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Abstract

NCD morbidity and mortality as shares of total morbidity and mortality have risen steadily in India and projected to surge rapidly. Currently, cardiovascular diseases, cancer, respiratory illness, and diabetes are the leading causes of death in India, accounting for almost 50% of all deaths. Underlying these rising shares are growing risks that are common to several NCDs. They are linked to aging and affluence and have replaced infectious diseases and malnutrition as the dominant causes of ill health and death in much of the world including India. The present study addresses three questions: Why has the prevalence of two NCDs, diabetes and heart diseases risen in recent years? Given the surge in these diseases, whether social protection policies and restructuring of medical services can mitigate such surges in the near future? A related but equally important concern is whether lifestyle and dietary changes could be induced to further prevent the rising burden of these NCDs. Our analysis is based on the only all-India panel survey-India Human Development Survey that covers 2005 and 2012. A robust econometric methodology is used to address the endogeneity of key explanatory variables. The results stress the need to make sure that pension and healthcare reforms are accompanied by greater awareness, expansion of old age pensions and public hospitals, and effective regulation of both public and private hospitals- a daunting but not insurmountable challenge.

Key words: NCDs, Diabetes, Heart diseases, Old age pensions, Hospitals, India

JEL codes: I18, I12, I38

Is the Growing Burden of Non-Communicable Diseases in India Preventable[1]?

1. Introduction

The older population of India is currently the world's second largest- 140 million people aged 60 and above (compared to 250 million people in China). Moreover, the average annual growth rate of the older population is almost three times higher than the overall population growth rate of India (Bloom et al. 2021).

Old-age morbidity is a rapidly worsening curse in India. The swift descent of the elderly in India (60 years +) into non-communicable diseases (e.g., cardiovascular diseases, cancer, chronic respiratory diseases and diabetes)/NCDs could have disastrous consequences in terms of impoverishment of families, excess mortality, lowering of investment and consequent deceleration of economic growth. Indeed, the government has to deal *simultaneously* with the rising fiscal burden of NCDs and substantial burden of infectious diseases (Bloom et al. 2014, 2014a, WHO, 2015, Yadav et al.2023). As a recent *Lance*t report (Ghebreyesus, 2018) points out, failure to devise a strategy and make timely investment now will jeopardise achievement of Sustainable Development Goals (SDG) 3 and target 4 of a one-third reduction in premature mortality from NCDs by 2030.

NCD morbidity and mortality as shares of total morbidity and mortality have risen steadily in India. In 1990, NCDs accounted for 40% of all Indian mortality and are now projected to account for three quarters of all deaths by 2030. Currently, cardiovascular diseases, cancer, respiratory illness, and diabetes are the leading causes of deaths in India, accounting for almost 50% of all deaths (IHME 2018).

Underlying these rising shares are growing risks that are common to several NCDs, as reported in Agarwal et al. (2021). These risk factors include tobacco use, alcohol abuse, and obesity due to sedentary lifestyles and diets increasingly high in simple carbohydrates and saturated fats. Many populations, particularly in remote rural areas, lack easy or frequent access to primary healthcare practitioners who can provide regular screenings for common NCDs.

Besides, with aging, disability becomes a major concern, seriously limiting Activities of Daily Living (ADL) and hence, increasing the caregiving burden (Kulkarni et al. 2018, Gaiha et al. 2022). The LASI (2020) surveyed impairments among older persons in India related to physical, mental, hearing, speech, and visual capabilities. Women over 80 years reported a far higher incidence of impairments (179 per 1,000) than their male counterparts (119 per 1,000).[2] Among the 60+ years, incidence of any impairment was found to be 105 per 1,000 population.

These and the projected marked future shift in the share of older Indians in the population are taking place in the context of changing family relationships and severely limited old-age public income support, hence bringing with them a variety of social, economic and health care policy changes (Beard & Bloom, 2015; WHO, 2015).

1.1 Social Security and Health Care

[1] We are grateful to Jere Behrman for his support and meticulous review and to Hans-Peter Kohler for his appreciation; K.L. Krishna, Katsushi Imai and Anil Deolalikar for their valuable suggestions on the econometric analyses; and to Nidhi Kaicker and Aashi Gupta for their enthusiastic help at different stages. The views are personal.

[2] A caveat is in order. The likelihood that weaker males might have already died cannot be ruled out (We owe this suggestion to Jere Behrman).

An overview of access to social security measures and medical care is thus pertinent. Drawing upon a recent report by IIPS and UNFPA (2023), a selective review is given below.

There are several social security measures/schemes that cater to the elderly (60 years +). These include Antodaya Anna Yojana (provides subsidised food to widows/terminally ill persons), Annapurna Scheme (persons aged 65 years + who are not receiving pension under National Old Age Pension Scheme are entitled to 10 kg of foodgrains per month free of cost), Varishtha Pension Bima Yojana (provides pension to senior citizens through The Life Insurance Corporation/LIC in the form of immediate annuity during the pensioner's lifetime), Indira Gandhi Old Age Pension Scheme /IGNOAPS (a non-contributory scheme that aims to benefit below-poverty-line/BPL senior citizens) and Indira Gandhi National Widow Pension Scheme/ IGNWPS (provides a monthly pension to BPL widows). In addition, the Maintenance and Welfare of Parents and Senior Citizens Act (MWPSC) 2007 allows older persons to claim maintenance from their children.

Old age pension schemes are marred by bribery and require onerous documentation that the elderly can ill-afford.

Recently, the Government of India prepared the National Multispectral Action Plan, 2017–22, for prevention and control of NCDs, which focuses on synergies among various programmes within the health sector and integrates with non-health stakeholders. The National Health Policy 2017 is designed to increase budgetary allocations and improve the public sector tertiary centre for prevention, treatment, and control of NCDs. The recent introduction of Ayushman Bharat scheme-supposedly a landmark insurance scheme- aims to provide health insurance coverage of up to Rs 5 lakh (USD 5996.97) per household among the bottom 40% of households.[3]

The growing menace of NCDs in a context of rapidly increasing old population calls for bold policy initiatives. Although such initiatives are not lacking, they are either underfunded or limited in coverage and uncoordinated (Chatterjee, 2017). A case in point is the National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS)/renamed as National Programme for Prevention & Control of Non-Communicable Diseases (NP-NCD), which was launched in 2010 with a focus on strengthening infrastructure, human resource development, health promotion, early diagnosis, management, and referral.

Inadequate access, utilisation and benefits from these schemes and services are a result of interplay of supply and demand associated reasons, as persuasively argued by Banerjee and Duflo (2021). The IIPS& UNFPA report (2023) elaborates these reasons drawing upon various official documents and the LASI survey (IIPS, 2020). A few illustrations suffice.

Consider, for example, the case of Ayushman Bharat Yojana/ABY. It is overambitious in its coverage. Assuming that hospital utilisation rates of the bottom 40% of Indians rise to the level of the top quintile (following the introduction of benefits under ABY), this would result in an extra cost of almost 1,000 billion rupees for 500 million Indians, almost 12 times the current budgetary provision for ABY. So, provision of secondary and tertiary medical care as envisaged is infeasible. On the demand side, ABY benefits will only accrue to the elderly if they are aware of the programme benefits and, in a position, to use them. This can be especially problematic for the poor disabled elderly or the very old, who are often left out of social transfer schemes for which they are eligible (Asri, 2019). Although the focus is on the less well-off, neither the state health insurance plans nor ABY make special provisions for targeting households containing the elderly (Kulkarni et al. 2019)

Although there are no immediate policy goals to ensure population-based screening, opportunistic screening of selected chronic diseases is an important strategy under NPCDCS/ NP-NCD. However, surveillance activities under this programme are inefficient due to funding constraints,

[3] The exchange rate conversion is based on the prevailing rate on May 29th, 2024.

weak operational guidelines and inadequate clinical, technical and managerial staff. Besides, demand is constrained by highly expensive long-term therapy. Encouraging the individuals to prioritise spending on long-term treatment and prevention of NCDs is particularly challenging in resource-poor settings (Jan et al., 2018).

This overview sets the stage for our analysis. We examine (i) whether the prevalence of major NCDs has risen over time; (ii) in an attempt to build substantially on the extant literature, using 2sls, we examine whether participation in social security measures/schemes reduces the prevalence of NCDs in the aggregate sample; and this is followed by (iii) whether utilisation of medical services/hospital visits also reduces prevalence of NCDs. As the India Human Development Survey (2005 and 2012)/IHDS is the only all-India panel survey to date, our analysis is based on this survey; and (iv) as we have estimates of BMI for a sub-sample of women in the reproductive age-group, we examine using 2sls whether among them (excluding ~~non-~~pregnant women in this age-group) there is a robust causal relationship between NCDs and obesity.

Section 2: Scheme

Our present study is organised as follows. Section 3 is devoted to a selective review of important recent contributions focusing on the surge of the NCD burden, access to social security measures, and medical services/hospital visits; section 4 reviews the data and methods used in the present study. Section 5 discusses the implementation strategy. We have detailed the results in section 6. Section 7 contains a discussion of their significance from a broad policy perspective. Section 8 concludes with a critical review of gaps in policies designed to mitigate the NCD burden, and their low awareness, access and utilisation of social protection schemes and hospital care..

Section 3: Literature Review

A mix of studies is reviewed, some are global and regional while others are specific to India.

Focusing on aging and NCDs in a global context, Prince et al. (2015) emphasise that the worldwide epidemic of chronic diseases is driven by population ageing. Disorders with a strong age-dependent relation are likely to increase in prevalence in parallel with the absolute and relative numbers (relative to the total population size) of the older people (≥60 years).

Low-income and middle-income countries face various stages of a double burden of infectious and non-communicable diseases, the balance shifting inexorably towards non-communicable diseases. A globalisation of risk behaviours, including diets rich in saturated fat, increase of tobacco use and low physical activity, with consequent obesity, is driving the rapid increase in the burden of chronic diseases in these regions (Prince et al. 2015)

Let us now turn to a few India-specific studies.

An important but somewhat dated contribution is Yadav and Arokiasamy (2014). Although it is focused on the epidemiological transition in India, it offers a rich analysis of the increase in the prevalence of NCDs among the old. It is based on NSS data on morbidity of persons ≥60 years for 1986-1987, 1995-1996, and 2004.

The age pattern of morbidity reveals a mounting concentration of morbidity prevalence in 60–64-years old and older age groups. The rising gradient of morbidity prevalence in the older ages peaks among 70-79 years old . By sex and residence, the prevalence rate of chronic diseases is highest among urban males and is characterized by a high prevalence among 70–79 years old and 80 years and above. Among 60–69 years old, the rise was much lower.

A more recent study (Yadav et al. 2023) finds old age morbidity (NCDs and their multi-morbidities rose significantly during 2004-2014. Using National Sample Survey data for 2004 and 2014, and ordered probit models, the underlying covariates are uncovered. There was a marked shift of NCDs and multi-morbidities from the younger to the old population. Scheduled Castes/Scheduled Tribes (the lowest rung of socio-economic hierarchy) were associated with low prevalence, while those associated with higher prevalence include urban households, widowed and divorced/separated, and being affluent. Above all, there is a (residual) positive time effect confirming higher prevalence of NCDs and their multi-morbidities in 2014.

As a contribution to the Global Burden of Diseases, Risk Factors, and Injuries (GBD) Study, the India State-Level Disease Burden Initiative Collaborators (2017, 2018) produced an analysis of state variations in epidemiological transition levels (ETL) during 1990–2016.[4]

The GBD studies found that leading cardiovascular diseases—heart diseases and stroke—made the largest contribution to the total burden of mortality in India in 2016 (about 28%). Besides, the contribution of cardiovascular diseases to mortality rose by over 34% from 1990 to 2016, given rapid population ageing and significantly higher levels of the main risk factors for cardiovascular diseases—high systolic blood pressure, air pollution, high total cholesterol, high fasting plasma glucose, and high body-mass index.

Diabetes contributes 3.1% of the total mortality burden, with slightly higher contributions among women (3.4%) than men (2.9%). The age-standardised diabetes prevalence rose by 29.7% in 1990–2016. Diabetes is especially prevalent in southern states.

Yet another major contribution is *The Lancet* Taskforce on NCDs (2018) with several individual contributions on different aspects of NCDs. A distillation of important findings is given below.

For all health conditions investigated, NCDs are associated with substantial economic burden on patients and their households from all strata, particularly in the poorest populations. Direct medical expenses for medicines, outpatient visits, diagnostics and hospitalisation are the main contributors to Out-of-Pocket (OOP) costs. Transport costs are substantial in some cases (e.g., about 40% of total medical expenditure for patients receiving a kidney transplant in India). Patients with haemophilia in India reported high transport costs as a major reason for not seeking necessary care during bleeding episodes (Jan et al., 2018).

The key messages of the Taskforce include: progress on NCDs is too slow; NCDs are major drivers of poverty; NCDs are important and growing causes of health inequalities; NCDs impose large economic burdens on households, notably, through OOP expenditure on health and long-term care and are thus an impediment to alleviation of poverty; financial risk protection—especially targeted to the poorest and most vulnerable populations—could dampen the risk of impoverishment; taxes on unhealthy products (e.g., fried food, alcohol and tobacco) will induce substantial health gains; and, finally, investments in cardiovascular disease prevention and control yield especially high economic returns (Horton & Sargent, 2018).

Section 4: Data and Methods

As our analysis is based on IHDS 2015, we first review its salient features.[5]

4.1 IHDS Survey

Our analyses draw upon the two rounds of the nationally representative India Human Development Survey (IHDS) data collected in 2005 and 2012 (Desai, Vanneman & NCAER,

[4] For an excellent review of these studies, see Arokiasamy (2018). Another important contribution is Dandona et al. (2017).

[5] As the data for the two rounds of the IHDS were made available in 2015, we refer to the combined survey as IHDS 2015.

2005 and 2011-12) The IHDS is conducted jointly by University of Maryland and the National Council of Applied Economic Research (NCAER). The first round (IHDS-1) comprises a survey of 41,554 households in 2005. The second round (IHDS-II) involves re-interviews with 83% of the original households as well as split households residing within the same locality, along with an additional sample of 2,134 households.[6] The total for IHDS-II is therefore 42,152 households. The nationally representative dataset has extensive information on individual-level health, education, and other household-specific characteristics. IHDS is the only nationally representative panel data collected in India. The individual-level panel data have tracked about 150,988 individuals in both time periods, of which the panel of individuals $\geq$60 years is 10,473 individuals. The sample is spread across 33 (now 34) states and union territories and covers rural as well as urban areas. Throughout the analysis, the computations are based on the 2005 age-distribution and other covariates of diabetes and heart diseases in 2012.

The topics covered by the IHDS relevant in the present context include short-term morbidity, major morbidity (including NCDs), limitations in ADLs, castes, assets, drinking water facilities, education, location, demographic characteristics (e.g., gender, age, household size), pension, health insurance, and medical services. In addition, to capture the association with diet, we have computed food prices at the PSU level.

The NCDs include cataracts, high blood pressure, heart disease, diabetes, leprosy, cancer, asthma, epilepsy, and mental disorders. However, the number of cases by NCD vary, forcing us to limit our analysis to a few NCDs (notably, heart disease, diabetes and high blood-pressure as an explanatory variable).

The main objective of this research is to understand the factors associated with diabetes and heart diseases and whether their rising incidence could be checked. Specifically, we aim to understand if social protection policy (social pension) and health-seeking behaviour through hospital visits and dietary restrictions can reduce the risks of diabetes and heart disease.

We have listed the key variables used in this study in Table 1.

Table 1 here

After accounting for missing information, we have detailed the summary statistics (Table 2) for more than 90,904 individuals. In 2012, on average, about 3% of the population had diabetes, and 1.4% suffered from heart disease. All explanatory variables refer to 2005. On average, about 2% of the sample suffer from high blood pressure. Slightly more than 30.5% of the sample live in urban areas, and less than 40% engage in non-physically demanding occupations. The vast majority of the sample are Hindus (82%), with Muslims (12%) and others (6%) constituting minorities. Distribution by caste comprises other backward castes (35%), Dalit and Adivasi (28%), forward caste (23%) and others (15%). From the data, we also observe that less than 3% of the population constitute the disabled, who have functional limitations in performing activities of daily living. We also observe that slightly more than 22% of the sample have between five-eight years of education, 17% have 9-10 years of education, and 14% have eleven or more than eleven years of education. From the age distribution, we observe that the age cohort of 15-30 years constitutes the largest age cohort (40%), followed by older cohorts.

Table 2 here

[6]An additional sample of 2134 households were added to IHDS-II urban areas to reduce the impact of high attrition on the standard errors of a few key variables. The simulations estimated that the attrition would increase standard errors to unacceptable levels if 8 out of 15 households were unreachable in each urban cluster. Hence, the interviewers were asked to report to NCAER supervisor if they were unable to recontact 5 or more households in a cluster. The supervisor verified the losses and randomly assigned households to the right, the left, or at the original location (for households that migrated) using a predefined rule. A similar addition to the rural sample was not attempted because of the much lower attrition rate. (Personal communication by Sonalde Desai). .

More than 26% of the sample are married, and slightly less than 50% of the sample are women. We have also constructed asset quartiles where Q1 is the base category. We find that more than 50% of the sample are above the median asset quartile (belong to Q3 and Q4). We have also constructed an inequality index using the Piketty measure (2014) which is defined as the ratio of share of top 1 % to that of the bottom 50% in total income. We find the average inequality level is greater than 0.46. More than 48% of individuals live in a household of 2-5 persons, and slightly more than 51% live in a household with more than five persons.

Price ratios of Rice to Cereals, Wheat to Cereals, Sugar to Cereals, Pulses to Cereals, Milk to Cereals, Edible Oil to Cereals, Meat to Cereals, and Eggs to Cereal are constructed at the Primary Sampling Unit/PSU level.[7] For our analyses, geometric means (GM) of these price ratios are used. The geometric mean (GM) prices of protein are higher than of rice, wheat and fats, and this is because the price of meat drives the price of protein rich foods. On excluding the price of meat, we find the mean price of pulses, milk, and eggs is lower compared with the price of meat.

Section 4.2: Model Specification

As already noted, the present study seeks to (i) understand the factors underlying the rise in the prevalence of NCDs- mainly diabetes and heart diseases in India (discussed in section 3). This is a serious concern as recent projections point to surge in their prevalence by 2030. (ii) It is therefore equally important to understand whether policy initiatives now have the potential to curb these surges in the near future. In order to address these concerns, we conduct two analyses: one focusing on a social protection measure (i.e. pensions) and another on medical care/hospital visits.

Let us begin with a general linear regression model, as specified below in eq. (1).

$$Y_{i,t+1} = \beta_0 + \beta_1 \boldsymbol{X_{1h,t-1}} + \beta_2 \boldsymbol{X_{2i,t-1}} + \beta_3 \boldsymbol{X_{3v,t-1}} + \beta_4 \boldsymbol{X_{4s,t-1}} + Pension\beta_5 \boldsymbol{X_{5h,t+1}} + Hospital\beta_6 \boldsymbol{X_{6i,t+1}} + \epsilon_i \quad (1)$$

The dependent variable comprises whether an individual, i, suffers from diabetes or heart diseases, Y. The dependent variable used is for 2012/t+1. The explanatory variables refer to 2005/t-1. This circumvents reverse causality. These variables are classified as follows. $\mathbf{X}_1$ captures the vector of household -specific characteristics (h), including living in an urban area, labour force participation, assets, caste, religion, number of persons in the household that are likely to be associated with the dependent variable. Individual-specific characteristics, including age, marital status, disability, education, having high blood pressure and gender, are captured by $\mathbf{X}_2$. $\mathbf{X}_3$ denotes the Primary Sampling Unit (PSU)- specific characteristics (v), including price ratios (GM) of rice and wheat, sugar, oil, pulses, milk, meat, and eggs, and the prevalence of social networks. The vector $\mathbf{X}_4$ represents state-level characteristics, including state per-capita income and income inequality measure. We have also controlled for state fixed effects.

The covariates of the NCDs include affluence (captured here by assets, education), disability, age, pre-existing health condition (high BP), work in a physically demanding sector/occupation (e.g., agricultural labour), socio-economic characteristics (sex, religion, caste, household size, marital status, assets), social networks, income inequalities, state affluence (per-capita state income), the

[7] The household level survey has detailed information on prices of various food items (discussed here). It should be noted that prices were computed as geometric means at PSU level and then the price ratios were calculated. These price ratios were computed for 2005 on the presumption that lagged consumption of nutrients or consumption over time influence health outcomes. For lack of price data overtime, we relied on price data for 2005. If the pattern of food price ratios shifts over time, use of the price ratios for 2005 would be problematic. Nor is the case for using the price ratios for 2012 stronger as the influence of current prices overlooks habit persistence in consumption. Whenever more than one food commodity was involved, a geometric mean (GM) was used. GM prices of protein consists of price ratios of pulse, meat and egg, while fats consist of price ratios of sugar and oil. These composite prices are illustrative and not comprehensive.

price ratios (GM) of carbohydrates (rice and wheat), fat (sugar and oil), meat, other protein-rich food commodities (pulses, eggs and milk).

As stated earlier, we also aim to assess the potential of policies in curbing the surge of these NCDs. Constrained by data limitations, we confine our analysis to a social protection measure (notably pensions) and utilisation of medical services (notably hospital visits). However, both participation in pension programmes and utilisation of medical services are endogenous.[8] OLS estimation of eq. (1) is thus problematic. Ideally, a 3sls method ought to be used. But this is not feasible as matching samples of those suffering from diabetes and heart diseases, those earning pensions, and those visiting hospitals restricted the sample size considerably. So as the next best alternative, we rely on 2sls. Specifically, we run the following 2sls regressions: (i) diabetes with pensions (and other covariates); (ii) diabetes with hospital visits (and other covariates); (iii) heart diseases with pensions (and other covariates); and (iv) heart diseases with hospital visits (and other covariates).

4.3 Two stage least square

In a standard 2sls, we instrument the endogenous variable (e.g., hospital utilisation) (T) with two instruments (L_1) and (L_2) (see details in equation 2).[9] We have denoted the subscript 'j' to distinguish the 2sls estimation from others (Gaiha, et al., 2024). Subsequently, we use the predicted values of T (from equation 2) to estimate equation 1a. $\mathbf{X}_j$ represents the explanatory variables (household/individual/state specific factors) that are likely to be associated with the dependent disease variables, and the instruments.

$$Y_{i,t+1} = \beta_0 + \beta_1 \boldsymbol{X_{1h,t-1}} + \beta_2 \boldsymbol{X_{2i,t-1}} + \beta_3 \boldsymbol{X_{3v,t-1}} + \beta_4 \boldsymbol{X_{4s,t-1}} + \beta_5 \boldsymbol{T^{\wedge}_{j,t+1}} + \epsilon_{1i} \quad (1\text{ a})$$

$$T_{j,t+1} = \alpha_0 + \alpha_1 L_{1j,t+1} + \alpha_2 L_{2j,t+1} + \alpha_3 \boldsymbol{X_{j,t-1}} + \varepsilon_{2i} \quad (2)$$

For the instruments (L_1, L_2,) to be valid they must satisfy some conditions (Wooldridge, 2009). First, the instruments should be correlated with the endogenous variable (relevance condition of the IV). Second, the instrument should not be directly correlated with the outcome variables (Y_i) other than through the endogenous variable also known as the exclusion restriction. Further, the instrument should be exogenous and should be uncorrelated with the error term.[10] The first stage F-statistic is used to verify the relevance condition (Ullah, Zaefarian and Ullah, 2021). Further, diagnostic tests, including Hansen J statistics and Stock and Yogo thresholds are provided in the results section to corroborate validity of the instruments. Following a similar exposition given in (2) and (1a) above, alternative estimations have been done, replacing the hospital variable with the pension variable. The same has been extended to the sub-sample of women in reproductive age where the dependent variables are the two NCDs, and the endogenous variable that is instrumented is obesity. We have elaborated on the instruments used and the results from the diagnostic test in sections 5 and 6.

Section 5: Implementation

5.1 Aggregate sample

Social assistance programmes (pension here) like IGNOAPS are targeted at the poor-elderly in India. They are non-contributory pension programmes given to the elderly living in poor

[8] Participation in pension programmes suffers from self-selection bias. Social assistance in the form of a pension needs to be demanded in order to receive it (see, Unnikrishnan and Imai, 2020). In the case of hospital utilisation, the direction of causality could be reversed, if individuals with NCDS are more likely to use medical services and not the other way around.

[9] Linear instrumental variables estimator has a similar performance to maximum likelihood estimator in large samples (Angrist, 1991).

[10] http://mchp-appserv.cpe.umanitoba.ca/supp/mchp/protocol/media/Instrumental_variables.pdf

households. We have instrumented pension (household receiving IGNOAPS) with the household head's father's/husband's father's education level. The instrument captures the prevalence of inter-generational poverty, which increases the household's dependence on social assistance programmes.

There is a strong correlation (negative) between education level and poverty in the context of India. Education is a significant predictor of inter-generational poverty as it affects not only socio-economic status but also other choices, including fertility and marriage, among others. (Kaushal, 2014). We mention inter-generational because we are interested in determining if the previous generation had the resources to invest in the subsequent one.[11]

Households (poor) within which elderly participate in the social pension programme (IGNOAPS) are those in which the persistence of inter-generational poverty is strong. Older people are likely to depend on government-sponsored welfare programmes if they had insufficient education, which prevented them from participating in the formal labour market and accessing contributory pension programmes. This is more evident in the context of a Low-Middle Income country such as India where 73% of the elderly are illiterate (Skirbekk, and James, 2014) and less than 10% of its work force are in the formal sector (Unnikrishnan and Imai, 2020). Therefore, we have used the instrument of household head's father's/ husband's father's education level as an instrument (inclusion criterion).

We have categorised education level as a dummy variable which takes the value zero if the household head's father/household head's husbands' father is illiterate or has a primary education, else it takes the value one. A higher level of education (head's father/husband's father) implies that they are less likely to depend on social assistance programmes.

For the endogenous variable utilisation of medical facilities/hospital visits we have used two instruments here. First, whether the respondent lives in the village/town where the health insurance (Rashtriya Swasthya Bima Yojana, RSBY henceforth) programme is implemented. The second instrument is the education level of the household head's father or husband's father, as used in our analysis of the pension programme.

In 2008, the Indian government launched the Rashtriya Swasthya Bima Yojana (RSBY), an inpatient health insurance scheme for the poor.[12] RSBY was among the world's largest hospital insurance schemes (Ahlin, Nichter, and Pillai, 2016). Assessment of its beneficial effects has, however, been mixed (Ecks and Kulkarni, 2023, and Nandi et al., 2015). RSBY promised families 'below poverty line' (BPL) up to Rs. 30,000 ($400) for medical expenses. Families enrolled for Rs. 30 ($0.41).

One of the instruments used here is whether the respondent lives in the village/town where the health insurance programme was implemented. In 2011, the programme only covered 27.8% of households Below the Poverty Line (Dror and Vellakkal, 2012), which suggests that the household-level coverage of the programme was not extensive. Besides, the empirical evidence suggests that the impact of the programme is limited (Karan et al., 2017). One important reason being delays in reimbursement.

Besides, we have used household head's father's/ husband's father's education level as an instrument. Similar to our explanation in the case of social pension, the education of the household head's father's/ husband's father's is a measure of the inter-generational persistence of poverty. A higher level of education for the previous generation is also likely to increase the next generation's productivity (Kaushal, 2014), which can minimise hospital visits.

[11] To avoid simultaneity bias we haven't used the education level of the household head as an instrument here (violates exclusion restriction).

[12] https://www.india.gov.in/spotlight/rashtriya-swasthya-bima-yojana

5.2 Sub-sample: women in reproductive age

Obesity is a significant risk factor for heart diseases and other non-communicable diseases (Ahirwar and Mandal, 2018; Zatonska et al., 2021). Abdominal obesity is 40% among women and 12% among men in India (Chaudhry and Sharma, 2023). However, there is still a gap in understanding the link between obesity and diabetes and heart diseases among women of reproductive age in India. There may be a two-way causality in terms of diabetes itself leading to obesity and the other way around. In order to circumvent this problem, we have applied 2sls to understand better if obesity is associated with heart diseases and diabetes among reproductive women (15-49 years old) in India.

We use spouse's age and their education level as instruments for obesity among women of reproductive age. Research has also shown that in Japan, for example, the husband's education is a key factor associated with obesity among wives (Murakami et al., 2017).

Spouses share similar characteristics, including age, among other attributes (Oreffice and Quintana-Domeque, 2010). The risk of obesity is positively associated with age. However, using women's age as an instrument could violate the exclusion restriction of the 2sls. Therefore, we have used the spouse's age as an additional instrument here. Evidence further suggests the presence of spouse resemblance in Body Mass Index (BMI) (Jacobson et al., 2007). Cohabitation, even briefly, makes spouses look similar in their BMI measurements (*ibid*). This implies that if the risk of obesity increases for the spouse (due to their age), it will also shape their partner's physical attributes.

Section 6: Results

Our aggregate sample comprises *complete* sub-samples of those suffering from diabetes and others, and heart diseases and others, respectively. Although these are sub-samples, but they are aggregate in the sense that they cover all individuals. In contrast, the sub-sample of women in the reproductive age-group is a sub-sample in so far as it covers only a segment of women respondents.

6.1 Aggregate sample-Role of pension

Following the 2sls specification as described in equations (1a and 2), we give the results in Table 3.

Table 3 to be placed here

Our first concern in the following analysis is validity of the instruments. The instrument used is household head's father's/ husband's father's education level.

To determine if the instrument for pension is relevant, we compare the Kleibergen-Paap rk Wald F statistic with the Stock and Yogo values provided (Table 3). The values reported under the Kleibergen-Paap rk Wald F statistics (21.629/22.11) are greater than a specific threshold provided under the Stock and Yogo (10% threshold, 16.38) signalling a strong instrument. The large F-statistic (value greater than 10, 1% level of significance) reported suggests that the instrument used here is relevant.[13] But the exclusion restriction E(z,u)=0 is not testable in a just identified system of equations (Kiviet, 2020).

From the first-stage results (Table 3), we find that completion of higher levels of education by the head's father or husband's education reduces the probability of receiving IGNOAPS.[14] We observe a negative association between living in urban areas and receiving IGNOAPS. Also, there is a positive association of religion and caste with receiving the pension. This is not surprising, given that the programme is targeted at the poor, and some caste groups (Dalit and Adivasi, Others) and religious groups (Muslims/Others) tend to be economically deprived. Higher levels of education

[13] http://mayoral.iae-csic.org/IV_2015/IVGot_lecture3.pdf

[14] All the significant results reported here are at the 5% level.

and assets are negatively associated with receiving IGNOAPS. As expected, there is a positive association between age and receiving IGNOAPS. Being married is positively related with being an IGNOAPS recipient while being female is negatively related. The positive association of social networks in accessing IGNOAPS is documented (see Unnikrishnan and Dey, 2023) as also the negative association of living in a larger household in accessing the programme (Unnikrishnan and Imai, 2020). Further, state per-capita income/ more precisely, log of state per capita income, is positively associated with being an IGNOAPS recipient. This is not surprising as higher state per capita income reflects the availability of public resources, which is critical to increasing the coverage of social pension programmes. The first-stage results remain broadly consistent for both the outcome variables (heart diseases and diabetes). However, there is no significant association (but a consistent coefficient sign) of social network variables and state-per-capita income with pension in the first-stage results reported for diabetes.

The second stage results suggest that, after instrumenting pension with the education of the head's father's/husband's father's education, access to IGNOAPS reduces the likelihood of diabetes and heart diseases. In terms of magnitude, our IV results suggest that the predicted value of pensions is likely to reduce heart disease by 44 percentage points and reduce diabetes by more than 100 percentage points.

There could be multiple channels through which this effect can transmit. Empirical evidence suggests that access to IGNOAPS has increased the share of expenditure on nourishing food (Unnikrishnan, 2022), likely reducing the risk of NCDs. It is also plausible that regular access to social pension programmes alleviates credit constraints and reduces psychological pressure, including stress/anxiety, contributing to a reduction in NCDs.

Our findings (Table 3-second stage) show that having a pre-existing health condition- specifically, high blood pressure (in 2005)- is positively associated with the probability of diabetes and heart diseases (2012). We find a significant effect of religion on these outcomes. Compared to Hindus, Muslims and others have a higher risk of heart diseases. Also, belonging to other religions has a significant positive association with the risk of diabetes. These results are not surprising, given that religion has implications for dietary behaviour. Religion affects food choices and diet behaviour often favouring consumption of red meat (Islam, for example, favours intake of red meat).[15] We find mixed effects of caste on these diseases. Belonging to other backward caste group and Dalit and Adivasi is, for example, positively associated with the probability of diabetes. But we do not find any association of caste with heart diseases. This is intriguing. We find that disability is positively associated with the probability of diabetes and heart diseases. Physical disability constrains engaging in strenuous activities and is thus positively associated with the risks of NCDs. Compared to an illiterate respondent, having completed higher and senior secondary education are negatively associated with the risk of heart disease. Also, having completed senior secondary education/degree lowers the risk of diabetes. Confirming the age gradient, the risks of diabetes and heart diseases are positively associated with age. Also, these risks are lower among women. Surprisingly, we have not found any association of a household's asset quartile with the risks of diabetes and heart diseases. This is intriguing as there is ample evidence confirming an asset gradient in these diseases. Whether our finding is in part due to measurement error in assets cannot, however, be ruled out.

A higher level of state per-capita income reduces the risk of non-communicable diseases. State per-capita income reflects plausibly the capacity to invest in health. Extreme income inequality is positively associated with the risks of diabetes and heart diseases. A plausible explanation may lie in limited access of the bottom 50% to good quality medical care, if any.

The price ratios (GM) of protein from pulses, meat and eggs to cereals is positively associated with the risk of heart disease. For example, pulses are a staple diet in India, and their higher price ratios,

[15] https://www.pewresearch.org/religion/2021/06/29/religion-and-food/

implying lower intake, are likely to be positively associated with diabetes. However, a surge in the price ratios of fat-dense foods (sugar and oil) has negative association with the risk of both diabetes and heart disease.

6.2 Aggregate Sample-Role of Hospital Care

Here again the focus is on the risks of diabetes and heart diseases and their covariates-especially the role of hospital care**.**

Table 4 to placed here

The Kleibergen-Paap rk Wald F statistic (26.572/37.351 in Table 4) is larger than the Stock and Yogo values (10% threshold, 19.93), suggesting that the instruments are relevant predictors of the endogenous variable (hospital visits). The same extends to the first-stage F value (26.572/37.351, 1% level of significance), which confirms the satisfaction of the relevance condition. Further, the Hansen J statistics (1.257/1.379) confirm satisfaction of the exclusion restriction.

The finding that possession of RSBY card reduced hospital visits is intriguing, but field-evidence from Mandya (Karnataka) unravels why members of RSBY are reluctant to use the card for hospital visits (Ecks and Kulkarini, 2023). Some of these reasons include cumbersome procedure for claiming expenses; narrow range and type of illnesses covered; limited number of empanelled hospitals where the RSBY card could be used; and, above all, users lacked accurate information about the healthcare provisions.

The first-stage results suggest that high blood pressure is positively associated with visiting a hospital. Being Muslim/others are negatively associated with visiting a hospital. The role of religious beliefs/caste in using hospitals is well-established (Mohapatra, 2019). We find mixed evidence on the association between education and using hospitals. There is a positive association between secondary education (9-10 years) and hospital visits for the first-stage results (on diabetes), but not with higher education. The *a priori* expectation is that education is positively associated with seeking health care. However, it is also possible that, with a higher level of education, people also have more information on healthy living, which can reduce hospital visits. There is a negative association between being 51-60 years old and visiting hospitals (in the case of heart disease), but not between age and hospitals (in the case of diabetes). Heart diseases are more expensive to treat than diabetes, and this discourage some (51-60 years) from visiting the hospital.

A higher level of assets, state per capita income, social networks and belonging to a larger household are all positively associated with hospital visits. This is not surprising, as these variables (assets/ social network/state-per capita income/living in a larger household) capture both financial and social resources available to the household, which is positively associated with hospital visits. We find that being married and having a higher level of inequality are negatively associated with using a hospital (first stage results for the outcome variable on diabetes). It may seem puzzling why married women are less likely to visit hospitals, but it is not as married women are often accompanied by a male relative. However, a higher level of inequality is associated with a lower level of resources available to the poor, and given the cost of hospital visits, inequality can reduce hospital visits among the poor. Overall, we do not observe any major difference in the first stage result (using hospitals) for the two diseases (heart diseases and diabetes). There are some minor differences in the statistical significance, which may be due to the difference in sample sizes, as we dropped the sample of those 15-30 years of age in the sample for heart diseases.

From the second stage, we find that the instrumented value of hospital use reduces heart disease by 20 percentage points and diabetes by 17.3 percentage points. Further, we find high blood pressure is positively associated with heart diseases and diabetes. Age and assets are also positively associated with heart disease and diabetes. We also observe that there is a negative association between being Muslim and having diabetes. The associations between the two NCDs and caste are mixed. Belonging to the Dalit and Adivasi castes is, for example, negatively associated with heart diseases.

But belonging to others (caste) is positively associated with diabetes. There are caste-based differences in dietary habits that might explain these findings. We find a positive association between engaging in non-physical tasks, being disabled and higher education levels and risk of diabetes. We also find a negative association between being married and having diabetes. Living in a large household and affiliation to social networks are positively associated with diabetes. If living in a large household involves unequal division of labour with males enjoying greater leisure, this may partly explain greater prevalence of diabetes. However, it is far from obvious why affiliation to a social network is positively associated with diabetes. There is a negative association between the price ratios of rice and wheat, and the price ratio of meat and risks of diabetes and heart diseases. Diets high in refined grain intake are associated with an increased risk of premature coronary artery while rice intake beyond a threshold is associated with higher risk of diabetes. Higher intake of red meats, such as beef, pork, and mutton, are also associated with higher risks of diabetes and heart diseases. So, when their prices rise, their intake falls and the risks of these NCDs decreases. Consistent with erstwhile results, state per-capita income is negatively associated with both diabetes and heart diseases. However, income inequality is positively associated with both the NCDs.

6.3 Supplementary analysis- women of reproductive age

A selective interpretation of the results in Table 5 is given below.

Table 5 here

We reject the hypothesis of weak instruments for obesity, as the Kleibergen-Paap rk Wald F statistic (57.193/55.59) is larger than the Stock and Yogo threshold (10%,19.93). The first-stage F statistics (57.193/55.59, at 1% significance) confirm that the instruments are relevant. The Hansen J statistics (0.552/0.159) validate the exclusion restriction.

The first stage results show that the spouse's age and education are significantly associated with the risk of obesity among women (15-49 years of age). Further, high blood pressure, living in an urban area, education, higher level of assets, and living in a large household are all positively associated with obesity. Our results are consistent with the discussion in Section 3.

After instrumenting obesity with spouse's age and education, being obese increases the likelihood of both diabetes (26.7 percentage points) and heart disease (10 percentage points). These results are plausible given that obesity is strongly associated with NCDs. Obesity is positively associated with lifestyle (captured by spouse's earnings) and spouse's resemblance (spouse's age). From the results of the second stage, we infer that living in urban areas is negatively associated with NCDs. We also find that a higher level of education is negatively associated with NCDs. Also, higher asset quartiles are negatively associated with diabetes and heart disease among women of reproductive age. It is surprising to observe that living in large households is negatively associated with diabetes unless women in these households are more likely be burdened more with household chores.

In the previous results, we found assets, education, and living in a large household are all negatively associated with the NCDs. In the case of the women subsample, education and assets, to some degree, signify their access to resources. Women's empowerment encompasses a wide range of indicators, including their autonomy. It is well-documented that education and assets do increase women's autonomy and their bargaining power within the household. If greater resources enable more autonomous behaviour in regard to allocation of food and medical care, the reduction in diabetes and heart diseases is plausible. The same extends to living in a large household as co-residence improves labour market participation of women in this age group (Ali et al., 2023). Besides, our conjecture that asymmetric division of labour is more unfavourable to women in such households may partly explain lower NCDs risks.

Section 7: Discussion

Here our focus is on selected findings from a broad policy perspective.

Considering the findings from the aggregate sample first, based on a rigorous econometric methodology, we demonstrate that access to pensions and hospital visits have important roles in curbing the rise in diabetes and heart diseases. Although intuitive and widely shared, demonstration of the important roles of these policy instruments at the all-India level merits attention of researchers and policy makers. Even though pension amounts are meagre, they supplement scanty resources of the elderly poor in covering healthcare expenses. For treatment of chronic ailments such as NCDs, hospital visits are unavoidable. However, travel costs, fees, and costs of medicines impose a huge financial burden, resulting in large out-of-pocket expenditure and indebtedness. While health insurance is potentially useful in restricting this financial burden, this potential is far from fully realised due to limited awareness of eligibility requirements, elaborate documentation, delays in payments, and rejection of claims. Some of the formidable challenges involved in pension and healthcare reforms are daunting, as elaborated in the following section.

Pension contributes to reduction of risks of diabetes and heart diseases. That pension accrues mostly to a segment of the elderly is not surprising, as it is intended for them. As lack of awareness of pension schemes (such as IGNOAPS) hinders participation in them, affiliation to social networks (such as self-help groups, women's associations, producer groups) may help overcome limited awareness. What matters of course is their density and agenda. Yet membership of a social network is significantly associated with pensions and hospital visits. If a state's revenue varies with its affluence, it augments its share of financing for this and other non-contributory pension schemes. These findings are largely similar in both sub-samples of diabetes and heart diseases.

Confirmation of a robust negative relationship between (predicted) pension and risks of diabetes and heart diseases has considerable policy significance. However, specific channels can't be identified. Health conditions such as high blood pressure are associated with both diabetes and heart diseases, raising concerns about efficacy of isolated treatment of NCDs when the focus should be on multi-morbidities. NCD risks vary with religious affiliation too, as culture and diets vary. Muslims, for example, eat rich meaty diets more often than Hindus among whom vegetarianism is more prevalent. It is thus not surprising that Muslims are more prone to heart diseases than Hindus. A not-so-surprising result is that disability is positively associated with both diabetes and heart diseases, primarily because, for example, visual impairment, speech impairment, and physical disability restrict mobility and employment, and impoverish those affected.[16] Higher education is associated with lower risks of diabetes and heart diseases. Several channels are involved, including better awareness of advantages of healthy living, medical services, better monitoring of health status and of course more resources for medical care. There is an age gradient in the risks of diabetes, implying that the risk rises with age. Incidence of diabetes rises as aging of the human body leads to impairment of energy homeostasis and abnormalities in carbohydrate metabolism. Hyperglycaemia stems from deficiency of insulin secretion developing with age and growing insulin resistance.

Another merit of the present study is confirmation of the robust link between hospital care and these two NCDs. Specifically, our analysis confirms that hospital care significantly reduces the risks of diabetes and heart diseases, controlling for other covariates.

Pre-existing health condition (i.e., high blood pressure) is positively associated with hospital visits. This accords with the general view that people visit hospitals mainly when they are ill. However, Muslims are less likely to visit hospitals in the subsamples of diabetes and heart diseases, as also other religious groups, relative to Hindus. As medical beliefs vary, it is plausible, for example, that Muslims prefer visiting *Hakims*. Educational attainments are unrelated to hospital care in the subsample of diabetes except at middle (5-8 years) and higher levels (9-10 years) while there is no significant association in the subsample of heart diseases. The mixed results are seemingly implausible as higher education is supposed to enhance awareness of seriousness of NCDs and

[16] See, for example, Gaiha et al. (2022)

pivotal role of specialised hospital care in their treatment. But highly educated are also likely to be better aware of poor quality of medical care, shortage of medicines, and beds. Recall that two different age categories are used for heart diseases and diabetes. In the subsample of heart diseases, those in the age group of 51-60 years are less likely to visit hospitals while in that of diabetes there is no significant association. If the cost of visiting the nearest hospital is high and local medical practitioners-often not formally qualified and referred to as quacks-abound, as they do, a large majority of rural residents rely on them (Das, 2016, Bloom et al. 2008).[17] An option is to train them. There is a striking contrast between the two subsamples in the use of hospital care by asset category. In the subsample of heart diseases, it is those who are moderately affluent (asset group 2) and most affluent (asset group 4) that rely more on hospital care while in that of diabetes all asset groups do. Whether perceptions of effectiveness of hospital care vary between heart patients and diabetics may be an obvious explanation but it is not unlikely that fewer hospitals are fully equipped to treat heart diseases than diabetes.

At the state level, its affluence measured in (log) per capita income is positively associated with use of hospital care in the two sub-samples. Most plausibly, this is a manifestation of more expenditure on public hospitals. If the quality also improves, for example, through availability of equipment's including pacemakers, implantable cardioverter defibrillator (ICD) and cardiac loop recorders for heart diseases, and continuous glucose monitor (CGM), insulin pump, insulin pen, blood glucose (blood sugar) monitor for diabetes, the significant association between state affluence and preference for hospital care points to the imperative of larger public health expenditure.[18]

In the second stage results, (predicted) use of hospital care significantly reduces the risks of diabetes and heart diseases. That hospital care makes a significant contribution to reducing the risks of these NCDs is not surprising as specialised treatments are often unavoidable. So not just easy access to hospitals but the quality of hospital care matters too. Prior health condition (i.e., high blood pressure) has a significant positive association with the risks of heart diseases and diabetes. As emphasised already, contrary to current practice, hospital care must be structured to deal with multi-morbidity of NCDs. Diabetes is less likely among Muslims and those affiliated to other religions, relative to Hindus. If Muslims and those from other religions are more likely to engage in manual and semi-skilled activities, it may corroborate these findings. It is indeed surprising that educational attainments are unrelated to heart diseases but consistently positively associated with diabetes. If higher education is positively associated with sedentary lifestyles, occupations that are not physically strenuous, and unhealthy diets (eating out, socialising with frequent alcohol consumption), our finding is plausible. But at the same time, it is intriguing that educational levels are unrelated to heart diseases as some of these features of unhealthy living are also linked to heart diseases. Aging has a weak relationship with heart diseases (only those in the age group 51-60 years show a significant association with these diseases) while diabetes is more prevalent among those in all age groups, pointing to an age gradient. Assets and the two NCDs show an interesting contrast. While the most affluent (in the fourth quartile) are likely to suffer from heart diseases, there is an asset gradient to diabetes. Evidently, the foremost reasons are rich diets and sedentary life styles. There are various reasons why diabetes rises with age: sedentary lifestyle, high-calorie diet, visceral adiposity, and high genetic predisposition mellitus (type 2) diabetes among Indians at a much younger age and at a lower body mass index (BMI) than the western population. Various population-based studies report that the average onset of type 2 diabetes among Indians is gradually increasing in the age groups below 50 years of age (Banerjee et al. 2020). Among older persons the risk is greater due to the combined effects of increasing insulin resistance and impaired pancreatic

[17] There is evidence that the frontline market often acts as a prohibitively high barrier to access services from private providers, forcing the poorest users to seek treatment from unqualified providers (for outpatient care) and public hospitals (for inpatient care). Since public hospitals function poorly in many areas, a large segment of the poor has to seek admission to private hospitals even at the risk of impoverishment (Bloom et al. 2008).

[18] The National Health Policy, announced in 2017, set the target of increasing public expenditure on health to 2·5% of GDP by 2025. Currently, public expenditure on health is 1·35% of GDP, with the central government contributing a mere 0·3% . So, a substantial increase in the near future seems highly unlikely notwithstanding assertions in the party manifestoes in the 2024 national elections in India (Sharma, 2024).

islet function.[19] These and other findings reinforce the case for disease prevention programmes as perhaps the safer bet for lowering future occurrence of NCDs and morbidity levels. Several existing programmes— most of them established recently—are promising. A case in point is the National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS)/renamed recently as National Programme for Prevention & Control of Non-Communicable Diseases (NP-NCD). However, its implementation has fallen far below expectations, as argued in the next section.

At the PSU level, the associations of food prices with heart diseases and diabetes are patchy. Although we do not find consistent evidence on the association between the prices of food items and the prevalence of diabetes and heart diseases, we observe that the price of fat-dense food is negatively associated with the prevalence of diabetes and heart disease. A negative association is likely since a surge in the price ratio of fat-dense food is associated with lower demand. However, the price ratio of pulses, meat and eggs is positively associated with heart disease. The surge in price ratio of pulses, meat and eggs lowers the demand for proteins, exacerbating the risk of heart disease. Food price stabilisation through an effective Public Distribution System is an option that has not worked well because of corruption and lack of storage capacity (Gaiha et al. 2015).

At the state level, its affluence has a significant negative association with both heart diseases and diabetes, suggesting that higher public expenditure on hospitals and their quality is likely and hence the reduction. So, growth acceleration may reduce the incidence of these NCDs through this channel. Another state level variable is the Piketty measure of inequality. This is positively associated with both heart diseases and diabetes. The higher the Piketty measure, the lower is the share of the bottom 50 % in total income, implying greater deprivation. Combined with lower access to hospital care, higher incidence of the NCDs is highly likely. Promotion of more remunerative employment opportunities in both non-farm and manufacturing may help reduce income disparity.

Our study also throws light on the relationship between risks of diabetes and heart diseases and obesity among women in the reproductive phase.[20]

Let us first focus on selected explanatory variables that are significantly associated with obesity. Obesity of women in both sub samples is positively caused by age and education of the male spouse. If these instruments indicate affluence, the positive effects on obesity are not surprising. The prior health condition-high blood pressure/hypertension- is positively associated with obesity among women in the reproductive age group. While obese subjects are prone to hypertension, hypertensive subjects also appear to be prone to weight gain. Recent studies have shown that future weight gain is significantly greater in hypertensive patients than in normotensive subjects, suggesting that even normal weight hypertensives are at a high risk of developing obesity. Therefore, the relationship between obesity and hypertension might be described as a 'two-way street', implying individual susceptibility to both conditions and common environmental factors (Narkiewicz, 2006). In both sub samples, women living in urban areas are more likely to be obese. Diets are likely to be unhealthy and lifestyles are often sedentary. Those engaged in occupations other than cultivation, and agricultural and non- agricultural labour are more likely to be obese in both sub samples. This is also an outcome of less strenuous work. Educational attainments of 5-8 years or more are associated with obesity in both sub-samples. Lower physical activity and perhaps more comfortable and sedentary lifestyles underlie this outcome. Relatively wealthy women in the third and fourth asset quartiles are more likely to be obese, pointing to both lower physical activity and affluent lifestyles including rich diets and alcohol consumption.[21] Households with 2-5 members or more are more likely to be obese than single member households presumably because

[19] As noted earlier, the IHDS 2015 does not distinguish between type 1 and type 2 diabetes.

[20] Recall that pregnant women are excluded from the sample.

[21] Rising affluence, aspirations, social pressure and exposure to a different lifestyle is driving women to experiment with alcohol, stated the survey, conducted by the Community Against Drunken Driving (CADD) among 5,000 women aged between 18 to 70 in Delhi.

the former are likely to have more resources (if incomes are pooled) that permit more comfortable living and perhaps also richer diets.

Obesity (predicted) causes diabetes and heart diseases. In fact, as WHO (2024) emphasises, obesity also causes musculoskeletal disorders like osteoarthritis, and some cancers (endometrial, breast and colon). These conditions cause premature death and substantial disability. So, the health challenges of obesity are many and sometimes devastating. However, living in urban areas is associated with lower risks of diabetes and heart diseases, presumably due to easier access to monitoring and treatment facilities. Educational attainments - higher levels of education 5- 8 years and more- are significantly associated with higher risks of heart diseases and diabetes, due presumably to more affluent and sedentary life styles. Relative to the least wealthy (i.e., in the first asset quartile), the wealthier (in the third and fourth quartiles) are more likely to suffer from diabetes and heart diseases. That prevention is better than cure needs to be hammered home even among those highly educated and wealthy by public health agencies *despite* its banality. That large households are associated with lower prevalence of diabetes is not so surprising as frequent monitoring and hospital visits, and diet control are likelier relative to single member households.

A recent ICMR study (Anjana et al. 2023) observes that, as different states in India are at different stages in the trajectory of the diabetes pandemic, state-specific strategies are imperative. States with a high prevalence of diabetes will need systems to ensure optimal risk factor control, to effectively prevent long-term complications.

Our study has a few limitations. The coverage of NCDs varies (e.g., very few cases of cancer and mental disorder). Hence the analysis is restricted to diabetes, heart diseases and high blood pressure (only as an explanatory variable). Another is absence of indicators of quality of medical care in public and private hospitals. A third is absence of estimates of undiagnosed diabetes.

Section 8: Conclusion

Some observations are made from a policy perspective.

If the likely surge in NCDs by 2030 is not contained soon, the delay will be extremely costly in terms of growth foregone, impoverishment of low- and middle-income classes, unmanageable morbidity and alarming mortality (Agarwal et al. 2021). The results indicate that the total macroeconomic cost of all NCDs in India will be $4.5 trillion from 2015 to 2030, while the cost of the five chronic conditions (cardiovascular disease, cancer, chronic respiratory disease, diabetes, and mental health) will be $2.7 trillion. These estimates suggest that the foregone investment and savings due to treatment costs account for 77% of the total economic burden of NCDs in India. The total macroeconomic burden of the five categories of NCDs, if measured as a percentage of aggregate GDP in 2015, is 195%. Hence prevention of NCDs is a high priority.

Given the focus of our analyses, we confine ourselves to the potential of pension and hospital care in curbing the rapid surge of NCDs in India.

Our analyses confirm that the potential of expanding pensions and hospital care is substantial in reducing the risks of diabetes and heart diseases. Hence greater public funding and reforms in their provision are necessary. These are daunting challenges but not beyond the realm of possibility.

Many of the social protection schemes are fraught with limited awareness and exacting documentation, limiting participation of the elderly. A little more than half of the elderly (55 per cent) are aware of the old-age pension scheme (IGNOAPS); 44 per cent about the widow pension scheme (IGNWPS); and 12 per cent about the Annapurna Scheme.

Even if aware, utilisation of these schemes is abysmally low. Enrolment for the various social security schemes involves multiple administrative procedures including extensive documentation, and physical presence at the offices to get the work done, discouraging the elderly. The reasons for

not utilising the social security schemes explored in the LASI survey ranged across— 'no need', 'not eligible or not applicable', 'do not have the proper documents', 'not yet applied', 'process of getting benefits is cumbersome', and 'other reasons'. More than a third (35 per cent) of the elderly men report that the process of getting benefits is cumbersome. Moreover, a quarter of the elderly men (26 per cent) have not applied for an old-age pension.

Utilisation of healthcare facilities is dismal too. Around 8 per cent of the elderly accessed in-patient care and 59 per cent accessed out-patient care in the 12 months preceding the LASI survey. Of the elderly availing in-patient care, 37.7 per cent accessed public facilities and 57 per cent accessed private facilities. Of the elderly availing out-patient care, 22.9 per cent accessed public facilities and 63.3 per cent accessed private facilities.

Health insurance is an option as in principle it facilitates hospitalisation without incurring the enormous burden of OOP. But, in fact, the reality is grim. As emphasised by Odipo et al. (2024), in practice insurance alone might not be sufficient to achieve access to quality care, which depends on a range of factors, such as healthcare infrastructure, provider availability, and local culture.

Of particular importance as an insurance scheme, as noted earlier, is the Ayushman Bharat Scheme that aims to provide health insurance coverage to the bottom 40% of households. But its potential has been far from fully realised.

It has two components: health and wellness centres and the Pradhan Mantri Jan Arogya Yojana (PMJAY).[22] The latter aims to provide a health cover of USD 5996.97 (Rs 5 lakh) per family per year for secondary hospitalisation to over 120 million (12 crore) families that form the bottom 40 % of the population. In the last year, some states have reported they are owed hundreds of crores in dues, and some are turning away PMJAY patients. This raises serious concerns about the design and implementation of this ambitious scheme. Of the empanelled hospitals, 43 % are private. There is a widespread assumption that private hospitals provide better health care. So even if there is a public hospital in the vicinity, patients prefer to go to a private hospital. The Union government has put caps on the amounts a hospital can charge for different treatments. This is not compatible with costs of private care (we are of course not overlooking the fact that private providers often inflate their costs by carrying out unnecessary procedures). So, it is imperative to strengthen public healthcare.

The National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular diseases and Stroke (NPCDCS) /recently renamed as National Programme for Prevention & Control of Non-Communicable Diseases (NP-NCD) aims to strengthen health systems. Its primary focus is to build capacity at all levels of public health system including training human resources for prevention and control of common NCDs. However, as noted earlier, surveillance activities under this programme are inefficient due to funding constraints, weak operational guidelines and inadequate clinical, technical and managerial staff.

As private hospitals are notorious for inflated prices of healthcare, the Supreme Court of India directed the Central government in February 2024, to find ways to regulate the rates of hospital procedures (Tiwari et al, 2024). As the Court observed, pricing decisions must be informed by a benchmark for price determination. Standard treatment guidelines/STGs can help establish relevant clinical needs, the nature and extent of care and the costs of total inputs required. However, this solution is oversimple (Tiwari et al. 2024). While command-and-control regulations through pecuniary measures such as price caps do influence actors' behaviour by making them follow the regulations, these effects tend to be temporary when enforcement mechanisms are weak.

Behavioural changes are no less important and perhaps also no less challenging. Evidence from LMICs and from India yield useful insights (WHO, 2015). Lack of physical activity and unbalanced high-calorie diet promote weight gains. Obesity is a risk factor for cardiovascular

[22] We draw upon an excellent review by Hamid (*The Hindu*, 3 May, 2024).

diseases and diabetes and can aggravate symptoms of CVD such as emphysema and bronchitis. Limiting tobacco consumption is expected to benefit at the individual level but wider reduction in multi-morbidity prevalence requires taxation on unhealthy products. For example, there is evidence that tobacco taxation reduces smoking, and such benefits might also lead to a reduction in certain multi-morbidity clusters (Academy of Medical Sciences, 2018).

In conclusion, while the surge in NCDs is alarming and the policy challenges are daunting, our study points to some grounds for optimism.

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Table 1: Variables used

	Definition
2005 explanatory variables	
High Blood Pressure	Take the value 1 if the respondent has a high blood pressure else zero
Living in urban area or not	Takes the value 1 if the household lives in an urban area or not
Labour classification (takes the value 0 if the household engages in cultivation, agricultural and non-agricultural wages, else one)	The variable captures if the household mainly engages in non-physically demanding tasks or not. The variable takes the value zero if the primary income source of the household comes from engagement in cultivation, agricultural and non-agricultural wages. If not, the variable takes the value one.
Religion (Hindus =0, Muslims =1 and other =2)	This variable takes multiple values depending upon the household head's religion. It takes the value zero if the head belongs to the Hindu religion. Alternatively, it takes the value one for Muslims and two for other religions.
Caste (0= FC, 1= OBC, 2= Dalit and Adivasi, 3=others)	The caste variables take values 0 (Forward caste),1 (Other Backward Caste), 2 (Dalit and Adivasi), and 3 (Others)
Person is disabled or not	It takes the value one if the person finds it difficult or unable to do tasks (including walking/toilet/dressing/hearing/speaking/ seeing) due to functional limitations. If not, the variable takes the value zero.
Edu_cat (0=illiterate, 1=one to 4 years, 2=5-8 years, 3=9-10 years, 4= greater than or equal to 11 years)	The variables take the value zero if the person is illiterate. 1=one to 4 years, 2=5-8 years, 3=9-10 years, 4= greater than or equal to 11 years.
Age cat (0=31-50years, 1=15-30 years, 2=51-60 years, 3=61-70 years, 4=>71years)	The variable denotes various age categories. It takes multiple values ranging from zero to four (0=31-50years, 1=15-30 years, 2=51-60 years, 3=61-70 years, 4=>71years).
New age _cate (0=31-50years, 1=51-60 years, 2=61-70 years, 3=>71years)	Same as above, we exclude those who are 15-30 here.
Married (not 0= married, 1 = married)	Takes the value 0 for unmarried and 1 for married.
Female (Male=0)	The variable on takes the value one for (female) and zero (male).
Asset quartiles (Q1 is base category)	Assert quartiles were generated separately for rural and urban India and later combined at the All-India level. Asset Index quartiles were generated on the basis of All India. Q1 is the base category; a higher assert quartile indicates more wealth.

Inequality measure	Piketty measure of inequality
Number of persons in the household (hh) (0=single person hh, 1 =more than one but less than five persons, 2=greater than five persons)	The variables take multiple values; the value is zero for a single-person household. It takes values one if the household has more than one member but less than five members. It takes the value two if the household has greater than five persons.
Proportion of people at Primary Sampling Unit who has more at least one social network	The variable captures the household's participation in at least a single social network at the Primary Sampling Unit level.
Log values of state per-capita income (logstatepc)	Log values of the state per-capita income
Price ratios	Price ratios Rice to Cereals, Wheat to Cereals, Sugar to Cereals, Pulses to Cereals Milk to Cereals, Edible Oil to Cereals, Meat to Cereals, Eggs to Cereal were constructed at the PSU level
Geometric means (GM) of the prices	When more than two price ratios are used geometric mean (GM)of the price ratios are used.
Gmean rice and wheat	Geometric mean (GM) values of the price ratios of rice and wheat are used here.
Gmean fat (sugar and oil)	Geometric mean (GM) values of the price ratios of sugar and oil are used here.
Gmean of pulse, milk and eggs	Geometric mean (GM) values of the price ratios of pulses, milk and eggs are used here.
Gmean protein (pulse, meat and eggs)	Geometric mean (GM) values of the price ratios of pulses, meat and eggs are used here.
Outcome variables (2012 values)	
Diabetes	Takes the value one if the respondent had diabetes or zero otherwise
Heart disease	Takes the value if the respondent had heart disease or zero otherwise
Endogenous variables	
IGNOAPS recipient	The variable takes the value if the household receive Indira Gandhi National Old Age Pension (IGNOAPS), else it takes the value zero.
Hospital	Takes the value one if the individual has visited a clinic/hospital for illness in the last five years. Else, the variable takes the value zero.
Instruments-2012 values	
Village/town has implemented health insurance (RSBY programme) in the last five years	Takes the value 1 if the village/town has rolled health insurance programme in 2012.
Education level of the household heads father/household heads husbands' father	The continuous variable captures the education level of the household head's father/household head's husbands' father.
Cat_education of head's father (0/1)	This dummy variable is constructed from the above variable (Education level of the household heads father/household heads

	husbands' father). The dummy variable takes the value zero if the household head's father/household head's husbands' father is illiterate or has a primary education, else it takes the value one.

Table 2: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Outcome variables (2012 values)					
Diabetes	90,904	0.031	0.172	0	1
Heart disease	90,857	0.014	0.118	0	1
Explanatory variables (2005 values)					
High Blood Pressure	90,904	0.020	0.141	0	1
Lives in urban area or not	90,904	0.302	0.459	0	1
Labour classification	90,904	0.395	0.489	0	1
Religion (Hindus =0, Muslims =1 and other =2)					
1	90,904	0.123	0.328	0	1
2	90,904	0.064	0.246	0	1
Caste (0= FC, 1= OBC, 2= Dalit and Adivasi, 3=others)					
1	90,904	0.350	0.477	0	1
2	90,904	0.282	0.450	0	1
3	90,904	0.155	0.362	0	1
Disability variable was constructed (takes the value one if someone has a disability else zero)					
1.disability	90,904	0.027	0.161	0	1
Edu_cat (0=illiterate, 1=one to 4 years, 2=5-8 years, 3=9-10 years, 4= greater than or equal to 11 years)					
1	90,904	0.083	0.276	0	1
2	90,904	0.229	0.420	0	1
3	90,904	0.173	0.378	0	1
4	90,904	0.140	0.347	0	1
Age cate (0=31-50years, 1=15-30 years, 2=51-60 years, 3=61-70 years, 4=>71years)					
1	90,904	0.404	0.491	0	1
2	90,904	0.113	0.317	0	1
3	90,904	0.059	0.235	0	1
4	90,904	0.018	0.134	0	1
Married (not married=0)	90,904	0.267	0.442	0	1
Female (male=0)	90,904	0.488	0.500	0	1
Asset quartile (Q1 is the base)					
Q2	90,904	0.214	0.410	0	1
Q3	90,904	0.260	0.439	0	1
Q4	90,904	0.308	0.462	0	1
Inequality measure	90,904	0.470	0.154	0.226	0.858
Number of persons in the household (0=single person hh, 1 =2-5 persons, 2=greater than five persons)					
1	90,904	0.484	0.500	0	1
2	90,904	0.511	0.500	0	1

Proportion of people at PSU atleast in one social network	90,904	0.171	0.174	0	1
Geometric means (Gmean)					
Gmean rice and wheat	90,904	1.014	0.126	0.627	1.223
Gmean fat (sugar and oil)	90,904	3.246	0.561	1.410	5.158
Gmean protein (pulse, meat and eggs)	90,904	4.063	0.919	1.453	7.291
Gmean of pulse, milk and eggs	90,904	2.256	0.442	0.870	3.483
Price of meat	90,904	7.424	2.613	1.141	16.118
Log values of state per-capita income (logstatepc)	90,904	9.651	0.256	9.168	10.15
New age_cate (0=31-50years, 1=51-60 years, 2=61-70 years, 3=>71years)					
1	54,179	0.190	0.393	0	1
2	54,179	0.098	0.298	0	1
3	54,179	0.031	0.173	0	1

Table 3: IV estimates for pensions

VARIABLES	(1) First stage- Household receiving IGNOAPS (2012 values)	(2) Second stage- Having Heart disease (2012 values)	(3) First stage- Household receiving IGNOAPS (2012 values)	(4) Second stage- Having Diabetes (2012 values)
2005 values				
High Blood Pressure	-0.011	0.047**	-0.017**	0.106**
	(0.007)	(0.008)	(0.006)	(0.013)
Lives in urban area or not	-0.018**	-0.001	-0.011**	0.006
	(0.003)	(0.005)	(0.002)	(0.005)
Labour classification (takes the value 0 if the hh engages in cultivation, agricultural and non-agricultural wages, else one)	-0.010**	-0.001	-0.007**	0.002
	(0.003)	(0.003)	(0.002)	(0.003)
Religion (Hindus =0, Muslims =1 and other =2)				
1.religion	0.040**	0.027*	0.023**	0.018
	(0.009)	(0.012)	(0.005)	(0.012)
2.religion	0.034**	0.021*	0.017**	0.023**
	(0.008)	(0.009)	(0.005)	(0.009)
Caste (0= FC, 1= OBC, 2= Dalit and Adivasi, 3=others)				
1.caste	0.012**	0.003	0.009**	0.011*
	(0.003)	(0.004)	(0.002)	(0.004)
2.caste	0.012**	0.000	0.008**	0.009*
	(0.003)	(0.004)	(0.002)	(0.004)
3.caste	-0.041**	-0.017	-0.021**	-0.009
	(0.009)	(0.011)	(0.005)	(0.011)
Disability variable was constructed (takes the value one if someone has a disability else zero)				
1.disability	0.013	0.019**	0.006	0.030**
	(0.007)	(0.006)	(0.006)	(0.009)
Edu_cat (0=illiterate, 1=one to 4 years, 2=5-8 years, 3=9-10 years, 4= greater than or equal to 11 years)				
1.edu_cat	-0.011**	-0.002	-0.011**	-0.002
	(0.004)	(0.004)	(0.003)	(0.005)
2.edu_cat	-0.029**	-0.010	-0.023**	-0.012
	(0.003)	(0.007)	(0.002)	(0.009)
3.edu_cat	-0.039**	-0.020*	-0.026**	-0.018
	(0.003)	(0.009)	(0.002)	(0.010)
4.edu_cat	-0.030**	-0.016*	-0.021**	-0.020*
	(0.003)	(0.008)	(0.002)	(0.009)
New age_cate (0=31-50years, 1=51-				

60 years, 2=61-70 years, 3=>71years)				
1.new_age_cat	0.124**	0.068*		
	(0.003)	(0.027)		
2.new_age_cat	0.209**	0.107*		
	(0.006)	(0.046)		
3.new_age_cat	0.222**	0.111*		
	(0.010)	(0.049)		
Married (not married=0)	0.020**	0.007	0.010**	-0.002
	(0.004)	(0.005)	(0.002)	(0.004)
Female (male=0)	-0.020**	-0.011*	-0.010**	-0.013**
Asset quartile (Q1 is the base)	(0.002)	(0.005)	(0.001)	(0.004)
Q2	-0.011**	-0.003	-0.006**	-0.001
	(0.003)	(0.003)	(0.002)	(0.003)
Q3	-0.022**	-0.007	-0.012**	-0.004
	(0.003)	(0.005)	(0.002)	(0.005)
Q4	-0.044**	-0.011	-0.026**	-0.001
	(0.004)	(0.010)	(0.002)	(0.010)
Inequality measure	-0.341	1.142**	-0.153	2.288**
	(0.303)	(0.245)	(0.199)	(0.392)
Number of persons in the household (0=single person hh, 1 =2-5 persons, 2=greater than five persons)				
1.hhpersons	-0.070**	-0.025	-0.076**	-0.065
	(0.020)	(0.019)	(0.019)	(0.036)
2.hhpersons	-0.071**	-0.029	-0.075**	-0.068
	(0.020)	(0.019)	(0.019)	(0.036)
Proportion of people at PSU atleast in one social network	0.012*	0.008	0.007	0.007
	(0.006)	(0.005)	(0.004)	(0.006)
Geometric means (Gmean)				
Gmean rice and wheat	-0.039*	-0.007	-0.023*	0.003
	(0.018)	(0.015)	(0.011)	(0.017)
Gmean fat (sugar and oil)	-0.005	-0.010**	-0.002	-0.009*
	(0.005)	(0.004)	(0.003)	(0.004)
Gmean of pulse, milk and eggs	-0.001	0.010*		
	(0.006)	(0.004)		
Price of meat	0.002*	0.000		
	(0.001)	(0.001)		
logstatepc	0.221*	-0.221*	0.092	-0.546**
	(0.099)	(0.087)	(0.064)	(0.128)
Age cate (0=31-50years, 1=15-30 years, 2=51-60 years, 3=61-70 years, 4=>71years)				
1.age_cat			-0.017**	-0.042**
			(0.001)	(0.006)
2.age_cat			0.125**	0.168**
			(0.003)	(0.047)
3.age_cat			0.212**	0.259**
			(0.006)	(0.079)
4.age_cat			0.227**	0.267**

			(0.010)	(0.085)
Gmean protein (pulse, meat and eggs)			0.002	0.005
			(0.002)	(0.002)
State fixed effects	Yes	Yes	Yes	Yes
First stage-instrument used				
Cat_education of head's father (0/1)	-0.011**		-0.006**	
	(0.002)		(0.001)	
Second stage- results				
IGNOAPS recipient (0/1)		-0.444*		-1.048**
		(0.221)		(0.372)
Under-identification test		21.561***		22.075**
Weak identification test				*
Kleibergen-Paap rk Wald F statistic		21.629		
				22.11
Stock and Yogo values				
10% max IV size		16.38		
15% max IV size		8.96		16.38
20% max IV size		6.66		8.96
25% max IV size		5.53		6.66
				5.53
Observations	54,173	54,173	90,904	90,904
R-squared	0.158		0.161	

Robust standard errors in parentheses
*** p<0.00, ** p<0.01, * p<0.05

Table 4: IV estimates for hospitals

VARIABLES	(1) First stage visiting hospital (2012 values)	(2) Second Stage having heart disease (2012 values)	(3) First stage visiting hospital (2012 values)	(4) Second stage having diabetes (2012 values)
2005 values				
High Blood Pressure	0.035**	0.043**	0.033**	0.076**
	(0.008)	(0.009)	(0.008)	(0.012)
Lives in urban area or not	0.015	0.002	0.017	0.001
	(0.015)	(0.010)	(0.011)	(0.011)
Labour classification (takes the value 0 if the hh engages in cultivation, agricultural and non-agricultural wages, else one)	-0.002	0.003	-0.002	0.007**
	(0.004)	(0.002)	(0.003)	(0.002)
Religion (Hindus =0, Muslims =1 and other =2)				
1.religion	-0.031**	-0.007	-0.021*	-0.017*
	(0.011)	(0.009)	(0.009)	(0.007)
2.religion	-0.019*	0.002	-0.014*	0.003
	(0.009)	(0.005)	(0.007)	(0.003)
Caste (0= FC, 1= OBC, 2= Dalit and Adivasi, 3=others)				
1.caste	0.013**	-0.001	0.012**	0.002
	(0.004)	(0.002)	(0.003)	(0.002)
2.caste	0.006	-0.006*	0.006	-0.001
	(0.005)	(0.002)	(0.003)	(0.002)
3.caste	0.018	0.010	0.010	0.022**
	(0.011)	(0.008)	(0.008)	(0.007)
Disability variable was constructed (takes the value one if someone has a disability else zero)				
1.disability	-0.002	0.009	-0.007	0.012*
	(0.008)	(0.005)	(0.008)	(0.006)
Edu_cat (0=illiterate, 1=one to 4 years, 2=5-8 years, 3=9-10 years, 4= greater than or equal to 11 years)				
1.edu_cat	0.010	0.003	0.000	0.008**
	(0.005)	(0.003)	(0.004)	(0.002)
2.edu_cat	0.004	0.003	0.007*	0.009**
	(0.004)	(0.002)	(0.003)	(0.002)
3.edu_cat	0.004	0.002	0.009*	0.006**
	(0.006)	(0.003)	(0.004)	(0.002)
4.edu_cat	-0.001	0.002	0.007	0.007**

	(0.007)	(0.004)	(0.005)	(0.003)
New age_cate (0=31-50years, 1=51-60 years, 2=61-70 years, 3=>71years)				
1.new_age_cat	-0.008*	0.009**		
	(0.004)	(0.002)		
2.new_age_cat	-0.010	0.004		
	(0.005)	(0.003)		
3.new_age_cat	-0.006	0.003		
	(0.009)	(0.005)		
Married (not married=0)	-0.001	-0.002	-0.006*	-0.008**
	(0.005)	(0.002)	(0.003)	(0.001)
Female (male=0)	0.003	0.000	0.004	-0.001
	(0.003)	(0.002)	(0.002)	(0.001)
Asset quartile (Q1 is the base)				
Q2	0.010*	0.001	0.006	0.003*
	(0.005)	(0.002)	(0.004)	(0.001)
Q3	0.008	0.003	0.008*	0.004**
	(0.004)	(0.002)	(0.003)	(0.002)
Q4	0.010*	0.009**	0.008*	0.019**
	(0.005)	(0.003)	(0.004)	(0.002)
Inequality measure	-0.474	1.338**	-0.472*	2.705**
	(0.328)	(0.282)	(0.240)	(0.413)
Number of persons in the household (0=single person hh, 1 =2-5 persons, 2=greater than five persons)				
1.hhpersons	0.035	0.008	0.040*	0.022*
	(0.019)	(0.009)	(0.019)	(0.009)
2.hhpersons	0.051**	0.008	0.052**	0.021*
	(0.019)	(0.010)	(0.019)	(0.009)
Proportion of people at PSU atleast in one social network	0.019*	0.000	0.024**	0.012**
	(0.009)	(0.004)	(0.007)	(0.004)
Geometric means (Gmean)				
Gmean rice and wheat	-0.146**	-0.022	-0.142**	-0.031*
	(0.025)	(0.016)	(0.019)	(0.013)
Gmean fat (sugar and oil)	0.030**	0.002	0.019**	0.000
	(0.007)	(0.004)	(0.005)	(0.002)
Gmean of pulse, milk and eggs	-0.003	0.009*		
	(0.008)	(0.004)		
Price of meat	-0.003*	-0.003**		
	(0.001)	(0.001)		
Gmean protein (pulse, meat and eggs)			0.003	0.004**
			(0.003)	(0.002)
Age cate (0=31-50years, 1=15-30				

years, 2=51-60 years, 3=61-70 years, 4=>71years)				
1.age_cat			0.005	-0.016**
			(0.003)	(0.001)
2.age_cat			-0.007	0.023**
			(0.004)	(0.003)
3.age_cat			-0.008	0.023**
			(0.005)	(0.004)
4.age_cat			-0.003	0.017**
			(0.009)	(0.006)
Log values of state per-capita income	0.225*	-0.344**	0.317**	-0.578**
	(0.106)	(0.082)	(0.076)	(0.123)
State fixed effects	Yes	Yes	Yes	Yes
First stage-instruments used				
1.Village has implemented health Insurance programme	-0.021**		-0.017**	
	(0.003)		(0.002)	
Education level of the household heads father/household heads husbands' father	-0.002**		-0.002**	
	(0.001)		(0.000)	
Second stage- results				
Visited Hospital		-0.200**		-0.173**
		(0.071)		(0.060)
Under-identification test		53.038***		74.438***
Weak identification test				
Kleibergen-Paap rk Wald F statistic		26.572		37.351
Stock and Yogo values				
10% max IV size				
15% max IV size		19.93		
20% max IV size		11.59		19.93
25% max IV size		8.75		11.59
		7.25		8.75
				7.25
Overidentification test for all instruments				
Hansen J stats		1.257		1.379
Observations	36,116	36,116	60,465	60,465
R-squared	0.032		0.031	

Robust standard errors in parentheses
*** p<0.00, ** p<0.01, * p<0.05

Table 5: Women in Reproductive age group (15-49 years of age)

VARIABLES	(1) First stage- Obesity (2012 values) _	(2) Second stage- Heart disease (2012 values)	(3) First stage- Obesity (2012 values)	(4) Second stage- Diabetes (2012 values)
2005 values				
High Blood Pressure	0.106**	0.010	0.109**	0.034
	(0.034)	(0.014)	(0.034)	(0.021)
Lives in urban area or not	0.169**	-0.015**	0.168**	-0.034**
	(0.011)	(0.005)	(0.011)	(0.008)
Labour classification (takes the value 0 if the hh engages in cultivation, agricultural and non-agricultural wages, else one)	0.030**	-0.005	0.031**	-0.001
	(0.010)	(0.003)	(0.010)	(0.004)
Religion (Hindus =0, Muslims =1 and other =2)				
1.religion	0.040	0.005	0.040	-0.012
	(0.032)	(0.011)	(0.032)	(0.015)
2.religion	-0.006	0.013	-0.006	0.019
	(0.024)	(0.007)	(0.024)	(0.010)
Caste (0= FC, 1= OBC, 2= Dalit and Adivasi, 3=others)				
1.caste	-0.019	0.001	-0.019	0.005
	(0.012)	(0.003)	(0.012)	(0.005)
2.caste	-0.021	-0.001	-0.021	0.006
	(0.013)	(0.003)	(0.013)	(0.005)
3.caste	0.006	0.003	0.006	0.013
	(0.032)	(0.010)	(0.032)	(0.015)
Disability variable was constructed (takes the value one if someone has a disability else zero)				
1.disability	0.001	-0.004	0.001	0.030
	(0.039)	(0.011)	(0.039)	(0.021)
Edu_cat (0=illiterate, 1=one to 4 years, 2=5-8 years, 3=9-10 years, 4= greater than or equal to 11 years)				
1.edu_cat	0.028	0.005	0.029	-0.001
	(0.015)	(0.004)	(0.015)	(0.006)
2.edu_cat	0.053**	-0.004	0.053**	-0.001
	(0.011)	(0.003)	(0.011)	(0.004)
3.edu_cat	0.081**	-0.008*	0.081**	-0.019**
	(0.014)	(0.004)	(0.014)	(0.006)
4.edu_cat	0.077**	-0.010*	0.078**	-0.031**
Married (not married=0)	(0.017)	(0.004)	(0.017)	(0.007)

1.married	0.007	-0.001	0.007	-0.008
	(0.021)	(0.006)	(0.021)	(0.008)
Asset quartile (Q1 is the base)				
Q2	0.021	-0.002	0.021	-0.005
	(0.011)	(0.003)	(0.011)	(0.004)
Q3	0.072**	-0.009*	0.072**	-0.015**
	(0.012)	(0.004)	(0.012)	(0.005)
Q4	0.139**	-0.014*	0.138**	-0.028**
	(0.014)	(0.006)	(0.014)	(0.008)
Inequality measure	1.676	0.100	1.664	0.721
	(1.620)	(0.206)	(1.620)	(0.557)
Number of persons in the household (0=single person hh, 1 =2-5 persons, 2=greater than five persons)				
1.hhpersons	0.306**	-0.020	0.306**	-0.077**
	(0.027)	(0.011)	(0.026)	(0.015)
2.hhpersons	0.287**	-0.020	0.288**	-0.074**
	(0.027)	(0.011)	(0.027)	(0.014)
Proportion of people at PSU atleast in one social network	-0.025	0.005	-0.025	0.012
	(0.024)	(0.006)	(0.024)	(0.010)
logstatepc	-0.505	-0.022	-0.501	-0.193
	(0.527)	(0.062)	(0.527)	(0.176)
State fixed effects	Yes	Yes	Yes	Yes
First stage-instruments used				
Age of the spouse	0.006**		0.006**	
	(0.001)		(0.001)	
Spouse education (takes the value 0 if spouse has no education or primary education, else it takes the value one)	0.027**		0.027**	
	(0.009)		(0.009)	
Second stage-result				
Being obese (1/0)		0.101**		0.267**
		(0.026)		(0.038)
Under-identification test		113.361***		112.560***
Weak identification test				
Kleibergen-Paap rk Wald F statistic		57.193		55.59
Stock and Yogo values				
10% max IV size		19.93		19.93
15% max IV size		11.59		11.59
20% max IV size		8.75		8.75
25% max IV size		7.25		7.25
Overidentification test for all instruments		0.552		0.159
Hansen J stats				

Observations	13,358	13,358	13,359	13,359
R-squared	0.120		0.120	

Robust standard errors in parentheses
*** p<0.00, ** p<0.01, * p<0.05