity, Conflict and Ambivalence: Complementary or Competing Perspectives on Intergenerational Relationship", *Journal of Marriage & Family*, Vol 64, No. 3.

Berkman, Lisa, Thomas Glass and Teresa Seeman. 2000. "From social integration to health: Durkheim in the new millennium", *Social Science and Medicine*, Vol. 51, No. 6: 843-857.

Berkner, Lutz. K. 1972. “The stem family and the developmental cycle of the peasant household: An eighteenth century Austrian example”, *American History Review* 77 (April): 398-418

Bernheim, B Douglas, A Schleifer & L Summers. 1985. “The strategic bequest motive”, *Journal of Political Economy*, Vol 93, No. 6: 1045-76.

Bianchi, S, V Joseph Hotz, Kathleen McGarry and Judith Seltzer. 2008. “Intergenerational Ties : Theories, Trends and Challenges”, in A. Booth, N Crouter, S. Bianchi & J Sceltzer (eds) *Intergenerational Caregiving*. Washington DC: Urban Institute Press.

Bloom, S.S, D. Wypij and M. Das Gupta. 2001. “Dimensions of women’s autonomy and the influence on maternal health care utilization in a northern Indian city”, *Demography*, 38(1): 67-78

Bongaarts, John and Z. Zimmer. 2002. “Living arrangements of older adults in the developing world: an analysis of demographic and health survey household surveys”, Journal of Gerontology, Vol 57B, No. 3: pp S145-S157.

Bonu, S, M. Rani and T.D Baker. 2003. The impact of national polio immunization on levels and equity in immunization coverage: Evidence from rural North India, *Social Science & Medicine*, 57: 1807-1819

Brand, Jennie & CN Halaby.2006. “Regression and matching estimates of the effects of elite college attendance on education and career achievement”, *Social Science Research* (35):749-770

Brand, Jennie & Yu Xie. 2007. “Who benefits most from college? Evidence for negative selection in heterogeneous economic returns to higher education”, *California Center for Population Research, Online Working paper Series*. Accessed at: http://repositories.org/ccpr/olwp/CCPR-033-07

Cain, M. 1991. “The activities of the elderly in rural Bangladesh” *Population Studies* 45: 189-202

Caldwell, John C.1976 “Toward a restatement of demographic transition theory”, *Population and Development Review*, 2(3/4): 321-366

Cameron, Lisa and D. Cobb-Clark. 2008. “Do coresidency and financial transfers from the children reduce the need for elderly parents to work in developing countries?, *Journal of Population Economics*, 21: 1007-1033.

Cangping, Wu. 1991. *The Aging of Population in China*. International Institute on Aging: Malta

Chanana, B and P.P Talwar. 1987. “Ageing in India: Its socioeconomic and health implications”, *Asia-Pacific Population Journal* 2(3): 23-38

Chaudhuri, A & K. Roy. 2007. “Gender differences in living arrangements among older persons in India” *Working Paper Series- May 17*, Social Science & Research Network. Accessed at: SSRN: http://ssrn.com/abstract=987327

Chen, Feinian and Susan Short. 2008. “Household Context and Subjective Well-Being Among the Oldest Old in China”, *Journal of Family Issues*, Vol 29, No. 10.

Chen, Feinian, Yang Yang and Guangya Liu. 2010. “Social change and Socioeconomic Disparities in Health over the Life Course in China: A Cohort Analysis”, *American Sociological Review*, 75(1): 126-150.

Chen, Marty and Jean Dreze. 1992. “Widows and Health in Rural India”, *Economic and Political Weekly*, Vol 27, No. 43/44.

Cochran, W. G & D B Rubin. 1973. “Controlling bias in observational studies: a review”, *Sankya, Series A* 35: 417-446

Cowgill, D and L.D Holmes. 1972. *Aging and Modernization*, Meredith Corporation: New York, NY.

Crosnoe, Robert. 2009. “Low income Students and the Socioeconomic Composition of Public High Schools”, *American Sociological Review*, (74): 709-730

Cutler, David, and Louise Sheiner. 1998. “*Demographics and medical care spending: Standard and non-standard effects*.” Working Paper #6866. Cambridge, MA: National Bureau of Economic Research

Dandekar, K. 1996. *The Elderly in India*, Sage Publications, New Delhi: India.

Darshan, S, ML Sharma & S.P Singh. 1987. “Health needs of senior citizens”, in Sharma and Dak (eds). *Aging in India*, Ajanta publications, New Delhi, India: 207-13

Desai, Sonalde B, et al. 2010. *Human Development in India: Challenges for a Society in Transition*, Oxford University Press, New Delhi.

Dyson, Tim and Mick Moore. 1983. “ On kinship structure, female autonomy and demographic behavior in India”, *Population & Development Review*, 9(1): 35-60.

Elman, C and P. Uhlenberg. 1995. “Co-residence in the early twentieth century: Elderly women in the United States and their children”, *Population Studies* 49(3): 688-704

Fontaine, Romeo, Agnes Gramain and Jerome Wittwer. 2009 "Providing Care for an Elderly Parent: Interactions among Siblings?", *Health Economics*, Volume 18, No. 9

Garg, C & A. Karan. 2008. "Reducing out-of-pocket expenditures to reduce poverty: a disaggregated analysis at rural-urban and state level in India", *Health Policy & Planning*, 34(2): 116-128.

Gaudin, S and A. S. Yazbeck. 2006. "Immunization in India 1993-1999: Wealth, gender and regional inequalities revisited", *Social Science & Medicine*, 62 (3): 694-706

Gilson, J.C & C. Molyneux. 2007. "Treatment-seeking behavior, cost burdens and coping strategies among rural and urban households in coastal Kenya: An equity Analysis", *Tropical Medicine & International Health*, 12: 673-686

Goldstein. H & J. Rasbash. 1996. "Improved approximations for multilevel models with binary outcomes", Journal of Royal Statistical Society, 159:505-513

Guo, G &. H. Zhao. 2000. "Multilevel Modeling for Binary Data", Annual Review of Sociology, Vol 26: 441-462

Guo, Shenyang & Mark Fraser. 2010. *Propensity Score Analysis: Statistical Methods and Applications*, Advanced Quantitative Techniques in the Social Sciences, Vol. 11. Sage.

Gupta, Indrani. 2009. *Out-of-pocket expenditures and poverty: Estimates from NSS 61st Round*, Report presented by Expert Group on Poverty, Planning Commission, Delhi: India. Accessed at: http://planningcommission.nic.in/reports/genrep/indrani.pdf

Ham, John, X Li, P B. Reagan. 2011 (in press). "Matching and semi-parametric IV estimation, a distance based measure of migration, and the wages of young men", *Journal of Econometrics*.

Hanson, B.S et al. 1989. "Social network and social support influence mortality in elderly men: the prospective population study of "men born in 1914"" Malmo, Sweden. *American Journal of Epidemiology*, Vol 130, No. 1 :100-111

Hermalin, A and Yang L. 2004. "Levels of support from children in Taiwan: Expectations versus reality", *Population and Development Review*, Vol 30, No. 3: 417-448.

Hermalin, A. 2002. *The Well Being of Elderly in Asia-A Four Country Comparative Study*, University of Michigan Press, Ann Arbor, MI.

Hirano, Keisuke & Imbens. GW. 2001. “Estimation of causal effects using propensity score weighting: An application to data on right heart catheterization”, *Health Services & Outcomes Research Methodology* (2): 259-278.

Hirve, S, S Juvekar, P Lele and D. Agarwal. 2010. “Social gradients in self- reported health and wellbeing among adults aged 50 and over in Pune district, India” *Global Health Action Supplement*, 2 (27 September)

Huckfeldt. R.1986. *Politics in Context: Assimilation and Conflict in Urban Neighborhoods*. Agathon Publishers.

Hughes, M.E and Linda Waite. 2002. “Health in the Household Context: Living arrangement and health in late middle age”, *Journal of Health and Social Behavior*, Vol. 43. No.1.

Iyer, A. 2005. *Gender, class, caste and health care access: experiences of rural households in Koppal district, Karnataka*. Sree Chitra Tirunal Institute for Medical, Sciences and Technology, Trivandrum, Kerala, India.

Jain, A.K. 1985. “Determinants of Regional variations in Infant Mortality in Rural India”, *Population Studies*, 39 (3): 407-424

Jejeebhoy, Shireen. 1995. *Women’s Education, Autonomy and Reproductive behavior: Experience from Developing Countries*.(International Studies in Demography): Oxford University Press. USA.

Joffe, MM. & Paul. R Rosenbaum. 1999. “Invited Commentary: Propensity Scores”, *American Journal of Epidemiology*, 150 (4).

Kaplan, H. 1997. “The evolution of the human life course”, in Kenneth Watcher and C. Finch (eds), *Between Zeus and the Salmon: The Biodemography of Longevity*, National Academy Press, Washington DC: 175-211

Kendig, H, A Hashimoto and L.C Coppard. 1992. *Family Support for the Elderly: The International Experience*, Oxford: Oxford University Press.

Kinsella, Kevin and David Phillips. 2005. *Global Aging: The Challenge of Success*. Population Bulletin, 60(1), Population Reference Bureau: Washington DC.

Knodel, J and N. Chayovan. 1997. “Family support and living arrangements of Thai elderly”, *Asia Pacific Population Journal*, 12 (4).

Kochar, Anjini. 1999. “Evaluating Familial Support for the Elderly: The intra-household allocation of medical expenditures in rural Pakistan”, *Economic Development and Cultural Change*, 47 (3): 621-656.

Kravdal, O. 2002. “Education and fertility in Sub-Saharan Africa: Individual and Community Effects”, *Demography*, 39(2): 233-250.

Kumar, A and A. Anand. 2006. *Poverty Target Programs for the Elderly in India: With special reference to National Old Age Pension Scheme, 1995*, Background Paper, Chronic Poverty Resource Center: Manchester, UK.

Landrum Mary Beth & John. Z. Ayanian. 2001. “Causal Effect of Ambulatory Specialty Care on Mortality following Myrocardial Infarction: A Comparison of Propensity Score and Instrumental variable Analyses”, *Health Services and Outcomes Research Methodology*, (2):221-245

Lau, D. T & J. Kirby. 2009. “The relationship between living arrangement and preventive care use among community dwelling elderly persons”, *American Journal of Public Health* 99 (7): 1315-1321.

Lee, Ronald. D. 1997 “Intergenerational relations and the Elderly”, in Kenneth Watcher and C. Finch (eds), *Between Zeus and the Salmon: The Biodemography of Longevity*, National Academy Press, Washington DC: 212-233

Levy, M. J. Jr. 1965. “Aspects of the analysis of family structure” in M.J levy, et al (eds), *Aspects of the Analysis of Family Structure*, Princeton University Press: Princeton.

Leuven. E and B Sianesi. 2003. “PSMATCH2: STATA module to perform full Mahalanobis and propensity score matching, common support graphing and covariate imbalance testing”. Accessed at: http://ideas.repec.org/c/boc/bocode/s432001.html

Luke, Douglas A. 2004. *Multilevel Modeling, Quantitative Applications in the Social Sciences*, No. 7 Series 143. Sage Publications, Inc. CA.

Mason, Karen. O. 1986. “The status of women: Conceptual and Methodological Issues in Demographic Studies”, *Sociological Forum* 1 (2): 284-300.

Mason, Karen. O. & Herbert Smith.2000. “Husbands’ versus wives fertility goals and use if contraception: The influence of gender context in five Asian countries”, *Demography*, 37 (3):299-311

McCaffery, D.F, G. Ridgeway, A.R Morral. 2004. “Propensity Score Estimation with Boosted Regression for evaluating causal effects in observational studies”, *Psychological Methods*, (9): 403-425.

Mitchell, Deborah. 1993 “Income security for Old age: Evidence from eight OECD countries”, Australian National University Research School of Social Sciences.

Moffitt, Robert. 2003. “Causal analysis in population research: An economist’s perspective”, *Population and Development Review* 29: 448-58

_____.2005. “Remarks on the analysis of causal relationships in population research”, *Demography* 42 (1): 91-108

Morgan, S.L & D.J. Harding.2006. “Matching Estimators of causal effects: Prospects and pitfalls in theory and practice”, *Sociological Methods And Research* (35):3-60

Moursund, Anne & O. Kravdal. 2003. “Individual and Community Effects of Women’s Education and Autonomy on Contraceptive use in India”, *Population Studies*, 57(3): 285-301.

National Institute on Aging, National Institutes of Health, *et al*. 2007. *Why Population Aging Matters: A Global Perspective*. Summit on Global Aging, Washington DC.

Navaneetham, K and A. Dharmalingam. 2002. “Utilization of maternal health care services in Southern India”, *Social Science & Medicine*, 55(10): 1849-1869

Pal, S. 2004. “Do children act as old-age security in rural India: Evidence from an analysis of elderly living arrangements”, paper presented in the North East Universities Development Consortium, Montreal, Canada. Accessed at: http://ideas.repec.org/e/ppa99.html

Palloni, Alberto. 2001. *Living Arrangements of Older Persons*, CDE Working Paper # 2000-02. Center for Demography & Ecology, University of Wisconsin-Madison.

Pande, Rohini and A.S. Yazbeck. 2002. Beyond national averages for immunization in India: income, gender and regional inequalities, The World Bank: Washington DC. Accessed at: http://siteresources.worldbank.org/INTURBANPOVERTY/Resources/india-immunization.pdf

Papenek. H. 1990. “To each less than she needs, from each more than she can do: Allocations, entitlements and value” in I. Tinker (eds). *Persistent Inequalities: Women & World Developmen*t, Oxford. Oxford University Press.

Parashar, Sangeeta. 2005. “Moving Beyond the mother-child dyad: women’s education, child immunization and the importance of context in rural India”, *Social Science & Medicine* 61: 989-1000

Ponnuswami. I. 1999. *Situation of Older Persons in India*, Ageing Research Foundation of India

Rahman, Omar and Jane Menken. 1990. “The Impact of marital status and living arrangements on old age female mortality in rural Bangladesh”, paper presented at the Population Association of America Meeting, Toronto.

Rahman, Omar. M. 2000. “The impact of co-resident spouses and sons on elderly mortality in rural Bangladesh”, *Journal of Biosocial Sciences* 32: 89-98.

Rajan, I S, U S Mishra & P S Sharma. 1995. “Living arrangements among the Indina elderly”, *Hongkong Journal of Gerontology*, Volume 9, No. 2: pp 20-28

Rajan, Irudaya S and Sanjay Kumar. 2003. “Living arrangements among Indian Elderly: New Evidence from the National Family Health Survey”, *Economic and Political Weekly*, Vol 38, No. 1: pp 75-80.

Rajan, S. Irudaya. 2006. *Population Ageing and Health in India*, The Center for Enquiry into Health and Allied Themes: Mumbai, India.

Raudenbush, Stephen andTony Bryk. 2002. *Hierarchical Linear Models: Applications and Data Analysis Methods*, (2nd edition), Sage Publications, New York.

Raudenbush, Stephen, Tony Bryk & Richard Congdon. 2000. *HLM 6 Hierarchical Linear and Non-linear Modeling*, Scientific Software International, Inc. Available at: www.ssicentral.com

Robins, JM & A. Ronitzky. 1995. “Semi-parametric efficiency in multivariate regression models with missing data”, *Journal of the American Statistical Association* (90): 122-129.

Rosenbaum, P R & DB Rubin. 1983. “The central role of the propensity score in observational studies for causal effects”, *Biometrika*, 70: 41-55

Rosenbuam, P R. 2002a. “Covariance Adjustment in randomized experiments and observational studies”, *Statistical Science*, 17: 286-304

Rosero-Bixby, L and John. B. Casterline. 1993. “Modeling diffusion effects in fertility transition”, *Population Studies*, 47(1): 147-167.

Schwartz, S, S Danziger & E. Smolensky. 1984. *The choice of living arrangements by the elderly*. Madison: University of Wisconsin-Madison, Institute for Research on Poverty.

Seeman, Teresa & Eileen Crimmins. 2001. “Social environment effects on health and aging: integrating epidemiological and demographic approaches and perspectives”, in Weinstein, Hermalin & Stoto (ed) *Population Health and Aging-Strengthening the Dialogue between Epidemiology and Demography*, Annals of New York Academy of Sciences, Volume 954; New York.

Sellstrom, E and S Bremberg. 2006. “The significance of neighborhood context to child and adolescent health and well-being: a systematic review of multilevel studies”, *Scandinavian Journal of Public Health*, 34 (5): 544-54

Sen, Mitali & A. Sharma. 2006. “Short term morbidity in India: Gender Disparity in Access to Health Care”, presented at *Seminar for Gender Access in South Asia*, IUSSP, Dhaka, Bangladesh.

Sen, Mitali and James Noon. 2007. “Living arrangement: How does it relate to the health of the elderly in India?”, Paper presented at the Annual Meetings of the Population Association of America

Shadish, W R, T. Cook and D. Campbell. 2002. *Experimental and quasi-experimental designs for generalized causal inference*, Wadsworth Publishing.

Shaikh. B. T & J. Hatcher. 2005. “Health seeking behavior and health service utilization in Pakistan: challenging the policy makers”, *Journal of Public Health*, 27(1): 49-54

Shaji, K.S, et al.2003. “Caregivers of people with Alzheimer’s disease: a qualitative study from the Indian 10/66 dementia research network”, *International Journal of Geriatric Psychiatry*, 18(1)

Silverstein, M. 2005. “Social Exchange Theory” in *Sourcebook of Family Theory and Research*, V. L. Bengston, et al (eds) (407-10). Thousand Oaks. CA: Sage.

Smeeding, T, Q. Gao, P. Saunders and C. Wing. 2008. *Elder Poverty in an Ageing Worls: Conditions of social vulnerability and low income for women in rich and middle-income nations*, Working Paper No. 497, Luxembourg Income Study Working Paper Series.

Smith, A. F. M. 1973. “A general Bayesian linear model”, *Journal of Royal Statistical Society*, Series B, 35: 61-75.

Smith, D. Scott. 1993. “The curious history of theorizing about the history of the western nuclear family”, *Social Science History*, 17: 325-53

Smith, Herb L. 2003. “Some thoughts on causation as it relates to demography and population studies”, *Population and Development Review* 29: 459-69

Smith, James P and R. Kington. 1997. “Demographic correlates of health in old age”, *Demography*, Vol 34, No. 1.

Subaiya, Lekha P. 2005. *The Role of Elders’ Resources in the Receipt of Family Support in Matlab, Bangladesh*, Doctoral Dissertation, Department of Sociology, University of Maryland, College Park.

Sugisawa, H, Jersey Liang and Xian Liu. 1994. "Social networks, Social support and Mortality among Older people in Japan", *Journal of Gerontology*, Vol. 49. No.1:S3-S13.

Suzman, Richard. 2010. "The INDEPTH WHO-SAGE multicenter study on ageing, health and well-being among people aged 50 years and over eight countries in Africa & Asia", *Global Health Action*, 3.

Treas, Judith and Barbara Logue. 1986. "Economic development and the Older Population", *Population and Development*, Vol 12. No.4: 645-673.

Treas, Judith and Philip Cohen. 2006. "Maternal Coresidence and Contact: Evidence from cross-national surveys, *International Studies in Population*, Vol 3: 117-137

United Nations. 2008. *World Population Prospects: The 2007 Revision*, United Nations Department of Economic and Social Affairs, Population Division, New York.

United Nations. 2002. *Report on the Second World Assembly on Ageing*, Madrid 8-12 April. United Nations. New York. Accessed at : http://www.c-fam.org/docLib/20080625_Madrid_Ageing_Conference.pdf

Van. Houtven, Courtney & Edward Norton. 2001. "Informal care and health care use of older adults", Draft. Chapel Hill, NC: University of North Carolina, Department of Health Policy Administration.

Wall, R. 1989. "Living arrangements of the elderly in contemporary Europe" in E. Grebneil et al (eds). *Later Phases of the Family Life Cycle*, (p 222-44), Clarendon Press: Oxford.

Waite, L & Hughes, M. E. 1999. "At risk on the cusp of old age: Living arrangements and functional status among Black, White and Hispanic Adults", *Journal of Gerontology*, Vol. 54, No.3: S134-S144.

Whyte & Xu. 2003. "Support for aging parents from daughters versus sons", in Whyte (eds) *China's revolutions and intergenerational relations,* Ann Arbor: University of Michigan, Center for Chinese Studies.

Wolf, Douglas. 1994. "The Elderly and their Kin: Patterns of Availability and Access", in Martin, Linda & Samuel Preston (eds) *Demography of Aging*, National Academic Press, Washington DC.

Wolfgang, W & T. Kurth. 2004. "Propensity Scores: Help or Hype?", *Nephrology Dialysis Transplantation*, Vol 19: 1671-1673

World Bank. 1994. *Averting the Old Age Crisis: Policies to protect the old and promote growth*, A World Bank Policy Research Report: Oxford University Press

World Bank, 2005. *An overview of women's transport issues in developing countries: Lessons from World Bank's projects*, by Riverson, J, Kuneida, M and Roberts, P. Accessed at: http://siteresources.worldbank.org/INTTSR/Resources/462613-1152683444211/06-0592.pdf

Wu, Z. Helen & Laura Rudkin. 2000. "Social contact, Socioeconomic status and the health status of older Malaysians", *The Gerontological Society of America*, Vol. 40, No. 2: 228-234.

Young, J.T, et al. 2006. "Who receives health care? Age and Sex differentials in adult use of health care services on rural Bangladesh", *World Health & Population*. February.

Yount, Kathryn M. 2009. "Gender and intergenerational co-residence in Egypt and Tunisia", *Population Research and Policy Review*, Vol 28: 615-640

Zimmer, Z. 2005. "Health and living arrangement transitions among China's oldest-old", *Research on Aging*, Vol. 27, No. 5: 526-555.