ASSOCIATION BETWEEN HOUSEHOLD SOCIAL CAPITAL AND CATASTROHPIC HEALTH EXPENDITURE IN INDIA: EVIDENCE FROM INDIA HUMAN DEVELOPMENT SURVEY-2012

By

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Abstract

In India, 62% of the total health expenditure incurred by the households is financed through their out-of-pocket payments, pushing a significant 50 million people annually in the state of 'hidden poverty'. Researchers have identified various socio-economic and health system factors associated with the incidence of catastrophic health expenditure on a household, neglecting the role of a household's structural social capital as an important correlate. This thesis explores the association between incidence of catastrophic health expenditure and a household's structural social capital utilizing the WHO's Commission on Social Determinants of Health framework. Using a FE logistic regression and a nationally representative India Human Development Survey-2012 data, this study finds that structural social capital, as measured by a household's social networks, is negatively associated with the incidence of incurring catastrophic health expenditure, after controlling for socio-economic and health system factors. The findings imply that government should implement community-based programs that increase social networks and associations among households in a community, thereby increasing their structural social capital which can act as a cushion against financial risks faced by the households during health emergencies.

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List of Abbreviations and Acronyms

Abbreviations	Full Description
CHE	Catastrophic Health Expenditure
CSDH	Commission on Social Determinants of Health
EFA	Exploratory Factor Analysis
FE	Fixed Effects
FRP	Financial Risk Protection
GDP	Gross Domestic Product
HH	Household
IHDS	India Human Development Survey
LPM	Linear Probability Model
OBC	Other Backward Castes
OLS	Ordinary Least Squares
OOPE	Out-of-Pocket Expenditures
SC	Scheduled Castes
SDG	Sustainable Development Goals
SE	Standard Errors
SSC	Structural Social Capital
ST	Scheduled Tribes
UHC	Universal Health Coverage
UN	United Nations
USA	United States of America
WHO	World Health Organization

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Introduction

Ensuring availability and access to quality health services and safeguarding citizens from the high cost of seeking and undergoing treatment during an illness is a significant public health challenge for policymakers, especially in low-income countries. The United Nation's 2030 Agenda for Sustainable Development Goals (SDGs) also emphasizes ensuring Universal Health Coverage (UHC) (Goal-3) for all in a manner that does not put households at a financial risk (UN General Assembly 2015). In absence of a government funded robust public health system, financing health care in developing and low-income countries like India is predominantly based on out-of-pocket expenditures (OOPE) incurred by households (Pandey, Ploubidis, et al. 2018). Safeguarding households against the financial risks arising out of high OOPE incurred while seeking treatment is central to the achievement of UHC for all (UN General Assembly 2015). Incidence of Catastrophic Health Expenditure (CHE) i.e. a situation when OOPE on health is more than 10% of the total household consumption expenditure (Saksena, Hsu, and Evans 2014a) is a useful "measure of the performance of the health system in a country" (Pandey, Kumar, et al. 2018, 2) and an indicator of financial risk faced by the households (Saksena, Hsu, and Evans 2014a). Although there is no consensus among authors on the threshold for defining the catastrophic incidence in previous studies, most authors have operationalized the concept of CHE with 10% threshold for total household expenditure and 40% threshold for the household's capacity to pay (Raban, Dandona, and Dandona 2013; Goli et al. 2016; Somkotra and Lagrada 2009; Pandey, Ploubidis, et al. 2018).

While India has seen unprecedented growth in its economic output and the overall size of the GDP since 1991, the share of GDP spend on financing healthcare in the country has remained stagnant at just 1% of GDP (Chandna 2019). The extent of OOPE on health in India is significantly higher than the global average, with some studies estimating it to be 62% of the

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total heath expenditure in the country (Pandey, Ploubidis, et al. 2018). The challenge of rising OOPE on health has become so acute that National Health Policy 2017 explicitly targets "achieving significant reductions in OOP payments, CHE and impoverishments due to health expenditure" (Pandey, Kumar, et al. 2018, 2). In the absence of government-provided formal health insurance, high OOPE pushes those who are slightly above the poverty line into poverty and those already below the poverty line into further impoverishment (Wagstaff and Doorslaer 2003). In India, 50 million people were estimated to be in the state of "hidden poverty" on account of exorbitantly high medical expenses (Keane and Thakur 2018).

Previous studies have extensively documented association of socio-economic factors like availability of assets, access to toilet, clear water facility, household size, urban vs rural location with the likelihood of a household incurring CHE (Muhammad Malik and Azam Syed 2012; Mahumud et al. 2018) and the coping mechanisms of the households (Mishra and Mohanty 2019). Households resort to various formal and informal measures, known as distress financing, to cope with these high OOPE on health care. Some of the distress financing measures include pledging assets or livestock, eating into savings and borrowing from landlords or moneylenders (Mishra and Mohanty 2019).

Having said this, there is dearth of literature studying the role of social networks and community ties of a household in meeting these expenses. Households borrow from relatives and friends to cope with the short-term liquidity shock, take in-kind help to avert the expenditure (like transportation in a neighbour's car instead of an ambulance) or leverage their network to avoid the expenditures altogether for e.g. by using influential connections with bureaucrats or politicians in the society. A household's ability to undertake any such cost-reducing measure often depends on the extent of its social networks and strength of the relationship within the community, commonly referred to as structural social capital (Pitkin Derose and Varda 2009, 2).

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Though the literature studying the pathways through which structural social capital affects various health outcomes like coverage and equity is extensive (Arezzo and Giudici 2017, 155; Carpiano 2006; Perry et al. 2008), the literature exploring the association between structural social capital and incidence of CHE on a household is scarce. Wilkes et al. (1998) provide some theoretical evidence that social networks are essential sources of labour and finance for households in distress due to illness and may help them finance unanticipated expenditures. However, their study was a qualitative one studying just 24 households from China. In another study, Reeves et al. (2014), while studying the contribution of social networks to the health of patients in England found that "network support substitutes for formal care and can produce substantial savings in traditional health service utilization costs". However, this study focused only on North West of England wherein data was collected using a postal questionnaire and face-to-face interviews with just 300 patients suffering from diabetes. It thus missed the catastrophe in rural areas and focused on just one chronic disease of diabetes. Moreover, disregarding the fact that social capital cannot influence health care outcomes in a void (Hasan et al. 2020, 2), most of the previous studies do not utilize a systematic framework to explore the relationship between social capital and different health outcomes (Pitkin Derose and Varda 2009, 16).

Since, financing health care in developing and low-income countries like India is still predominantly based on out-of-pocket expenditures and an important coping mechanism of households - relying on social networks to bridge or evade these expenses, remains understudied. This study seeks to fill this gap by quantitatively studying the association between household's structural social capital and OOPE on health among households in India using a nationally representative dataset. Thus, the thesis tests the hypothesis that a household's structural social capital, as measured by its social networks, is negatively associated with the incidence of incurring CHE.

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In this study, I have utilized the framework developed by WHO's Commission on Social Determinants of Health, which identifies a set of socio-economic and health system factors that interact with a household's social capital and lead to ill health and health inequities (WHO 2010). I use a nationally representative - India Human Development Survey (IHDS) - dataset from 2011 (Desai and Vanneman 2015). To test the hypothesis, first, I employ a logistic regression model with robust standard errors and district fixed effects. I find that structural social capital as being significantly associated with the likelihood of incurring CHE, along with other covariates identified in the previous studies. District fixed effects are used to control for unobserved variables at the district level that may influence health care expenditure of a household. Second, as specific social groups and disadvantaged rural communities in India face discrimination and devise social protection mechanisms that impact their health outcomes and bridge health inequities (George 2015), heterogenous fixed effects estimates from logistic regression of structural social capital on incidence of CHE by caste and region is performed.

There are several key findings of the study. First, I find a significant negative association between a household's structural social capital and likelihood of incurring CHE. A 10% increase in structural social capital is associated with 5.38% reduction in likelihood of incurring CHE. This means that a 10% increase in the size of the network of a household as measured by its acquaintances, relationships, friends and membership in professional and social groups, reduced the probability of incurring high expenditure that may pose financial risk to the household by 5.38%. Second, structural social capital is significantly and negatively associated with households belonging to different caste groups, but the magnitude of effect and significance levels differ for all the caste groups. Maximum effect is observed for households belonging to '*Scheduled Tribe'* category where a 10% increase in structural social capital is associated with 7.66% decrease in probability of incurring CHE. Whereas across regions, households in rural areas have the highest association with 10% increase in structural social

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capital associated with 6.1% decrease in likelihood of CHE. Finally, consistent with previous studies, I find factors which are positively associated with the likelihood of incurring CHE: undergoing treatment in a private health facility, having to go to another town or a city for the treatment, undergoing a surgery, household size, illness of a very old member (above 80 years) of the household and having more number of ill members in the household. Some factors like a higher education of household head, household head having some form of employment (as a laborer, in informal business or formal jobs) instead of agriculture and the house having access to safe drinking water and toilet are found to be negatively associated with the likelihood of incurring CHE.

To the best of my knowledge, this is the first quantitative study of association between structural social capital and CHE utilizing a systematic framework in the context of India, a country with huge disparities and inequities in health care utilization and associated costs. The study contributes to the literature on catastrophic health expenditure in low income countries especially India and provides a direction for future research. First, since the study does not provide any causal information due to non-experimental, cross-sectional nature of the dataset used for the analysis, it will be important that future studies try to explore the causality aspect. Second, measurement of the structural social capital was limited by the questions asked during the survey, which at best provides a crude approximation of quantity of social networks of a household without any information on the quality of those networks. While interpreting the results, this limitation should be kept in mind. Finally, though the fixed effect regression control for unobservable variables at the district level, important household level unobservable variables may be present. This limitation can be overcome by utilizing a panel dataset which IHDS provides, however, was not used in this study as it was not available. Future studies can utilize the panel dataset and to control for time-invariant household fixed effects by utilizing the difference -in -differences approach which requires a panel dataset.

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The present study contributes to the existing literature on factors associated with CHE in low-income countries especially in India. Specifically, I expand on existing literature by quantitatively demonstrating significant negative association between structural social capital, as measured by households' social networks, and likelihood of incurring CHE. In addition, I study various factors associated with CHE identified in previous studies across various countries in the context of India. Given the potential of social networks to improve the health outcomes, interventions designed to promote diverse, heterogenous networks in communities and promoting membership of individuals in social and professional groups like self-help groups, credit or cooperative societies, etc. will be beneficial to bridge inequities in healthcare especially among marginalized households.

The thesis is structured as follows. The first chapter begins with the review of existing academic literature on CHE and various factors associated with it. This chapter also discusses the conceptualization of social capital in general and structural social capital as relevant to public health domain and concludes with the discussion on associated pathways through which structural social capital affects health outcomes. The second chapter presents the study framework, research design and analysis of results from the fixed effects logistic regressions. The conclusion summarizes the results and provides direction for further policy action and research.

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Chapter 1. Catastrophic Health Expenditure and Structural Social Capital

High and continuously increasing cost of seeking and undergoing treatment in case of an illness is one of the major public health challenges for policy makers in low-income countries. Financing health care in developing and low-income countries like India is still predominantly based on out-of-pocket expenditures (OOPE) incurred by households (Pandey, Ploubidis, et al. 2018). In the absence of a government provided formal health insurance, high OOPE, known as catastrophic health expenditure (CHE), pushes those who are slightly above poverty line into poverty and those already below poverty line into further impoverishment (Wagstaff and Doorslaer 2003). Households resort to various formal and informal measures to cope with these OOPE on health care like borrowing from relatives and friends, taking in-kind help to avert the expenditure (like transportation in a neighbor's car instead of an ambulance) or leverage their network to avoid the expenditures altogether (Wilkes et al. 1998). Household's ability to undertake any such cost reducing step often depends on its social networks and strength of the relationship within the community, often referred to as social capital. Thus, before carrying out an analysis of CHE and its relationship with household social capital, it is necessary to understand the determinants of CHE, and relationship between social capital and health in general.

This chapter begins with a review of existing research on CHE, its definition, impoverishment effects in India and factors which affect CHE. It is followed by the review of literature exploring pathways through which social capital affects healthcare utilization and ultimately CHE. Finally, the framework highlighting the factors that are relevant determinants of CHE are discussed highlighting the dearth of evidence on social capital as a determinant of CHE.

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1.1 Catastrophic Health Expenditure, its Impoverishment Effects and Correlates

1.1.1. Definition and Measurement Issues

The Third Sustainable Development Goal (SDG) adopted by the United Nations (UN) General Assembly in 2015 envisions Universal Health Coverage (UHC) for all by 2030 (UN General Assembly 2015). An important component of achieving UHC is ensuring Financial Risk Protection (FRP) which is defined as the absence of, or safeguarding people against, the financial risk and uncertainty in accessing health services (Saksena, Hsu, and Evans 2014b, 2). A household is said to be exposed to substantial financial risk when the household foregoes the consumption of other necessary goods and services like adequate nutrition or quality education while for paying for the treatment (Saksena, Hsu, and Evans 2014b, 2).

Based on this conceptualization, various studies have conceptualized FRP on the closely related concept of CHE (Wagstaff and Doorslaer 2003). CHE is expressed as the OOPE incurred by the household on healthcare either as a proportion of total household expenditure (Saksena, Hsu, and Evans 2014b, 3) or of the household's capacity to pay (Pandey, Ploubidis, et al. 2018, 19). Although there is no consensus among authors on the threshold for defining the catastrophic incidence in previous studies, most authors have operationalized the concept of CHE with 10% threshold for total household expenditure and 40% threshold for the household's capacity to pay (Raban, Dandona, and Dandona 2013; Goli et al. 2016; Somkotra and Lagrada 2009; Pandey, Ploubidis, et al. 2018).

1.1.2. Impoverishment Effects and Correlates of Catastrophic Health Expenditure

In the absence of a formal insurance mechanism within the health system, people face severe financial hardships when an illness strikes. Xu et al. (2007) estimated that more than 150 million individuals from 44 million households face severe financial hardships due to OOPE incurred while seeking treatment. Moreover, more than 90 percent of these individuals live in low-

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income countries (Xu et al. 2007). In absence of robust health systems and nearly absent insurance systems, OOPE remain the major source of financing healthcare in most of the resource starved low-income economies of Bangladesh, Nepal, China and particularly India (van Doorslaer et al. 2007).

For the last two decades, share of public expenditure on health has been stagnant in India at 1% of GDP, whereas the cost of seeking treatment has considerably gone up (Chandna 2019). OOPE on health has increased considerably over the last two decade with such payments accounting for 62% of total health expenditure in 2014 (Pandey, Ploubidis, et al. 2018). According to some studies the growth rate in per capita health expenditure by the households was twice that of growth rate in per capita consumption expenditure over the period 1993-2012 (Mohanty et al. 2016). *Figure 1* and *Table 2* in Appendix 1 provide further details on the growth in household annual per capita consumption expenditure and annual per capita health expenditure at constant prices in India over the period 1993–2012.

Researchers studying the incidence of CHE have mostly concentrated on overtime trends in specific countries like Nigeria, India, Bangladesh (Aregbeshola and Khan 2018; Chuma and Maina 2012; Khan, Ahmed, and Evans 2017; Pandey, Ploubidis, et al. 2018), others have undertaken the cross-national comparisons (Wagstaff et al. 2018); Xu et al. 2003), while some have studied the incidence of CHE to a particular domain like maternity care and its impoverishment effects (Mishra and Mohanty 2019). Previous studies have also identified the determinants of CHE (Mahumud et al. 2018; Muhammad Malik and Azam Syed 2012) and financing options available to households in the context of low-income countries (Wilkes et al. 1998; Akinkugbe, Chama-Chiliba, and Tlotlego 2012).

Previous studies have identified that socio-economic determinants of a household like the literacy level of the head of the household, access to clean drinking water and availability of a hygienic toilet are negatively associated with the OOPE on health and thus odds of incurring

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CHE (Muhammad Malik and Azam Syed 2012). Second, in Bangladesh, gender of the household head, location of the house, household's income group, and employment status of the individual seeking treatment were found to be significant predictors of OOPE on health (Mahumud et al. 2018). Female headed, rural households were positively associated with the OOPE, while being employed was negatively associated i.e. unemployed peoples spent significantly less out-of-pocket on health because of poor financial resources available at their disposal (Mahumud et al. 2018). Some others have identified that factors like presence of an older member above the age of 65 years or a younger member less than five years, a member with a chronic disease, household size and education of the head of the household, among others are significantly associated with CHE (Aregbeshola and Khan 2018; Buigut, Ettarh, and Amendah 2015).

Households resort to multiple distress financing measures to cope with high OOPE on health. The extent and nature of distress financing varies across countries however most common forms across low and middle-income countries are relying on savings, selling household assets, selling livestock and crops, and borrowing from moneylenders, friends and relatives (Mishra and Mohanty 2019). Studies have also observed that other coping strategies such as task reallocation among household members was also used for meeting indirect health expenses (except medical treatment and related financial costs) in low income countries (McIntyre et al. 2006). Household's ability to undertake a mitigation measure like borrowing from friends and relatives and task reallocation often depends on its social networks and its strength of the relationship within the community, often know as social capital. Though people have studied various determinants of CHE and methods of distress financing, limited empirical evidence exists about the relationship between social capital and CHE and its role as a financial risk protection measure.

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Wilkes et al. (1998) qualitatively studied the coping strategies of households in China and found that social networks outside of the household were important sources of labor and finance for households and helped them finance unanticipated expenditures. They also posited that households which otherwise would not have been able to finance their expenditure as they were excluded from formal credit markets were able to seek credit from their friends and relatives (Wilkes et al. 1998, 1). However, not everyone is able to borrow from their social network as resource endowment in the social network may not be enough to support explicit funding. In such instances households were able to reduce their caring burden of hospitalization by relying on labor resources from the social network (Wilkes et al. 1998, 17). Reeves et al. (2014) while studying the contribution of social networks to the health of patients in England also found that "network support substitutes for formal care and can produce substantial savings in traditional health service utilization costs" (Reeves et al. 2014, 8).

While both the studies contribute to the knowledge base of role of social capital in potentially mitigating CHE on health, both provide a partial picture. The study by Wilkes et al. was a qualitative study of 24 households from China and study by Reeves et al. focused on North West of England wherein data was collected using a postal questionnaire and face-to-face interviews with 300 diabetes patients. While Wilkes et al. studied the rural households and provided valuable insights into potential mechanisms the study is not nationally representative. The study by Reeves et al. consequently missed the catastrophe in rural areas and focused on just one chronic disease of diabetes. It is important to study the association of OOPE on health, CHE and social capital quantitatively reflecting the national situation and multiple disease profiles. Before we study the association of social capital with CHE, I review how social capital is defined in public health literature and pathways through which social capital influences health outcomes.

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1.2 Structural Social Capital and Health

1.2.1. Definition and Measurement Issues

Social capital can be defined as the "networks, groups, or relationships between people, based on mutual trust, set of norms, and understanding, and formed to facilitate collective action for common benefits" (Herberholz and Phuntsho 2018, 104). Recently, with an increasing interest in the role of contextual factors like household familial relations and neighborhood characteristics that link individual's health status, healthcare utilization and health financing options with larger social determinants, public health and health economics research has seen proliferation of studies utilizing the sociological concept of social capital. While some researcher have cautioned against the ambiguity of the concept and its application to health research (Leeder and Dominello 1999), others have argued that because of the interdisciplinary nature of the research, the concept has eluded a unified definition or a common framework of measurement (Arezzo and Giudici 2017, 155) and thus researcher have operationalized the concept based on their context of study.

Despite the criticisms and concerns, public health researchers have tried to conceptualize social capital because of its relevance in explaining various health outcomes by dichotomizing it into "structural" and "cognitive" factors (Pitkin Derose and Varda 2009). Structural social capital relates to the extent of social relation and networks and this conceptualization is credited to a French Sociologist, Pierre Bourdieu, who in 1986 defined social capital as an individual's size of the network and the resources possessed by each agent in that network (Pitkin Derose and Varda 2009, 2). Cognitive social capital, on the other hand, relates to the quality of those social relations and aligns closely with the conceptualizations forwarded by U.S academics James Coleman and Robert Putnam (Coleman 1988; Putnam 1993).

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To understand the mechanism through which social networks and resources embedded in these networks affect health outcomes, researchers have further dichotomized structural social capital between "bonding", "bridging" and "linking" networks (Pitkin Derose and Varda 2009, 5). Bonding social capital refers to the strong ties among persons who share a common social identity like caste or religion or ethnicity, whereas bridging social capital comprises of weak ties among persons in the form of respectful and mutual relations who do not share a common social identity but are more or less equal in terms of status and power (Pitkin Derose and Varda 2009, 5). Networks formed among people in the same profession and by way of participation in a group like women's group or a farmer's collective are example of bridging social capital. Linking social capital has been defined as networks formed across hierarchical structures and "explicit, formal, or institutionalized power or authority gradients in society" (Pitkin Derose and Varda 2009, 5). Political and official networks are an example of linking social networks.

Cognitive social capital which measures the quality of social relations is based on the concepts of trust and reciprocity among individuals and is measured by individual's perceptions of cooperative behavior in a group, and collective efficacy in community environment (Herberholz and Phuntsho 2018, 104). Measured in this way cognitive social capital is complementary to structural social capital and provides an alternate mechanism through which social networks may impact health outcomes; not through explicit resources but through implicit resources like information and psychosocial support.

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1.2.2. Pathways between Structural Social Capital and Health

Previous studies that have studied social capital have explored relationship between social capital and self-rated health (Xue, Mo, and Reed 2016), health service utilization (Herberholz and Phuntsho 2018), some have focused on specific domains like maternal and child health (Story 2014) and immunization (Hasan et al. 2020), others have studied role of social capital in improving health seeking behavior through health promotion (Eriksson 2011).

Authors that study structural social capital and health argue that networks may improve health outcomes through one of the following pathways: by improving the availability of information, substituting formal care with home care and through collective community action which may enhance healthcare services by acting as a pressure group (Pitkin Derose and Varda 2009, 4). Carpiano (2006) established that civic participation, as measured by membership in social groups, can impact healthcare use by collectively addressing community issues. Similarly, Perry et al. (2008) used the concept and explored another mechanism wherein group membership helped low-income individuals in overcoming barriers to care and thus improved their health outcomes through psychosocial support.

Even though a large body of literature examines potential mechanism through which structural social capital or social networks affect various health outcomes, there is dearth of literature studying association between social capital and OOPE on health or CHE. Moreover, most of these studies rely on individual effect of social capital by controlling for various socio-economic indicators but do not utilize a systematic framework to explore the relationship between social capital and various health outcomes. As social capital cannot influence health care outcomes in a void (Hasan et al. 2020, 2) it must interact with other social determinants like material circumstances, governance structures and supply-side determinants like health service availability. Pitkin Derose and Varda (2009, 16) while undertaking a comprehensive systematic review of social capital and health noted that "research on health care access in a social capital context suffers from the absence of a comprehensive framework".

To overcome the aforementioned gaps this study will rely on a comprehensive framework developed by the World Health Organization's (WHO) Commission on Social Determinants of Health (CSDH) (WHO 2010) and use nationally representative datasets to quantitatively examine the influence of social capital on CHE.

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The next chapter focuses on the study design and thus will begin with discussing the conceptualization of social capital and CHE within the framework of CSDH, followed by the research hypothesis, description of the data source, operationalization of key concepts of social capital and CHE as relevant to this study, empirical strategy and the robustness checks. The chapter will conclude with analysis and discussion of the results.

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Chapter 2. Structural Social Capital and its association with Catastrophic Health Expenditure

After the literature review of the topic, it is now possible to proceed with the empirical analysis. This chapter, first, presents the framework which this study utilizes, then, moves on to describe the hypothesis, dataset, variables and empirical strategy, and finally, presents the analysis of the results.

2.1. Study Framework

As highlighted in the literature review, with the exception of Hasan et al. (2020), none of the reviewed studies have utilized a systematic framework to quantitively explore the relationship among social determinants of health, particularly the association between structural social capital and CHE. This study will utilize the WHO's Commission of Social Determinants of Health framework initially drafted in 2005 and finalized in 2010 (WHO 2010) to study this relationship. The conceptual framework presented in *Figure 2* in Appendix 2**,** is adapted from WHO (2010) and (Hasan et al. 2020, 3), and identifies three broad categories of determinants which influence health outcomes either directly or in relation with each other.

First category of factors reflects the socio-economic position of an individual or a household in the society. Indicators like gender, household wealth, race/ethnicity, education, etc. generate social class divisions in the society. These factors have also been the primary measure of interest in most of the studies in public health and health economics. These factors endow different groups or individuals with differential level of power and access to resources in the society (WHO 2010, 5), which can directly impact health outcomes, particularly household OOPE (Muhammad Malik and Azam Syed 2012).

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Second category, defined here as health system factors, affects an individual or a group's access to health services and exposure and vulnerability to a health shock. Health system factors mediate the differential consequence of an illness on peoples' material lives by ensuring that sickness doesn't lead to deterioration in people's social and economic status (WHO 2010, 40). Examples include appropriate models of health financing like free primary health care or providing subsidies for undergoing tertiary care treatment like surgeries which can prevent an individual from impoverishment due to exorbitant cost of medical care (WHO 2010, 40).

Third category in the framework is the social capital which is defined as a cross-cutting determinant. It interacts with both the socio-economic position and the health system factors to influence the health outcomes, either directly by leveraging the resources embedded in the network or across the power gradients, or indirectly by utilizing information, facilitating coordination and cooperation among individuals and groups for mutual benefit (WHO 2010, 41). Social capital does not impact health outcomes in a vacuum. It interacts with other social, economic and political factors that create an individual or a group's socio-economic position by stratifying the populations on observable criteria. (WHO 2010, 5). These social positions reflect social hierarchies, networks and relations and explain "individual experience [of] differences in exposure and vulnerability to health-compromising conditions" (WHO 2010, 5).

The relevance of this framework in studying association of social capital with health outcomes is that it proposes using the notion of social capital, defined by power gradients and embedded group resources in the society, to nurture cooperative and collaborative relationships between citizens and institutions (WHO 2010, 43). Defined in this manner, the framework is a useful tool for public policy professionals for shaping opportunities for civic engagement and strengthening local and regional institutions to constitute concrete spaces of participation.

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2.2. Hypothesis

The study hypothesis is based on the review of the literature and the conceptual framework presented above, which depicts the factors and complex potential mechanism through which structural social capital affects a household's expenditure while undergoing a treatment for long-term of short-term illnesses. The main hypothesis is that a household's structural social capital, as measured by its social networks, is negatively associated with the incidence of incurring CHE.

The potential mechanism through which this could happen can either be relationships with people of influence in communities or enhanced availability of in-kind resources from social groups or professional associations, which enable health service use at lower out of pocket costs. One important aspect to note here is that hypothesis doesn't make a causal claim on the potential mechanism at play but only tests the directional association between structural social capital and likelihood of incurring CHE. The cross-sectional nature of the data and potential endogeneity of social capital as a concept limit the ability of the study to comment on causality.

2.3. Study Population and Dataset

To analyze the question under consideration, this study utilizes the data from 2011-12 India Human Development Survey (IHDS), a multi-topic, cross-sectional, nationally representative survey of 42,155 households; 27,582 rural and 14,573 urban, spread across 33 states and union territories of India (Desai and Vanneman 2015)[1]. Indian states are further sub-divided into sub-divisional administrative units known as districts which contain villages in rural, and blocks in urban areas. India had 640 districts in 2011 (Census of India 2011), and the IHDS data was collected from 384 districts spanning 1420 villages and 1,042 urban blocks (Desai and

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[1] India is federal union of states and union territories. At present the country has 36 units; 28 states and 8 union territories. However, at the time of the survey there were a total of 33 units.

Vanneman 2015). IHDS covered a wide range of topics including caste and community, consumption and standard of living, employment, illness events, healthcare expenditure, social capital and household and family structure. Detailed description of sampling technique, data collection methodology and quality assurance has been documented previously (Desai and Vanneman 2015).

Each household was asked questions on three short-term illness and fourteen long-term illness episodes including accidents faced by various family members within the last 30 days (short-term illness) and 5-year (long-term illness) preceding the interview date. Out of all the households interviewed, 30,105 households had at-least one member who faced some form of illness. These households constitute the main sample size for the study. For empirical analysis, I further omitted the households with any item missing data, which leaves the final sample of analysis to 29,895 households. Table *3* in Appendix 3 provides the percentage of missing values in observations in the dataset.

2.4. Variables

2.4.1. Response variable

As mentioned previously in the literature review, I have operationalized the extent of financial risk of a household by measuring the proportion of OOPE out of total household consumption expenditure and incidence of CHE. Thus, the key response variables for this study is *CAT_EXP* defined as the incidence of catastrophic health expenditure faced by the household.

The health module of IHDS asked the household heads if any member of their household had suffered from short-term or long-term illness and visited a health facility or care provider seeking the treatment. It further collected data on the expenditure incurred by a household in paying for the doctor's fees, hospital admission, surgery, tests, purchasing medicines and expenses incurred on travel and lodging while seeking health services. Proportion of OOPE out

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of total household consumption expenditure on health is measured by totaling all these expenditures net of any insurance payments received and then dividing it by the household's total consumption expenditure.

A household is further categorized as incurring a CHE when the proportion of OOPE on health is more than 10% of the total household consumption expenditure. The threshold of 10 percent for defining catastrophic expenditure, as discussed previously in the literature review, is consistent with studies undertaken in this domain (Xu et al. 2003; Saksena, Hsu, and Evans 2014b). This indicator is a binary variable which takes a value of 1 when proportion is beyond 10 percent and 0 otherwise.

2.4.2. Explanatory Variables

Social Capital & Social Networks

The primary explanatory variable of interest is the structural social capital variable (SSC). For this study, as mentioned previously in the literature review, structural social capital variable is measured by the extent of social networks a household has. Social capital module of the IHDS included questions on household's membership in social organizations and having personal acquaintances with people in various occupations, among and outside the caste and community. Responses to a total of thirteen questions, measured on a binary scale of yes/no, were considered for creating the *SSC* variable. *SSC* was created by summing the binary responses of a household across thirteen questions and then dividing it by thirteen to rescale the variable between 0 - 1.

Questions like personal acquaintance of any member of the household with someone who works in government service, who is officer and above; other government employees not at the level of officers; people in politics like elected members such as Members of Parliament, Members of Legislative Assembly, *Zilla Parishad* (District Council) Member, which are beyond *Gram Panchayat* (Village Council) or urban ward level; and other political party officials were asked.

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All these questions were asked separately for acquaintances both within the caste or community and outside of it. Besides these, direct membership of any household member in *Gram Panchayat* or *Nagar Palika (Municipal Body)* or ward committee was also used to capture a household's social networks. Finally, the IHDS also asked questions on membership of any member of the household in social and professional organizations like self-help groups, credit or savings groups, and religious, caste or festival organization.

The components of structural social capital identified above represent the bonding (membership in caste and social groups), bridging (membership in self-help groups and credit or saving groups) and linking (acquaintances in government service and politics) type of structural social capital.

One potential challenge of measuring structural social capital in this summative manner is reliability and validity of the measure. Public health literature relies on undertaking Exploratory Factor Analysis (EFA) as preferred method of measuring social capital from observational data (Story 2014; Hasan et al. 2020; Arezzo and Giudici 2017). I have calculated *SSC* variable by undertaking EFA as a robustness check measure, where I compare the results between *SSC* variable calculated here in the summative manner with scores from EFA analysis. This result is presented later in the chapter under the section on robustness checks.

Socio-economic position

Utilizing the WHO's Commission on Social Determinants of Health framework, individual and household level socio-economic and demographic variables are included in the empirical analysis. As discussed in the literature review, previous studies have identified that these variables are important determinants of OOPE and CHE and thus are included as control variables in the model. Individual characteristics include an individual's age group and marital status. Age was self-reported in the survey and was captured as a continuous variable from 0 to

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99. It is converted into five distinct categories of 20-year blocks with less than 20 years as the reference category.

Household characteristics include household head's gender, education level, primary occupation, household size, asset ownership of a household, household's religion, caste, availability of clean toilet, access to clean drinking water and urban vs. rural location. Household head's education level was divided into five distinct categories; no education (reference category), primary education, secondary education, higher secondary, and graduate and above. Primary occupation was also divided into five categories; being employed in agriculture, as a laborer, working in unorganized small business, organized formal business, or other (reference category). All the other control variables mentioned before, except for household's caste and religion, are used as binary variables. Caste was categorized as "General category", "Other backward castes", "Scheduled Castes", "Scheduled Tribes" and "Others" (reference category). Religion was categorized as "Hindu", "Muslim", "Christian", "Sikh" and "Other" (reference category).

Health System Factors

Health system factors are considered as second group of control variables in the analysis. Health system variables include the source of the treatment, location of the treatment and the type of the treatment. Source of the treatment variable was divided into three categories i.e. whether all the ill members of the household underwent the treatment by a government doctor or a nurse (reference category), by a private doctor or a nurse in private facility, or at least one member was treated either by a pharmacist, traditional healer or witchcraft. Similarly, location of treatment variable has three distinct categories measuring whether the treatment of all ill members was undertaken in the village or the neighborhood (reference category), other town including district headquarter, or at least one member having to travel to another city or abroad for the treatment. Treatment type variable captured the nature of treatment i.e. allopathic,

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homeopathic/ayurvedic/herbal, surgery, or other (reference category) undertaken by the ill member of the household.

2.5. Empirical Strategy

To begin with, a descriptive analysis studying the distribution of CHE across covariates as numbers and percentages is provided. Next, five successive logistic regression models are fitted to study the association between *SSC* (key explanatory variable) and *CAT_EXP* (dependent variable).

Model 1 *(M1)* is a null model without any covariates and will serve as a benchmark for comparison with other models. Model 2 *(M2)* is same as *M1* and includes health system factors as control variables. Model 3 *(M3)* successively adds individual level controls from socio-economic position category defined in the framework. Model 4 *(M4)* further extends *M3* by including household level controls to the analysis. Model 5 *(M5)* is the last model and includes all the covariates from *M4* and adds district level fixed effects (FE) to control for district level factors that may influence the association between dependent variables and explanatory variables. Thus, the final equation with all the controls is:

$$(M5) \qquad Y_i = \alpha + \beta_0 * SSC_i + \beta_1 X_{ij} + \ldots + \beta_j X_{ij} + \gamma_k + u_i$$

Where, Y_i is the dependent variable; *CAT_EXP*,

SSC_i is the main household structural social capital explanatory variable,

X_{ij} (j= 1…n) are various individual, household and health system level controls,

i is the household,

α is the constant term in the regression,

β_0 is the coefficients of the main structural social capital explanatory variable,

β_j (j= 1…n) are the coefficients of the independent variables,

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γ_k is the district fixed effects,

And, u_i is the error term.

Further, heterogenous effects in the association between *SSC* and *CAT_EXP* among different caste groups and across different regions are studies. To undertake this analysis, *M5* specification is used in the regression for different caste groups, and for urban and rural regions separately.

Authors who have studied the relationship of social capital with health outcomes have highlighted the endogeneity concerns as there may be omitted variables that are correlated with a household's social capital and the expenses incurred by them in seeking the treatment. While to overcome this challenge, instrumental variable analysis is suggested, the data on instruments used in previous studies are not available in IHDS (Xue, Mo, and Reed 2016). Thus, this aspect of the model is unexplained in this thesis and is a subject of further study in this domain. However, to estimate the bias arising from omitted variables, I have compared the ratio of coefficient from restricted (base model) with the full model (Altonji, Elder, and Taber 2005).

Additionally, robustness of the results is checked, first, by undertaking the outlier analysis i.e. removing the outliers in the dataset and running fixed effect logistic regressions, and second by dividing the sample into four quartiles based on per capita consumption expenditure and then running the full specification model (*M5)* for each quartile.

2.6. Results and Discussion of Results

2.6.1. Descriptive Analysis

Descriptive statistics presented in Appendix *4*

Table 4 in Appendix 4 show that out of a total of 42,155 households surveyed in IHDS, 30,105 reported having at least one member facing a short-term or long-term illness and undergoing a medical treatment. Among these, 85.87% were headed by males and 14.13% by females.

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Approximately 1/3rd of the head of the households were uneducated and approx. 20% had studied till primary grade, with only 6.86 % households reporting the head of the household studying till graduate level or beyond. More than 2/3rd of the head of the households were employed in agriculture or as laborers with only 27.61% engaged in unorganized small business or any kind of organized formal employment. About 50% households reported having access to safe drinking water and 58.29% having access to any kind of toilet facility. A higher percentage (65.67%) of households were in rural areas. Distribution of illness across different caste groups show that OBCs (41.02%) were the largest group reporting illness followed by general category (28.69) and scheduled caste households (21.88).

Descriptive statistics presented in Table *5* in Appendix 4 show that among households who reported an illness episode, 20.24% households incurred CHE, with the household spending on an average 31% of the total household consumption expenditure on treatment. The mean OOPE on health for households incurring CHE (Rs. 37678.72) was more than three times the overall average (Rs. 9549.22). Expenses incurred while paying for doctor's fees, hospital admission expenses and surgery constitute the major burden (22%), followed by the amount spend on medicines and tests (8%), and travel by bus/train/taxi or lodging while getting treatment (2%).

Households incurring CHE also see a higher number of members falling ill on an average, which could be one possible reason of higher OOPE and incidence of CHE. These households also undergo treatment at a private health facility as compared to a government one. 65.56% households incurring CHE undergo a treatment at a private facility which is significantly higher than 60.28% households who did not incur CHE. Since, public health facilities in India either subsidize the treatment or provide treatment at free of cost, going to a private facility is positively correlated with the higher OOPE (Prinja et al. 2012) and may partially explain incidence of CHE.

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Further, a significantly higher percentage (60.96%) of households incurring CHE undergo a treatment in a city or a different town as compared to only 25.62% households who did not incur CHE. Besides, a higher proportion of households (9.57%) incurring CHE undergo a surgery in comparison to just 3.38% who did not incur a CHE. These factors also partially explain the high OOPE and incidence of CHE as traveling to a different town or a city or undergoing an advanced medical treatment like surgery adds to the overall cost of the treatment (Prinja et al. 2012).

Comparing the structural social capital, as defined by household social networks, we observe that households incurring CHE have lower acquaintances or affiliates in government services or political establishments and have lesser membership in caste / religious / professional groups; 1.64 connections as compared to 1.71 with the ones incurring CHE. Though the difference is not significant, there is an observable negative correlation between the percentage of total consumption expenditure a household spends while undergoing a treatment and the number of acquaintance and connections a household has in the society. I will further explore this relationship in the empirical analysis below.

2.6.2. Empirical Analysis

Estimated relationship between Social Capital and Catastrophic Health Expenditure

There are two parts to the empirical analysis. First part is to study the hypothesized directional association between a household's total *SSC* and *CAT_EXP*. My expectation here is to observe a negative relationship between *SSC* variable and likelihood of incurring a *CHE*. The second part of the empirical analysis studies the heterogenous effect of structural social capital on *CHE* across different caste groups and region categories.

Table 1 below presents the results from fixed effect logistic regression model. Here, I regress *CAT_EXP* on SSC (Column 1 to 5) and report odds-ratio. All the regression models use robust

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standard errors. District fixed effects are used to control for unobservable variables at the district level that may affect the expenditure incurred by the households in seeking treatment.

Table 1: Model comparison for fixed effects estimates of incidence of catastrophic health expenditure

	Logistic Regression				
	Dep var: CHE				
	(1)	(2)	(3)	(4)	(5)
Variables	M1	M2	M3	M4	M5
Structural Social Capital (As measured by social networks)	0.795**	0.611***	0.570***	0.795**	0.679***
	(0.076)	(0.064)	(0.060)	(0.090)	(0.093)
Household treatment source = 1, all members treated in private		1.470***	1.500***	1.577***	1.576***
		(0.061)	(0.063)	(0.067)	(0.076)
Household treatment source = 2, at least one treated in govt. or by a traditional healer		1.165***	1.180***	1.209***	1.267***
		(0.064)	(0.065)	(0.067)	(0.076)
Household treatment location = 1, all members treated in town		3.955***	3.878***	3.995***	4.633***
		(0.139)	(0.137)	(0.144)	(0.189)
Household treatment location = 2, atlest one member treated in city		4.531***	4.490***	4.546***	5.195***
		(0.203)	(0.204)	(0.208)	(0.255)
Household treatment type = 1, all members receiving non-allopathic treatment		2.035***	2.015***	1.987***	2.041***
		(0.140)	(0.140)	(0.140)	(0.155)
Household treatment type = 2, atlest one member had surgery		2.286***	2.234***	2.263***	2.266***
		(0.151)	(0.149)	(0.151)	(0.157)
Number of ill members in the household		1.234***	1.231***	1.292***	1.296***
		(0.018)	(0.018)	(0.020)	(0.022)
Age categories = 1, 20 to 39 years			1.137	1.213	1.152
			(0.601)	(0.645)	(0.627)
Age categories = 2, 40 to 59 years			1.579	1.836	1.787
			(0.835)	(0.977)	(0.973)
Age categories = 3, 60 to 79 years			2.143	2.296	2.216
			(1.134)	(1.221)	(1.208)
Age categories = 4, 80 years and above			2.730*	2.578*	2.440
			(1.467)	(1.392)	(1.350)
Marriage = 1, Married			1.037	1.113*	1.094
			(0.047)	(0.071)	(0.072)
Marriage = 2, Unmarried			2.133***	2.073***	2.077***

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	Logistic Regression				
	Dep var: CHE				
	(1)	(2)	(3)	(4)	(5)
Variables	M1	M2	M3	M4	M5
			(0.345)	(0.354)	(0.378)
Gender - HH head = Male				1.171**	1.234***
				(0.081)	(0.088)
Education - HH head = Primary				0.991	0.994
				(0.045)	(0.047)
Education - HH head = Secondary				0.990	0.980
				(0.044)	(0.046)
Education - HH head = Higher Secondary				0.982	0.987
				(0.076)	(0.080)
Education - HH head = Graduate and above				0.843**	0.856*
				(0.068)	(0.073)
Occupation - HH head = Agriculture				0.702***	0.692***
				(0.039)	(0.040)
Occupation - HH head = Labor				0.743***	0.714***
				(0.041)	(0.041)
Occupation - HH head = Unorganized small business				0.726***	0.715***
				(0.047)	(0.048)
Occupation - HH head = Organized formal employment				0.743***	0.752***
				(0.047)	(0.049)
HH size cluster = 1, more than 5				0.683***	0.653***
				(0.025)	(0.025)
Total household assets (0-33)				0.964***	0.958***
				(0.004)	(0.004)
Religion - HH head = 1, Hindu				0.926	0.911
				(0.139)	(0.148)
Religion - HH head = 2, Muslim				0.854	0.876
				(0.134)	(0.151)
Religion - HH head = 3, Christian				1.077	0.786
				(0.197)	(0.164)
Religion - HH head = 4, Sikh				1.187	0.973
				(0.208)	(0.202)
Caste - HH head = 1, General				1.038	1.077
				(0.147)	(0.163)
Caste - HH head = 2, OBC				0.941	0.905
				(0.133)	(0.135)
Caste - HH head = 3, SC				0.886	0.939
				(0.128)	(0.144)
Caste - HH head = 4, ST				0.607***	0.666**
				(0.095)	(0.111)
Region = 1, urban 1				1.022	1.151**
				(0.043)	(0.066)

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	Logistic Regression				
	Dep var: CHE				
	(1)	(2)	(3)	(4)	(5)
Variables	M1	M2	M3	M4	M5
Access to safe drinking water = 1, yes				1.043	1.041
				(0.037)	(0.048)
Access to toilet = 1, yes				1.112**	1.186***
				(0.046)	(0.056)
Constant	0.261***	0.070***	0.042***	0.071***	0.070***
	(0.005)	(0.003)	(0.022)	(0.041)	(0.044)
Observations	30,000	30,000	30,000	30,000	29,895

*Notes: Coefficient values in column 1 to column 5 report odds ratio from the logistic regression. Robust SE in parentheses. *** p<0.01, ** p<0.05, * p<0.1.*

Column 1 in *Table 1* represents the base model i.e. model without any control variables. Here, we can observe that the coefficients of *SSC* variable in column 1 is significant at 1 % level of significance. Moreover, odds-ratio of less than 1 in column 1 is in line with the hypothesized negative effect of *SSC* on likelihood of incurring CHE. As *SSC* variable is measured on a scale of 0-1, the odds-ratio tells us the association between structural social capital and CHE on two extremes of social capital index. Having maximum structural social capital (=1) reduces the likelihood of incurring CHE by approx. 20.5% (odds-ratio of 0.795 in column 1). Ideally, structural social capital should be measured along a continuous scale as it is rarely the case that households either have maximum networks in the communities or no networks. Thus, to aid the interpretation of the coefficients of the *SSC* variable, I will multiply it by 10 and accordingly rescale the coefficient value. In this manner, the coefficient of *SSC* shows that for each one-unit increase in structural social capital (a 10% increase in SSC) reduces the likelihood of incurring CHE by 2.05%. I will use this method of interpreting the coefficient further also. Having said this, this regression is the base model and doesn't serve much purpose as we need to control for more variables as outlined in the framework above.

In *M2,* we control for the health system factors like source, location and nature of the treatment. Here also, we observe that the variable of interest-*SSC* has a significant (at 1% level of

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significance) negative relationship with the CHE (Column 2). The odds-ratio has decreased further to 0.611 (column 2) implying that for 10% change in *SSC* variable the likelihood of incurring CHE goes down by 3.89%. Besides this and expectedly so, undergoing treatment in a private health facility (odds-ratio: 1.470), having to go to a town (odds-ratio: 3.955) or a city (odds-ratio: 4.531) for the treatment or undergoing a surgery (odds ratio: 2.286) also significantly increase the likelihood of incurring CHE, as the odds-ratios above one show us. These results are in line with the previous studies which have extensively documented the financial burden a household faces by undergoing treatment at private health facilities or inpatient treatment like a surgery (Ezat Wan Puteh and Almualm 2017). Unsurprisingly, having a higher number of ill members in the household also increased the likelihood of incurring CHE. Each additional sick member of the household increases the likelihood of incurring CHE by 23.4%.

Going forward, I added the individual level controls of age and marital status of the ill member of the household in *M3.* The *SSC* variable continues to have a significant negative impact on the possibility of a household incurring CHE. Though the odds-ratio dropped marginally from 0.611 to 0.570, it continues to remain significant at 1% level of significance. Besides this, illness of a very old member of the household (above 80 years of age) (odds ratio:2.730) and being unmarried (odds ratio: 2.073) are significant at 10% and 1% level of significance, respectively and are positively associated with likelihood of incurring CHE. This is line with the findings of Muhammad et al. (2012) who also identified a positive association between an elderly member in the household and increased OOPE on health.

Finally, *M4* in column 4 provides results after including household level controls which, as mentioned in the framework, define a household's socio-economic position and thus channelize the relationship between social networks and health system to affect the health outcomes. *M5* is same as *M4* but includes district fixed effects in addition to household level controls. Odds

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ratio of 0.679 on *SSC* variable in column 5 shows that after controlling for health system factors and variables that determine a household's socio-economic position, having social networks significantly (at 1% level) reduces the likelihood of incurring CHE. To be precise, a 10% increase in structural social capital is associated with 3.21% reduction in likelihood of incurring CHE. This is an important result considering social networks' influence on access to health care and the distribution of health resources in the society as documented by Zhu (2017). While studying the relationship between racial diversity, social networks and health inequalities in United States of America (USA), she documented that community networks promote individual's access to health care services by disseminating information about low-cost health care markets, removing barriers to care and ultimately have a negative impact on inequality in health care (Zhu 2017).

Also consistent with the previous studies mentioned in the literature review are determinants like having a higher education and having some form of employment (as a laborer, in informal business or formal jobs) instead of being engaged in agriculture successively reduces the odds of incurring CHE (Mahumud et al. 2018).

A higher household size will mean more people who can contribute to household resources and thus can provide a cushion against a health shock which may decrease the likelihood of the household incurring CHE. Which is what we observe here; a significant relationship with odds ratio of 0.653 *(M5)*.

A higher number of assets in the household is negatively associated with likelihood of incurring CHE (odds ratio: 0.958 in column 5). This result is also consistent with the previous literature which has argued that the relationship between a household's prosperity as measured by its income or assets and out of pocket expenditures on health could be mixed and we can observe negative association due to indirect effect through care provider and treatment choice (Wang, Temsah, and Carter 2016, 16).

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After understanding the overall association between *SSC* and *CAT_EXP*, we will now proceed to disaggregate this association across different caste groups and regions. This is important because previous studies have highlighted that specific social groups and disadvantaged rural communities in India face discrimination and devise social protection mechanisms that impact their health outcomes and bridge health inequities (George 2015). *Table 6* in Appendix 5 provide heterogenous fixed effects estimates from logistic regression of *SSC* on incidence of CHE, by caste and region. Here also, *SSC* is negatively associated with likelihood of incurring CHE for households belonging to different castes and across different regions but is significant only for '*Other Backward Caste*' category and households in rural areas. The results are significant at 1% level for both the categories i.e. households belonging to OBC category and in rural areas. A 10% increase in SSC leads to 4.44% decrease in likelihood of incurring catastrophic health expenditure among both households belonging to 'OBC' category as well as in rural areas.

2.6.3 Robustness Checks

Now we will proceed to the robustness checks. To begin with we estimate the potential existence of omitted variables in the model by examining coefficient stability. Altonji, Elder, and Taber (2005) provide a technique, where one can calculate the influence of unobservable factors by measuring the influence on observables (assuming observable and unobservable are independently drawn). If the coefficients on the variable of interest does not change significantly when we include observable variables, it is suggestive that the omitted variable bias stemming from unobservable variables is limited. Calculating the ratio of coefficients from the full model with the difference of restricted model ($\frac{\beta f}{\beta r - \beta f}$) in *Table 1*, we get a value of -6.85 ($\frac{0.795}{0.679-0.795}$). The smaller is the difference between restricted and unrestricted coefficients the lower the influence of omitted variables bias. This suggests that the selection on un-

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observables must be about 7 times greater than the selection on observables to wipe out the estimated relationship.

Second, we estimate the hypothesized relationship between structural social capital and likelihood of catastrophic health expenditure among households belonging to different income quartiles. *Table 7* provide the relevant regression results. Column 1 to column 4 provide the regression results from the four quartiles respectively. In all the specifications I have added district fixed effects and estimated the model with robust standard errors. The coefficient value (odds ratio) of the SSC variable remains below one in all the four quartiles. However, it is significant (at 1% level) only for the second and fourth quartile. Moreover, some other variables which are significant for full sample become insignificant for some quartiles. For instance, likelihood of CHE is not significantly positively associated with a household in the poorest quartile having a member undergoing a surgery. This may be because the household belonging to the poorest quartile rely mostly on government healthcare system which is either heavily subsidized or free in most of the cases.

The sub-sample analysis of different consumption quartiles provides us mixed results, and this may be because the presence of outliers in the dataset. Finally, we estimate the regression results after removing the outliers from the dataset. 99 percent of the households spend less than or equal to 63.3% of their total household consumption expenditure on health treatment. There are 422 households who spend more than this percentage and are outliers in the dataset. After removing these observations, we are left with 29,409 households. Fixed effect logistic regression results from the reduced sample (after removing outliers) and on the subsample of different income quartiles are consistent with the results from the full sample.[2] This provides some confidence in the robustness of the results.

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[2] These results are not included in the thesis. However, can be provided on request.

To conclude, the analysis presents here indicates a negative association between structural social capital and incidence of catastrophic health expenditure on a household. This analysis has its limitations like potential omitted variable bias and require richer data for more robust analysis.

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Conclusion

The aim of the thesis was to determine the factors significantly associated with the likelihood of incurring catastrophic health expenditure by a household and test the hypothesis of negative association between structural social capital and catastrophic health expenditure in India using the India Human Development Survey from 2011-12. To accomplish this, relationship between household structural social capital, as measured by a household's social networks and incidence of catastrophic health expenditure on a household is analyzed using a quantitative approach consisting of logistic regression. It is shown that a household's structural social capital is negatively associated with the likelihood of incurring catastrophic health expenditure and the relationship is significant at 1% level of significance. The relationship is studied under the WHO's Commission on Social Determinants of Health Framework as it provides a systematic framework to study the interactions between various determinants of health; the socio-economic factors, health system factors and the social networks (WHO 2010).

Variables identified in the previous studies that are significantly associated with the out-of-pocket expenditure or catastrophic health expenditure are added as control variables. Then, estimates for different caste groups and households in urban and rural regions are estimated separately to study the heterogenous effects. District level fixed effects are used to control for regional variations and models are estimated with robust standard errors.

The study identifies significant negative relationship between structural social capital and likelihood of catastrophic health expenditure. In the full specification, with controls and district fixed effects, a 10% increase in structural social capital is associated with 5.38% reduction in likelihood of incurring catastrophic health expenditure. Across caste groups, maximum effect is observed for households belonging to '*Scheduled Tribes'* category where 10% increase in structural social capital is associated with 7.66% decrease in probability of incurring

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catastrophic health expenditure followed by '*Other Backward Castes'* (6.63%). The result for '*Scheduled Tribe*' category is significant at 10% level of significance and for '*Other Backward Caste'* at 1% level of significance. Across regions, households in rural areas have the highest association with 10% increase in structural social capital associated with 6.1% decrease in likelihood of catastrophic health expenditure as compared to the ones in the urban areas (4.6%).

The thesis contributes to the academic literature studying catastrophic health expenditure, out-of-pocket expenditure and social capital in India and other low-income countries. This is the first study which utilizes a systematic framework to quantitatively assess the nature of relationship between structural social capital and CHE in India using a nationally representative dataset. The thesis also confirms findings from the earlier studies identifying positive association between undergoing treatment in a private health facility, having to go to another town or a city for the treatment, undergoing a surgery, household size, illness of a very old member (above 80 years) in the household and having more number of ill members in the household (Ezat Wan Puteh and Almualm 2017; Muhammad Malik and Azam Syed 2012). Some factors like a higher education of household head, household head having some form of employment (as a laborer, in informal business or formal jobs) instead of being engaged in agriculture and the house having access to safe drinking water and toilet are found to be negatively associated with the likelihood of incurring CHE (Muhammad Malik and Azam Syed 2012; Mahumud et al. 2018).

This research can be extended in several ways. To begin with, non-experimental, cross-sectional nature of the dataset limits the analysis in the study to just provide associational inferences and not make any causal claims. a deeper look in the mechanisms behind the negative association between structural social capital or social networks and catastrophic health expenditure may be taken for better identification. Ideally, an instrument for structural social

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capital is needed to test the existence of causal relationship with catastrophic health expenditure and overcome the omitted variable bias in the study.

Second, though the fixed effect regression analysis employed in the study controls for unobservable variables at the district level, important household level unobservable variables may still lead to omitted variable bias. This limitation can be overcome either by identifying a suitable instrument as described above or by utilizing a panel dataset which allows for controlling for household fixed effects and deploying a difference-in-differences approach to make some causal claims by studying the trend overtime. IHDS provides a panel dataset that can be accessed and utilized provided enough funding for the study is available.

Finally, measurement of the structural social capital was limited by the questions asked during the survey and the summation methodology used to capture the structural social capital. This methodology is at best provide a crude approximation of quantity of social networks of a household but fall short of providing any information on the distribution and quality of those networks. Further research is required for appropriately measuring a household's structural social capital. Some guidance in this respect can be taken from Story (2014) and Hasan et al. (2020) who deploy an exploratory factor analysis or a confirmatory factor analysis technique to measure structural social capital in their studies.

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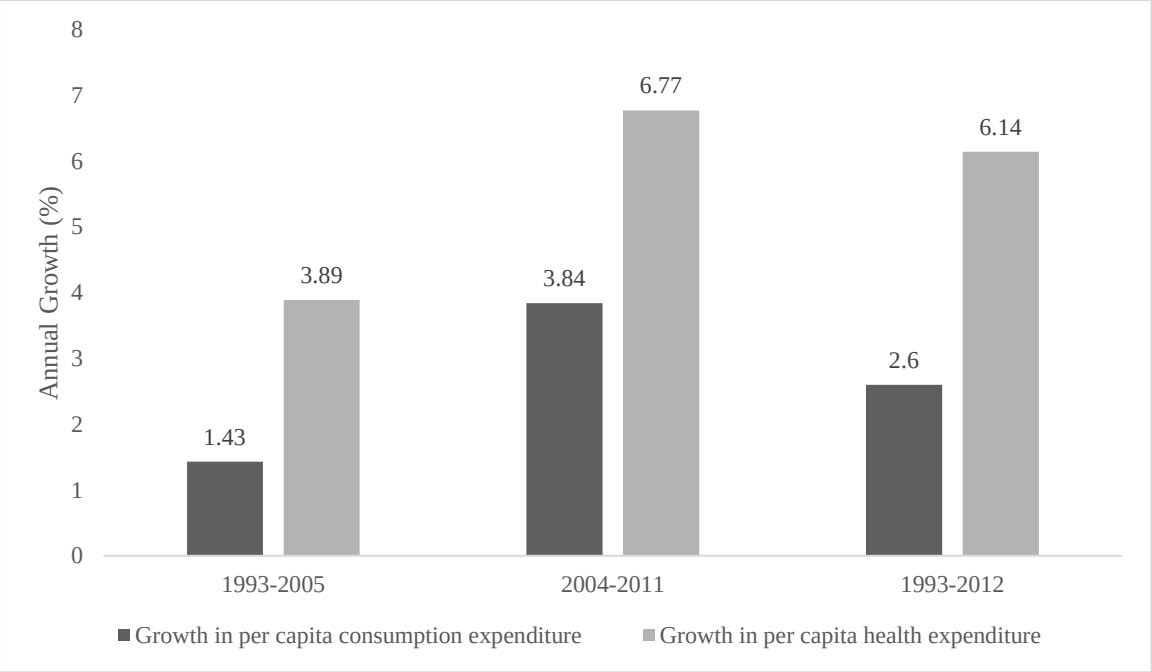
Appendix 1

Figure 1: Growth in annual per capita consumption expenditure and annual per capita health expenditure at constant prices in India over the period 1993–2012



Source: (Mohanty et al. 2016)

Table 2: Growth in annual per capita consumption expenditure and annual per capita health expenditure at constant prices in rural and urban areas in India over the period 1993–2012

Variable	Growth in per capita consumption expenditure			Growth in per capita health expenditure		
	1993–2005	2004–2012	1993–2012	1993–2005	2004–2012	1993–2012
Place of residence						
Rural	1.06	3.16	2.02	3.39	6.20	5.38
Urban	1.98	3.81	3.01	4.92	6.86	7.12

Source: (Mohanty et al. 2016)

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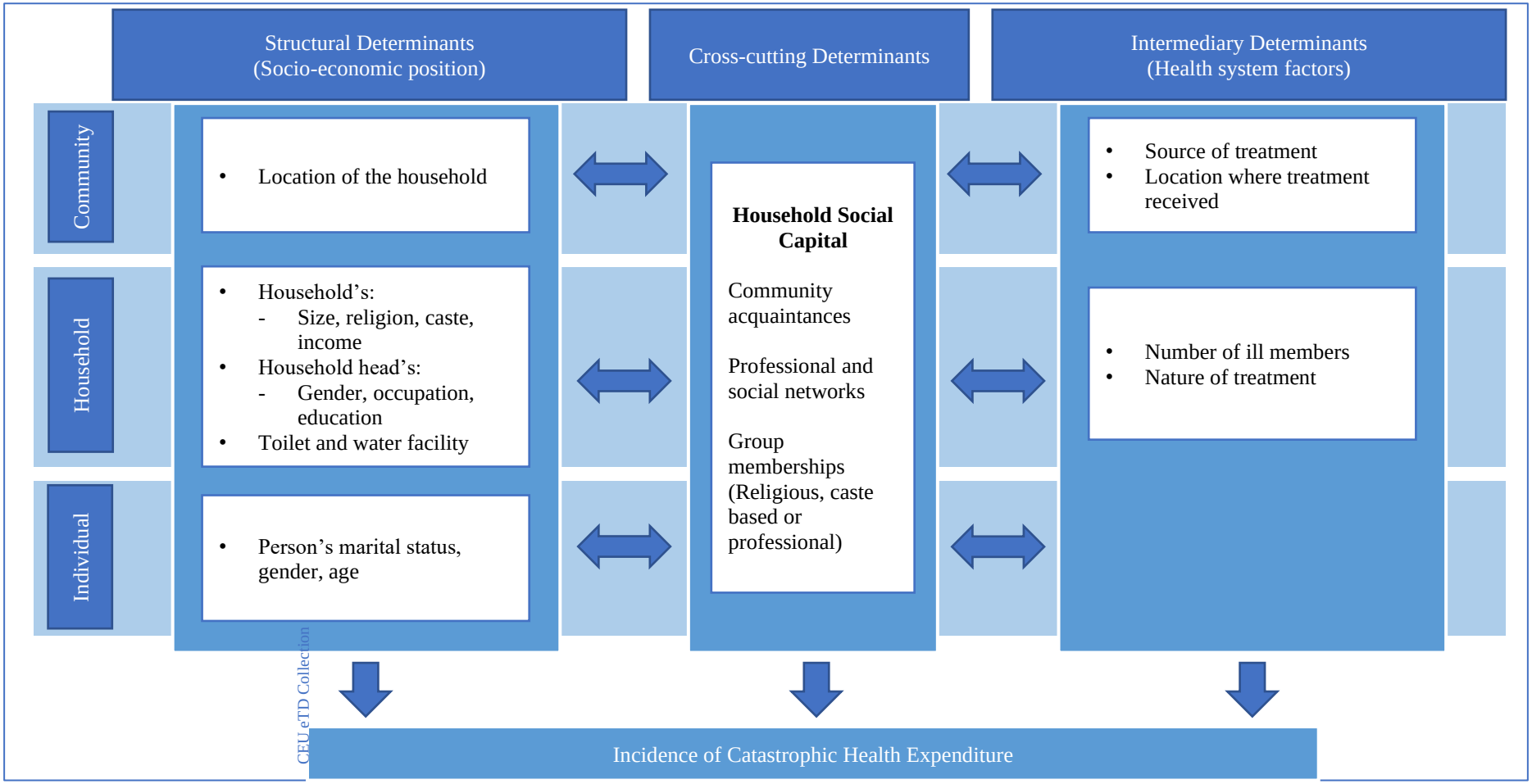
Appendix 2

Figure 2: Conceptual framework to explore the role of structural social capital as a determinant of CHE in India



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Source: Adapted from WHO (2010, 6) and Hasan et al. (2020, 3)

Appendix 3

Table 3: Percentage of missing values in observations

Variable	Label	Missing	Total	Percent Missing
treatsource	Source of the treatment	0	30,105	0.00
treatlocation	Location of the treatment	0	30,105	0.00
treattype	Type of the treatment	0	30,105	0.00
numberill	Number of ill members in the household	0	30,105	0.00
agegroup	Age group	0	30,105	0.00
marriage	Marriage status	0	30,105	0.00
hhgender	Gender of the head of the household	0	30,105	0.00
hheduc	Education status of the head of the household	21	30,105	0.07
hhoccupation	Occupation status of the head of the household	0	30,105	0.00
hhsizecluster	Household size cluster	0	30,105	0.00
loghhpcce	Log of household per capita consumption expenditure	10	30,105	0.03
hhreligion	Religion of the household	0	30,105	0.00
hhcaste	Caste of the household	62	30,105	0.21
urban	Location of the household (urban vs. rural)	0	30,105	0.00
water	Access to safe drinking water	0	30,105	0.00
toilet	Access to clean toilet	0	30,105	0.00
district	District	15	30,105	0.05

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Appendix 4

Table 4: Descriptive statistics of control variables

	Household Catastrophic Expenditure			p-value
	No N=24,011	Yes N=6,094	Total N=30,105	
	% (n)	% (n)	% (n)	
Total household assets (0-33) [b]	15.46 (6.69)	15.01 (6.51)	15.37 (6.66)	<0.001
Age categories				<0.001
less than 19 years	0.07 (18)	0.07 (4)	0.07 (22)	
20 to 39 years	24.77 (5,947)	16.87 (1,028)	23.17 (6,975)	
40 to 59 years	48.99 (11,764)	46.75 (2,849)	48.54 (14,613)	
60 to 79 years	24.21 (5,812)	33.02 (2,012)	25.99 (7,824)	
80 years and above	1.96 (470)	3.30 (201)	2.23 (671)	
Marriage				0.13
Otherwise	14.63 (3,514)	14.79 (901)	14.67 (4,415)	
Married	84.52 (20,294)	84.10 (5,125)	84.43 (25,419)	
Unmarried	0.85 (203)	1.12 (68)	0.90 (271)	
Gender - HH head				0.23
Female	14.25 (3,422)	13.65 (832)	14.13 (4,254)	
Male	85.75 (20,589)	86.35 (5,262)	85.87 (25,851)	
Education - HH head [a]				<0.001
None	31.99 (7,682)	34.87 (2,125)	32.58 (9,807)	
Up to primary	19.89 (4,776)	20.32 (1,238)	19.98 (6,014)	
Up to secondary	34.88 (8,375)	33.67 (2,052)	34.64 (10,427)	
Up to higher secondary	6.04 (1,450)	5.28 (322)	5.89 (1,772)	
Graduate and beyond	7.14 (1,714)	5.74 (350)	6.86 (2,064)	
Occupation - HH head				<0.001
Other	18.61 (4,468)	24.71 (1,506)	19.84 (5,974)	
Engaged in agriculture	23.36 (5,609)	25.25 (1,539)	23.74 (7,148)	
Laborer	29.29	26.90	28.80	

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	Household Catastrophic Expenditure			
	No N=24,011	Yes N=6,094	Total N=30,105	p-value
	% (n)	% (n)	% (n)	
	(7,032)	(1,639)	(8,671)	
Engaged in unorganized small business	12.26 (2,944)	10.55 (643)	11.91 (3,587)	
Organized formal employment	16.48 (3,958)	12.59 (767)	15.70 (4,725)	
HH size cluster				0.008
Less than 5	65.40 (15,703)	67.20 (4,095)	65.76 (19,798)	
More than 5	34.60 (8,308)	32.80 (1,999)	34.24 (10,307)	
Religion - HH head				0.029
Other	1.35 (324)	1.02 (62)	1.28 (386)	
Hindu	81.26 (19,512)	81.10 (4,942)	81.23 (24,454)	
Muslim	12.58 (3,020)	12.50 (762)	12.56 (3,782)	
Christian	2.27 (546)	2.25 (137)	2.27 (683)	
Sikh	2.54 (609)	3.13 (191)	2.66 (800)	
Caste - HH head [a]				<0.001
Other	1.20 (287)	1.23 (75)	1.20 (362)	
General	28.17% (6,765)	30.74% (1,873)	28.69% (8,638)	
OBC	40.62 (9,754)	42.58 (2,595)	41.02 (12,349)	
SC	22.19 (5,327)	20.69 (1,261)	21.88 (6,588)	
ST	7.64 (1,835)	4.45 (271)	7.00 (2,106)	
Region				<0.001
Rural	64.58 (15,506)	69.95 (4,263)	65.67 (19,769)	
Urban	35.42 (8,505)	30.05 (1,831)	34.33 (10,336)	
Access to safe drinking water				0.002
No	49.22 (11,818)	51.39 (3,132)	49.66 (14,950)	
Yes	50.78 (12,193)	48.61 (2,962)	50.34 (15,155)	

Notes: Groups are compared using Pearson's chi-squared test for categorical variables.
a: Contain missing values.
B: Mean (SD) for continuous measures

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Table 5: Descriptive statistics of key social capital and illness variables

	Household Catastrophic Expenditure			
	No N=24,011	Yes N=6,094	Total N=30,105	p-value
	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	
Social Capital variables				
Household Structural Social Capital (As measured by Social Networks)	1.71 (1.99)	1.64 (1.93)	1.70 (1.98)	0.017
Bonding (Caste and Religious ties)	0.19 (0.49)	0.19 (0.50)	0.19 (0.49)	0.91
Bridging (Economic and professional ties)	0.28 (0.56)	0.27 (0.55)	0.28 (0.56)	0.14
Linking (Government and Political ties)	1.25 (1.69)	1.19 (1.63)	1.23 (1.68)	0.022
Illness and Treatment Related Variables				
Number of ill members in the household	1.67 (1.00)	2.03 (1.17)	1.74 (1.05)	<0.001
Household treatment source [a]				<0.001
All members treated in government	23.94% (5,749)	15.52% (946)	22.24% (6,695)	
All members treated in private	60.28% (14,475)	65.56% (3,995)	61.35% (18,470)	
At least one treated by a traditional healer	15.77% (3,787)	18.92% (1,153)	16.41% (4,940)	
Household treatment location [a]				<0.001
All members treated in village	74.38% (17,859)	39.04% (2,379)	67.22% (20,238)	
All members treated in town	17.46% (4,193)	35.90% (2,188)	21.20% (6,381)	
At least one member treated in city	8.16% (1,959)	25.06% (1,527)	11.58% (3,486)	
Household treatment type [a]				<0.001
All members had allopathic treatment	93.36% (22,417)	84.28% (5,136)	91.52% (27,553)	
All members - other than allopathic	3.36% (807)	6.15% (375)	3.93% (1,182)	
At least one member had surgery	3.28% (787)	9.57% (583)	4.55% (1,370)	
OOPE related variables				
HH per capital consumption expenditure	26867.41 (32598.96)	28677.89 (28874.01)	27233.42 (31888.87)	<0.001
Household OOPE (in Rs)	2409.94 (5319.39)	37678.72 (60840.10)	9549.22 (31186.21)	<0.001
Household OOPE (proportion out of total)	0.02 (0.02)	0.31 (0.68)	0.08 (0.33)	<0.001
OOPE for Doctor's fees (in Rs)	462.07	11418.00	2679.83	<0.001

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	Household Catastrophic Expenditure			
	No N=24,011	Yes N=6,094	Total N=30,105	p-value
	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	
	(2005.20)	(38437.42)	(17933.69)	
OOPE for Doctor's fees (proportion out of total)	0.01 (0.02)	0.22 (0.53)	0.05 (0.25)	<0.001
OOPE on Medicines (in Rs)	314.31 (1536.96)	3763.39 (10335.35)	1012.49 (5042.30)	<0.001
OOPE on Medicines (proportion out of total)	0.01 (0.01)	0.08 (0.20)	0.02 (0.09)	<0.001
OOPE for Travel expenses (in Rs)	56.61 (293.95)	729.02 (2721.11)	192.73 (1280.87)	<0.001
OOPE for Travel expenses (proportion out of total)	0.00 (0.00)	0.02 (0.05)	0.00 (0.02)	<0.001

Notes: Groups are compared using Pearson's chi-squared test for categorical variables.
a: For categorical variables column percentages and sample size (in parenthesis) are reported.

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Appendix 5

Table 6: Model comparison for heterogenous fixed effects estimates of incidence of catastrophic health expenditure, by caste and region

	Dep var: Incidence of Catastrophic Health Expenditure (1=Yes)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	Other	General	OBC	SC	ST	Rural	Urban
Structural Social Capital (as measured by household social networks)	0.709	0.907	0.556***	0.753	0.296	0.556***	0.861
	(1.133)	(0.212)	(0.126)	(0.279)	(0.220)	(0.100)	(0.191)
Household treatment source = 1, all members treated in private	1.169	1.478***	1.687***	1.548***	1.828***	1.511***	1.757***
	(0.765)	(0.135)	(0.130)	(0.171)	(0.408)	(0.089)	(0.153)
Household treatment source = 2, at least one treated in govt. or by a traditional healer	2.743	1.122	1.370***	1.205	1.769**	1.248***	1.320**
	(3.062)	(0.124)	(0.133)	(0.164)	(0.513)	(0.091)	(0.144)
Household treatment location = 1, all members treated in town	6.495***	4.306***	4.897***	5.965***	6.649***	5.463***	3.701***
	(4.009)	(0.334)	(0.315)	(0.580)	(1.460)	(0.275)	(0.287)
Household treatment location = 2, atlest one member treated in city	63.033***	5.018***	5.204***	6.718***	8.526***	5.998***	4.219***
	(74.854)	(0.462)	(0.403)	(0.750)	(2.506)	(0.357)	(0.400)
Household treatment type = 1, all members undergoing non-allopathic treatment	8.389**	2.082***	1.939***	2.619***	3.455***	2.351***	1.644***
	(7.242)	(0.284)	(0.247)	(0.460)	(1.228)	(0.224)	(0.223)
Household treatment type = 2, atlest one member had surgery	8.400*	2.202***	2.096***	2.753***	3.955***	2.304***	2.303***
	(9.146)	(0.275)	(0.231)	(0.464)	(1.458)	(0.199)	(0.272)
Number of ill members in the household	1.662*	1.352***	1.279***	1.287***	1.342***	1.275***	1.353***
	(0.464)	(0.044)	(0.033)	(0.049)	(0.153)	(0.027)	(0.040)

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	Dep var: Incidence of Catastrophic Health Expenditure (1=Yes)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	Other	General	OBC	SC	ST	Rural	Urban
Age categories = 1, 20 to 39 years	0.001***	0.568	0.160	7.596**	0.769	1.176	0.897
	(0.002)	(0.542)	(0.216)	(6.493)	(1.340)	(0.738)	(0.929)
Age categories = 2, 40 to 59 years	0.006**	0.875	0.259	11.240***	1.307	1.801	1.457
	(0.012)	(0.834)	(0.349)	(9.626)	(2.286)	(1.129)	(1.509)
Age categories = 3, 60 to 79 years	0.010**	1.046	0.318	15.977***	1.352	2.152	1.885
	(0.020)	(0.996)	(0.428)	(13.721)	(2.369)	(1.349)	(1.955)
Age categories = 4, 80 years and above		1.190	0.291	22.788***	2.530	2.073	2.872
		(1.145)	(0.394)	(20.690)	(4.810)	(1.322)	(3.016)
Marriage = 1, Married	0.879	1.116	0.950	1.325*	1.195	1.078	1.181
	(1.014)	(0.133)	(0.100)	(0.198)	(0.461)	(0.085)	(0.150)
Marriage = 2, Unmarried	13.612	1.565	1.603	5.374***	3.099	1.809***	2.581***
	(25.971)	(0.532)	(0.475)	(2.158)	(4.361)	(0.407)	(0.775)
Gender - HH head = Male	0.822	1.182	1.393***	1.139	1.673	1.425***	0.922
	(0.956)	(0.158)	(0.159)	(0.180)	(0.717)	(0.123)	(0.125)
Education - HH head = Up to Primary	0.784	0.977	1.029	0.969	0.805	0.941	1.144
	(0.585)	(0.097)	(0.075)	(0.101)	(0.187)	(0.052)	(0.113)
Education - HH head = Upton Secondary	2.117	0.901	0.999	0.899	1.427	0.901*	1.178*
	(1.525)	(0.084)	(0.072)	(0.093)	(0.334)	(0.050)	(0.109)
Education - HH head = up to Higher Secondary	1.290	1.020	1.015	0.874	0.765	0.904	1.216
	(1.528)	(0.143)	(0.134)	(0.183)	(0.402)	(0.095)	(0.165)
Education - HH head = Graduate and beyond		0.888	0.953	0.523**	0.851	0.680***	1.142

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	Dep var: Incidence of Catastrophic Health Expenditure (1=Yes)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	Other	General	OBC	SC	ST	Rural	Urban
		(0.124)	(0.137)	(0.145)	(0.518)	(0.087)	(0.149)
Occupation - HH head = Engaged in agriculture	0.862	0.677***	0.742***	0.614***	0.576*	0.671***	0.802
	(0.849)	(0.070)	(0.067)	(0.091)	(0.178)	(0.045)	(0.142)
Occupation - HH head = Engaged as a laborer	1.070	0.690***	0.728***	0.711***	0.848	0.688***	0.753***
	(0.887)	(0.085)	(0.066)	(0.090)	(0.260)	(0.049)	(0.081)
Occupation - HH head = Engaged in informal small business	0.784	0.596***	0.722***	0.970	0.964	0.779***	0.673***
	(0.869)	(0.073)	(0.075)	(0.171)	(0.412)	(0.072)	(0.069)
Occupation - HH head = Engaged in formal employment	0.536	0.728***	0.715***	0.896	0.937	0.741***	0.751***
	(0.587)	(0.081)	(0.078)	(0.139)	(0.373)	(0.070)	(0.074)
HH size cluster = 1, more than 5	1.240	0.657***	0.638***	0.656***	0.695*	0.634***	0.695***
	(0.746)	(0.049)	(0.038)	(0.058)	(0.131)	(0.029)	(0.049)
Total household assets (0-33)	0.877*	0.950***	0.950***	0.967***	0.982	0.960***	0.948***
	(0.065)	(0.008)	(0.007)	(0.010)	(0.022)	(0.005)	(0.008)
Religion - HH head = 1, Hindu	0.949	0.996	0.311*	0.707	1.285	0.829	1.110
	(0.936)	(0.388)	(0.190)	(0.230)	(0.584)	(0.169)	(0.326)
Religion - HH head = 2, Muslim	1.644	0.910	0.308*	1.124	0.659	0.816	1.049
	(2.113)	(0.369)	(0.189)	(0.601)	(0.700)	(0.178)	(0.321)
Religion - HH head = 3, Christian		1.139	0.243**	0.547	2.028	0.783	0.812
		(0.527)	(0.162)	(0.268)	(1.292)	(0.221)	(0.285)
Religion - HH head = 4, Sikh		1.074	0.487	0.526		0.859	1.351
		(0.462)	(0.325)	(0.229)		(0.230)	(0.490)

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	Dep var: Incidence of Catastrophic Health Expenditure (1=Yes)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	Other	General	OBC	SC	ST	Rural	Urban
Region = 1, urban	0.777	1.310**	1.065	1.203	0.843		
	(0.653)	(0.139)	(0.099)	(0.178)	(0.331)		
Access to safe drinking water = 1, yes	1.034	0.951	1.181**	0.818*	1.136	1.061	0.934
	(0.681)	(0.082)	(0.087)	(0.092)	(0.310)	(0.061)	(0.078)
Access to toilet = 1, yes	0.104**	1.261**	1.221***	1.205*	0.917	1.159***	1.296**
	(0.108)	(0.119)	(0.089)	(0.129)	(0.255)	(0.063)	(0.139)
Caste - HH head = 1, General						1.128	1.057
						(0.225)	(0.260)
Caste - HH head = 2, OBC						0.930	0.938
						(0.183)	(0.228)
Caste - HH head = 3, SC						0.943	1.057
						(0.189)	(0.267)
Caste - HH head = 4, ST						0.663*	0.755
						(0.142)	(0.235)
Constant	3.296	0.178	1.057	0.056**	0.043	0.056***	0.150
	(9.861)	(0.193)	(1.654)	(0.075)	(0.102)	(0.042)	(0.179)
Observations	263	8,431	12,094	6,182	1,770	19,681	10,181

Notes: Coefficient values report odds ratio from the logistic regression. Robust SE in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

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Table 7: Model comparison for fixed effects estimates of incidence of catastrophic health expenditure, by income quartile

	Dep var: Incidence of Catastrophic Health Expenditure (1=Yes)			
	(1)	(2)	(3)	(4)
Variables	Quartile 1 (poorest)	Quartile 2	Quartile 3	Quartile 4 (wealthiest)
Structural Social Capital (as measured by household social networks)	0.688	0.464**	0.796	0.540***
	(0.288)	(0.155)	(0.225)	(0.121)
Household treatment source = 1, all members treated in private	1.747***	1.445***	1.699***	1.448***
	(0.190)	(0.151)	(0.167)	(0.140)
Household treatment source = 2, at least one treated in govt. or by a traditional healer	1.475***	1.219	1.451***	1.072
	(0.190)	(0.155)	(0.179)	(0.138)
Household treatment location = 1, all members treated in town	6.502***	6.139***	4.243***	3.780***
	(0.641)	(0.548)	(0.347)	(0.299)
Household treatment location = 2, atlest one member treated in town or city	8.851***	6.136***	4.472***	4.010***
	(0.990)	(0.622)	(0.460)	(0.411)
Household treatment type = 1, all members - other than allopathic	1.707**	2.284***	2.057***	2.341***
	(0.356)	(0.405)	(0.312)	(0.308)
Household treatment type = 2, atlest one member had surgery	1.307	2.129***	2.539***	3.036***
	(0.230)	(0.331)	(0.348)	(0.397)
Number of ill members in the household	1.199***	1.361***	1.390***	1.330***
	(0.043)	(0.048)	(0.052)	(0.052)

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	Dep var: Incidence of Catastrophic Health Expenditure (1=Yes)			
	(1)	(2)	(3)	(4)
Variables	Quartile 1 (poorest)	Quartile 2	Quartile 3	Quartile 4 (wealthiest)
Age categories = 1, 20 to 39 years	0.180**	0.757	0.437***	0.507***
	(0.154)	(0.209)	(0.109)	(0.110)
Age categories = 2, 40 to 59 years	0.304	1.159	0.675*	0.668**
	(0.260)	(0.305)	(0.159)	(0.132)
Age categories = 3, 60 to 79 years	0.347	1.344	0.923	0.846
	(0.297)	(0.343)	(0.211)	(0.159)
Age categories = 4, 80 years and above	0.436			
	(0.386)			
Marriage = 1, married	1.120	1.011	1.425***	0.955
	(0.168)	(0.145)	(0.195)	(0.123)
Marriage = 2, unmarried	1.559	2.001	3.769***	1.145
	(0.829)	(0.857)	(1.297)	(0.384)
Gender - HH head = 1, Male	1.282	1.392**	1.067	1.407**
	(0.220)	(0.220)	(0.157)	(0.194)
Education - HH head = 1, up to primary	1.086	0.829*	1.008	1.008
	(0.105)	(0.080)	(0.102)	(0.113)
Education - HH head = 2, up to secondary	0.945	0.852*	0.953	0.944
	(0.099)	(0.082)	(0.092)	(0.097)
Education - HH head = 3, up to higher secondary	0.808	0.959	0.868	0.983

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Variables	Dep var: Incidence of Catastrophic Health Expenditure (1=Yes)			
	(1) Quartile 1 (poorest)	(2) Quartile 2	(3) Quartile 3	(4) Quartile 4 (wealthiest)
	(0.194)	(0.183)	(0.137)	(0.146)
Education - HH head = 4, graduate and beyond	0.615	0.863	0.787	0.789*
	(0.225)	(0.225)	(0.140)	(0.113)
Occupation - HH head = 1, engaged in agriculture	0.517***	0.661***	0.795**	0.647***
	(0.075)	(0.082)	(0.091)	(0.075)
Occupation - HH head = 2, employed as a labor	0.729**	0.758**	0.790**	0.540***
	(0.102)	(0.093)	(0.092)	(0.070)
Occupation - HH head = 3, engaged in unorganized small business	0.799	0.761*	0.846	0.562***
	(0.143)	(0.113)	(0.113)	(0.070)
Occupation - HH head = 4, engaged in organized formal employment	0.678*	0.778	0.856	0.656***
	(0.144)	(0.126)	(0.111)	(0.073)
HH size cluster = 1, more than 5	0.805**	0.809**	0.656***	0.671***
	(0.068)	(0.067)	(0.058)	(0.063)
Total household assets (0-33)	0.970***	0.931***	0.952***	0.925***
	(0.010)	(0.009)	(0.009)	(0.009)
Religion - HH head = 1, Hindu	0.696	1.452	1.131	0.852
	(0.221)	(0.620)	(0.443)	(0.267)
Religion - HH head = 2, Muslim	0.632	1.495	0.983	0.963
	(0.218)	(0.664)	(0.401)	(0.325)

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	Dep var: Incidence of Catastrophic Health Expenditure (1=Yes)			
	(1)	(2)	(3)	(4)
Variables	Quartile 1 (poorest)	Quartile 2	Quartile 3	Quartile 4 (wealthiest)
Religion - HH head = 3, Christian	0.573	1.511	0.812	0.749
	(0.316)	(0.881)	(0.383)	(0.275)
Religion - HH head = 4, Sikh	1.105	2.822*	1.083	0.873
	(1.205)	(1.617)	(0.505)	(0.313)
Caste - HH head = 1, General	0.450*	1.263	0.894	1.154
	(0.196)	(0.552)	(0.262)	(0.269)
Caste - HH head = 2, OBC	0.391**	0.946	0.774	1.014
	(0.171)	(0.411)	(0.222)	(0.233)
Caste - HH head = 3, SC	0.389**	1.179	0.772	1.047
	(0.172)	(0.517)	(0.229)	(0.257)
Caste - HH head = 4, ST	0.286***	0.696	0.718	0.608
	(0.130)	(0.320)	(0.240)	(0.196)
Region = 1, urban 1	1.103	1.088	1.076	1.325**
	(0.170)	(0.142)	(0.118)	(0.149)
Access to safe drinking water = 1, yes	0.943	1.106	0.928	1.191**
	(0.114)	(0.116)	(0.083)	(0.105)
Access to toilet = 1, yes	1.002	1.273**	1.219**	1.220*
	(0.106)	(0.125)	(0.115)	(0.133)
Constant	2.567	0.099***	0.132***	0.308**

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Variables	Dep var: Incidence of Catastrophic Health Expenditure (1=Yes)			
	(1)	(2)	(3)	(4)
	Quartile 1 (poorest)	Quartile 2	Quartile 3	Quartile 4 (wealthiest)
	(3.168)	(0.087)	(0.091)	(0.182)
Observations	6,946	7,141	7,197	7,326

Notes: Coefficient values report odds ratio from the logistic regression. Robust SE in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

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