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# Old-age dependency and catastrophic health expenditure: Evidence from Longitudinal Ageing Study in India

Sanjay K. Mohanty[1] | Umakanta Sahoo[1,2] | Rashmi Rashmi[1]

[1]Department of Population and Development, International Institute for Population Sciences, Mumbai, India

[2]Department of Statistics, Sambalpur University, Burla, India

**Correspondence**
Sanjay K. Mohanty, Department of Population and Development, International Institute for Population Science, Mumbai, India.
Email: sanjayiips@yahoo.co.in

## Abstract

**Background:** Out-of-pocket (OOP) payments and catastrophic health expenditure (CHE) have a strong age gradient. Though studies have examined the socio-demographic and geographic inequality in OOP payments and CHE in India, the role of old-age dependency in financial catastrophe remains unclear. Disaggregated estimates of CHE by the level of old-age dependency of households may help identify the most vulnerable sub-group and provide evidence for specific policies for the financial protection and health care of the elderly. The present study aims to estimate the incidence and intensity of CHE by the old-age dependency of households among middle-aged adults and the elderly in India.

**Methods:** A total of 42,949 households from the Longitudinal Aging Study in India (LASI), 2017–18, covering households with at least one-member aged 45+ years, were included in the analysis. Households were classified into three mutually exclusive groups: no old-age dependency, low old-age dependency, and high old-age dependency. The incidence and intensity of CHE were estimated using the capacity-to-pay (CTP) approach. Concentration indices and concentration curves examine the extent of socioeconomic inequality in CHE. Binary logistic regression helps to understand the potential predictors of CHE across each type of old-age-dependent household.

  

**Results:** We estimated the overall incidence of CHE at 24.6% (95% CI: 23.3–25.8) among middle-aged adults and the elderly in India. The incidence was 33.2% (95% CI: 31.4–35.1) among households with high old-age dependency, 23.1% (95% CI: 20.8–25.5) among those with low old-age dependency, and 20.4% (95% CI: 19.0–21.7) among no old-age dependency households. CHE intensity was highest among households with low old-age dependency compared to those no old-age dependents. Catastrophic health expenditure was higher among the poorer households in each type of old-age dependency. Among all households, the odds of incurring CHE were higher among households with high old-age dependency (AOR: 1.52; 95% CI: 1.36–1.69) than those with no old-age dependency. Lower-income households, households with pensions as the main source of income, households belonging to scheduled castes, and households residing in rural areas had higher odds of incurring CHE. The co-variates of CHE varied significantly across the type of old-age dependency households. A household's enrolment into a health insurance scheme did not necessarily lower its CHE.

**Conclusion:** Households with high old-age dependency had a higher probability of incurring CHE in India. Providing preventive and curative geriatric care in primary health centres (PHC) is recommended.

**KEYWORDS**
catastrophic health expenditure, incidence, India, intensity, LASI, old-age dependency

## Highlights

- The incidence of catastrophic health expenditure (CHE) in India was 33.2% among households with high old-age dependency, 23.1% among households with low old-age dependency, and 20.4% among households with no old-age dependency.
- The intensity of CHE was higher among households with low old-age dependency than those with no old-age dependency in India.
- The incidence of CHE was higher among the poor across all three types of old-age dependency households.
- A household's enrolment into a health insurance scheme did not necessarily lower its CHE.

## 1 | INTRODUCTION

Disease burden, need for and use of health services, and medical spending have a strong age gradient.[1–3] With the demographic and epidemiological transition under way, middle-aged adults and the elderly are at an increased risk of morbidity, disability, mortality, and hospitalisation.[4,5] The prevalence of chronic diseases is high among adults aged 45+ years,[6,7] leading to high hospitalisation rates, frequent outpatient visits, and high out-of-pocket payments.[8–10] In 2015, 930 million people worldwide incurred catastrophic health spending (out-of-pocket expenditure exceeding 10% of a household's consumption), and 26 million were impoverished due to health spending.[11] Though financial protection has been integrated into the national and global health policies, catastrophic health expenditure (CHE) continues to be high for the poor, the elderly, and the chronically ill.[12,13] Furthermore, the risk of financial catastrophe from medical spending has increased among the elderly and poor households.[2,14,15]

The Sustainable Development Goal (SDG) monitoring framework that used CHE, defined as mean out-of-pocket (OOP) health expenditure exceeding the threshold limit (10% or 25%) of household resources (consumption/income),[16] has been widely used and debated in literature.[17–19] Though this indicator is simple and easy to use, it has been criticised for its normative thresholds, higher incidence of CHE among the rich, and lack of fit with the reliable, available, credible, and robust (RACR) framework.[17,18,20] Studies also suggest using a CHE curve to compare financial catastrophe across the population.[21]

Besides the methodological limitations, data inconsistencies and gaps in consumption and health expenditure across surveys in India also pose challenges in deriving reliable estimates.[22] While some surveys use a single question or few questions to derive consumption expenditure in health surveys, others collect data on health expenditure in routine surveys. As a result, estimates derived from these surveys are not consistent.[22,23] A recent study made a commendable attempt by estimating CHE across household age composition using the data available over 2 decades and suggested that households with the elderly were vulnerable to financial catastrophe.[2] However, the study estimated CHE using the budget share approach, provided a point estimate, analysed CHE by the presence of elderly/children in the household, and the health expenditure was part of household consumption.

India is in the midst of a demographic, epidemiological, and health transition. By 2050, those aged 45+ are projected to account for over 40% of India's population.[24] Along with the demographic change, the family structure and the living arrangements of the households are also changing fast. In 2017–18, around 4.4% of the elderly (60+) in rural India and 3.6% in urban India lived alone.[25] The proportion of the elderly living with only a spouse has also increased from 10.4% in 2004 to 15.5% in 2018 in urban areas and from 12.5% in 2004 to 13.4% in 2018 in rural areas.[25] Sixty-three percent of deaths are due to non-communicable diseases (NCDs), and NCDs are the leading cause of hospitalisation and disability.[26,27] Though health insurance coverage has increased from 4.8% in 2005–06 to 28.7% by 2015–16, OOP and CHE have remained high.[28,29] With the changing demography, family structure, disease pattern, and high OOP, middle-aged adults and the elderly are the most vulnerable sub-group of the population.

In this context, the main objective of this paper is to estimate the incidence and intensity of CHE among middle-aged adults and the elderly by the level of old-age dependency in Indian households. We made a number of improvements to the existing literature. First, while several previous studies have shown increasing inequality in out-of-pocket payments and incidence of CHE in the overall population over time,[2,22,30] few have found a higher incidence of CHE among elderly households.[2,31] The present study used the household old-age dependency approach to capture the effect of old-age members on household CHE.[32] Second, we used the capacity-to-pay approach for estimating CHE and estimated concentration curve as it addresses equity consideration. We also plotted a CHE curve across old-age dependency households as recommended in literature.[21,33] Third, we kept health expenditure out of consumption expenditure. Finally, we used a more recent data set that adequately captures household consumption and health expenditure and is specifically designed to provide evidence on the social and economic well-being of middle-aged adults and the elderly in India.

## 2 | DATA AND METHODS

### 2.1 | Data

The unit data from the first wave of the Longitudinal Aging Study in India (LASI), conducted during 2017–2018, was used in the analysis. LASI interviewed 42,949 households and 72,250 individuals aged 45+ years, and their spouses, across all states and union territories of India except Sikkim. Data of Sikkim was not availabe at the time of drafting this paper. Longitudinal Aging Study in India adopted a multistage stratified area probability cluster sampling design: a three-stage sampling design in rural areas and a four-stage sampling design in urban areas. The details of the sampling design and the survey findings are available in the LASI report.[34]

LASI Wave 1 canvassed four schedules: household, individual, biomarker, and community which collected comprehensive information on the economic, social, and health aspects of the older adults and their households. The household schedule collected detailed information on housing, assets and debts, consumption, and income of the households. The household consumption schedule collected household expenditure on outpatient visits in a reference period of 30 days and inpatient visits in a reference period of 365 days. These expenditures were standardized to a 30 days reference period and were further used to estimate the health expenditure. The medical expenses included medicines, tests, doctor's fees, hospital stay, travel expenses, and other expenses, including dental care. Data on reimbursement for medical expenses from all sources were also collected. The individual schedule collected detailed information on the demographics, work, employment, social networking, health care utilization, health spending, and health insurance of adults aged 45+ and their spouses. It may be mentioned that estimating CHE requires information on the health spending of all household members in a given reference period. The information was available in the household schedule and used in the analysis. The LASI metadata is publicly available and can be accessed by registration at https://iipsindia.ac.in/sites/default/files/LASI_DataRequestForm_0.pdf.

### 2.2 | Outcome variables

The two main outcome variables for the analysis were OOP payment and CHE. OOP payment is the sum of inpatient and outpatient expenditure less reimbursement, standardized to 30 days. The household health expenditure was standardized to 30 days to estimate OOP payment and CHE.

### 2.3 | Group variables

To understand the effect of old age members on household CHE, we derived a household measure, the Old-Age Dependency Ratio (OADR), defined as the ratio of old-age dependents (60 years and above) to members in the working-age (18–60 years).[24,32]

$$\text{OADR} = \frac{\text{Number of household members aged 60 years and older}}{\text{Number of household members aged 18-60 years}} \quad (1)$$

Based on OADR, we grouped the households into three categories:

(a) No OADR (households with no old-age dependency); that is, OADR = 0
(b) Low OADR (households with low old-age dependency, i.e., having two or more working members per old-age member); that is, 0<OADR<= 0.5

(c) High OADR (households with high old-age dependency, i.e., having less than two working members per old-age member); that is, OADR>0.5

## 2.4 | Independent variables

We included the predictors of CHE based on prior literature and the availability of the variables in the LASI data.[2,22,23] The variables used in the analysis were: place of residence (rural and urban), monthly per capita consumption expenditure (MPCE) quintile, household size (1–3, 4–6 and 7+), main source of income of household (agriculture, self-employed, wage or salary, pension, and others), coverage of health insurance (yes and no), sex (male and female), education (no education, less than 6 years of schooling, 6–11 years of schooling, and 11+ years of schooling), marital status of head of household (currently married, widowed, and other), caste (Schedule Tribe [ST], Schedule Caste [SC], Other Backward Caste [OBC], and others) and religion (Hindu, Muslim, Christian, and others). MPCE did not include household health expenditure as it was our outcome variable.

## 2.5 | Statistical methods

We estimated the incidence and intensity of CHE using the capacity-to-pay approach. Concentration indices and concentration curves examine the extent of inequality in CHE. Binary logistic regression was used to understand the key predictors of CHE. A brief description of the methods used in the analysis is given below.

The budget share approach and capacity to pay (CTP) approach are often used in estimating CHE. The budget share approach shows a lower incidence of CHE among the poor and does not capture the equity concern of the health system. Estimates derived using the CTP show a higher incidence of CHE among the poor, capture the equity concern of the health care system, and are recommended for use in low-and-middle-income countries.[13,22,35] CTP is defined as household consumption less of subsistence expenditure (SE). Subsistence expenditure is derived in two steps. In the first step, the food to consumption expenditure ratio was estimated. In the second step, the mean of food expenditure in the 45$^{th}$ and 55$^{th}$ percentile (ratio of food to consumption expenditure) was estimated as subsistence expenditure.[36] Under the CTP approach, a household is said to have incurred CHE if its OOP exceeded 40% of its CTP. Mathematically, the incidence of CHE, using the CTP approach, is defined in two steps:

$$E_i = 1 \text{ if } \frac{\text{OOP}_i}{(C_i - \text{SE}_i)} = \frac{\text{OOP}_i}{\text{CTP}_i} \geq 0.4 \tag{2}$$

$$E_i = 0 \text{ if } \frac{\text{OOP}_\text{i}}{(C_i - \text{SE}_i)} = \frac{\text{OOP}_i}{\text{CTP}_i} < 0.4 \tag{3}$$

where, $C_i$ = total consumption expenditure less of health expenditure; $\text{SE}_i$ = Subsistence expenditure

$$\text{CHE}_{\text{Incidence,CTP}} = \frac{1}{N} \sum E_i \tag{4}$$

The intensity of CHE was based on the households that incurred CHE and is defined as

$$\text{Intensity of CHE} = \frac{1}{U} \sum \left( \frac{\text{OOP}_i}{\text{CTP}_i} \right) - 0.4 \tag{5}$$

where U is the number of households that incur CHE.

For estimating CHE, the household and subsistence expenditures were adjusted to the equivalent household size. To derive the coefficient, we regressed food expenditure on household size separately for rural and urban areas.

A coefficient of 0.655 was derived from the data for the rural areas and a coefficient of 0.514 was derived for the urban areas.

Using a descending cumulative distribution function (CDF), we presented OOP payments as a share of household consumption expenditure at various thresholds in the form of a 'catastrophic spending curve".[21,33] Concentration curves and indices were computed to understand the socioeconomic inequality in CHE. A concentration curve above the diagonal line suggests the concentration of CHE among the poor, while a concentration curve below the diagonal line suggests the concentration of CHE among the rich. The concentration index was used to quantify the extent of socioeconomic inequality in CHE. The concentration index varies between −1 and +1, with a negative value suggesting a concentration of CHE among the poor and a positive value indicating a concentration of CHE among the rich.[37] As a robustness analysis, we have measured Erreygers concentration indices.[38]

Three binary logistic regression models were estimated for each old-age dependent household type to examine the CHE predictors. The dependent variable was dichotomous, that is, 1 if a household incurred CHE and 0 otherwise. The binary logistic regression results were presented in adjusted odds ratios (AOR). All the analyzes were performed in Stata 14. The *'syvset'* command accounted for the sampling weights, clustering and stratification.

## 3 | RESULTS

### 3.1 | Descriptive statistics

Appendix 1 presents the sample distribution of middle-aged adults and the elderly (45+) by socioeconomic characteristics and household old-age dependency in India. Of all households with members aged 45+, about 23.29% had a high old-age dependency, 30.63% had a low old-age dependency, and 46.08% had no old-age dependency. The sample population was predominately rural. The sample distribution varied in socioeconomic characteristics by type of old-age dependency households.

Table 1 presents the descriptive statistics of selected variables by household old-age dependency in India. The median age in households with high old-age dependency was 58 years compared to 30 years in households with low old-age dependency and 26 years in households with no old-age dependency. The MPCE (less health expenditure) of households with high old-age dependency was marginally higher (INR 2618) than that of households with no old-age dependency (INR 2588) and was the least among households with low old-age dependency (INR 2558). At the national level, among all middle-aged adult (aged 45+) households, per capita health expenditure accounted for 13% of the total consumption expenditure. It was 16.6% of the MPCE in households with high old-age dependency compared to 12.5% in those with low old-age dependency and 11.9% in those with no old-age dependency. Among households that had experienced hospitalisation of a member in a 365-day reference period, the per capita health expenditure on inpatient care was INR 7712 among households with high old-age dependency compared to INR 5135 among those with no old-age dependency. Reimbursement of health spending was low in the population. The proportion of households that derived income from a wage or a salary was the highest among households with no old-age dependency (31.9%) followed by households with high old-age dependency (12.4%).

Table 2 presents the monthly per capita OOP payment on healthcare as a share of MPCE among middle-aged adults and the elderly by socioeconomic characteristics in India. We found variations in OOP expenditure as a share of MPCE across all types of old-age dependency households. Across each of the characteristics, the OOP expenditure as a share of MPCE was higher among households with high old-age dependency compared to the other households. For instance, among households belonging to the poorest MPCE quintile, the OOP expenditure as a share of MPCE was 21.9% among households with high old-age dependency compared to 16% in households with the other two types of old-age dependency. However, the share of health spending was regressive across MPCE quintiles in all three old-age dependency households. Households with high old-age dependency had pensions as the main source of income and spent 18.5% of the MPCE on health care. Households with low old-age dependency spent 12.5% of the MPCE on

**TABLE 1** Descriptive statistics of per capita consumption, health expenditure, health care utilization and income source of middle-aged adults and elderly (aged 45+) by household old age dependency status in India, 2017–18

| Study variables | Households with no old age dependents | Households with low old age dependents | Households with high old age dependents | All households' member (aged 45+) | *p*-value |
|---|---|---|---|---|---|
| Number of households | 19,793 | 13,154 | 10,002 | 42,949 | |
| Median age of household members | 26 | 30 | 58 | 30 | |
| *MPCE (95% CI) in rupees | 2588 (2560–2616) | 2558 (2479–2636) | 2618 (2578–2658) | 2581 (2549–2612) | $p < 0.01$ |
| Per capita health expenditure in rupees | 349 (335–364) | 364 (351–378) | 521 (495–547) | 386 (376–396) | $p < 0.01$ |
| Per capita health expenditure as % share of consumption expenditure | 11.9 | 12.5 | 16.6 | 13.0 | |
| % Household availed inpatient care | 19.0 | 21.9 | 17.1 | 19.4 | $p < 0.01$ |
| % Household availed outpatient care | 66.1 | 73.0 | 70.1 | 69.4 | $p < 0.01$ |
| Monthly per capita health expenditure on inpatient care (last 365 days) in rupees | 5135 (4472–5797) | 5104 (4745–5462) | 7712 (6961–8463) | 5518 (5181–5855) | $p < 0.01$ |
| Monthly per capita health expenditure on outpatient care (last 30 days) in rupees | 377 (363–390) | 355 (340–369) | 537 (509–565) | 396 (387–406) | $p < 0.01$ |
| % Household reported reimbursement | 1.8 | 1.8 | 1.3 | 1.7 | $p < 0.01$ |
| Reimbursement as a share of health expenditure | 2.5 | 1.4 | 1.8 | 1.9 | |
| % household's income from agriculture | 13.6 | 12.5 | 7.2 | 33.3 | $p < 0.01$ |
| % household's income from non-agriculture/ self-employed | 3.1 | 3.1 | 1.3 | 7.5 | $p < 0.01$ |
| % household's income from wage or salary | 31.9 | 23.6 | 12.4 | 67.9 | $p < 0.01$ |
| % household's income from pension | 1.2 | 3.8 | 3.7 | 8.7 | $p < 0.01$ |

*Note*: *MPCE- Monthly per capita consumption expenditure does not include the household health expenditure.

healthcare. Among households with insurance coverage, the OOP spending as a share of MPCE was higher among high old-age dependency households than those with no old-age dependency. We did not find any consistent pattern in OOP expenditure as a share of MPCE by household size, educational attainment, caste, and religion of the head of the household within any old-age dependency households.

Figure 1 presents the OOP expenditure as a share of household consumption (i.e., catastrophic spending curve) among middle-aged adults and the elderly at varying thresholds by type of old-age dependency households in India. At all thresholds, the OOP expenditure as a share of household consumption was the highest among households with high old-age dependency and the lowest among households with no old-age dependency. For instance, at the threshold of 10%, the incidence of CHE was 41.7% (95% CI: 40.8–42.7) among households with high old-age dependency, 37.3% (95% CI: 36.5–38.2) among those with low old-age dependency, and 33.7% (95% CI: 33.1–34.5) among those with no old-age dependency. With an increasing threshold share, OOP expenditure as a share of household consumption expenditure observes a decreasing pattern. The proportion was consistently higher among households with high old-age dependency than the other two types of households.

**TABLE 2** Monthly per capita Out-of-pocket (OOP) payment on healthcare as percentage of per capita consumption expenditure among-middle aged adults and elderly (aged 45+) with socioeconomic characteristics in India, 2017–18

| | Households with no old-age dependency | | Households with low old-age dependency | | Households with high old-age dependency | | All households Members (aged 45+) | |
|---|---|---|---|---|---|---|---|---|
| Socioeconomic characteristics | Monthly per capita health expenditure in rupees | Monthly per capita health expenditure as % share of MPCE | Monthly per capita health expenditure in rupees | Monthly per capita health expenditure as % share of MPCE | Monthly per capita health expenditure | Monthly per capita health expenditure as % share of MPCE | Mean monthly per capita health expenditure in rupees | Monthly per capita health expenditure as % share of MPCE |
| Place of residence | | | | | | | | |
| Rural | 336 | 13.4 | 337 | 13.5 | 472 | 17.4 | 361 | 14.2 |
| Urban | 380 | 9.7 | 426 | 11.0 | 638 | 15.4 | 444 | 11.3 |
| MPCE quintile | | | | | | | | |
| Poorest | 213 | 16.3 | 209 | 16.0 | 297 | 21.9 | 225 | 17.1 |
| Poorer | 247 | 12.4 | 312 | 15.2 | 406 | 18.7 | 303 | 14.8 |
| Middle | 363 | 13.4 | 351 | 13.0 | 570 | 19.8 | 395 | 14.4 |
| Richer | 434 | 11.7 | 495 | 13.0 | 497 | 12.9 | 470 | 12.5 |
| Richest | 636 | 9.4 | 713 | 8.9 | 1025 | 14.9 | 741 | 10.2 |
| Household size | | | | | | | | |
| 1–3 | 496 | 11.8 | 588 | 14.1 | 697 | 18.6 | 596 | 14.9 |
| 4–6 | 358 | 11.6 | 410 | 11.8 | 485 | 15.4 | 398 | 12.2 |
| 7+ | 258 | 13.0 | 294 | 13.1 | 316 | 14.3 | 284 | 13.2 |
| Household income source | | | | | | | | |
| Agriculture | 329 | 12.1 | 369 | 13.8 | 481 | 16.2 | 377 | 13.7 |
| Non-agriculture/Self employed | 290 | 8.3 | 382 | 12.4 | 528 | 14.0 | 374 | 11.3 |
| Wage or salary | 350 | 12.1 | 354 | 12.3 | 409 | 15.2 | 360 | 12.6 |
| Pension | 548 | 14.7 | 411 | 12.5 | 817 | 18.5 | 548 | 14.9 |
| Other | 331 | 10.8 | 361 | 12.0 | 592 | 17.8 | 420 | 13.4 |

TABLE 2 (Continued)

| Socioeconomic characteristics | Households with no old-age dependency | | Households with low old-age dependency | | Households with high old-age dependency | | All households Members (aged 45+) | |
|---|---|---|---|---|---|---|---|---|
| | Monthly per capita health expenditure in rupees | Monthly per capita health expenditure as % share of MPCE | Monthly per capita health expenditure in rupees | Monthly per capita health expenditure as % share of MPCE | Monthly per capita health expenditure | Monthly per capita health expenditure as % share of MPCE | Mean monthly per capita health expenditure in rupees | Monthly per capita health expenditure as % share of MPCE |
| Household insurance coverage | | | | | | | | |
| No | 326 | 11.9 | 372 | 12.6 | 504 | 16.4 | 378 | 13.1 |
| Yes | 414 | 11.9 | 337 | 11.9 | 578 | 17.2 | 412 | 12.9 |
| Sex of head of household | | | | | | | | |
| Male | 350 | 11.8 | 351 | 12.7 | 512 | 16.5 | 379 | 13.1 |
| Female | 345 | 12.2 | 445 | 11.6 | 487 | 15.5 | 411 | 12.4 |
| Education of head of household | | | | | | | | |
| No education | 337 | 12.8 | 289 | 13.2 | 417 | 16.6 | 335 | 13.7 |
| less than 6 years of schooling | 327 | 12.5 | 316 | 12.8 | 495 | 17.8 | 352 | 13.6 |
| 6–11 years of schooling | 343 | 11.5 | 424 | 12.6 | 609 | 17.9 | 418 | 13.0 |
| 11+ years of schooling | 436 | 10.2 | 453 | 10.9 | 600 | 13.6 | 476 | 11.2 |
| Marital status of head of household | | | | | | | | |
| Currently married | 357 | 12.0 | 344 | 12.4 | 531 | 16.9 | 384 | 13.1 |
| Widowed | 309 | 11.5 | 434 | 12.6 | 478 | 15.1 | 400 | 12.6 |
| Others | 291 | 9.7 | 411 | 13.9 | 407 | 13.6 | 360 | 12.1 |
| Caste of head of household | | | | | | | | |
| Schedule tribe (ST) | 199 | 8.9 | 168 | 8.4 | 461 | 17.5 | 229 | 10.4 |
| Schedule caste (SC) | 343 | 13.4 | 295 | 13.0 | 440 | 17.4 | 340 | 13.9 |
| Other backward class (OBC) | 369 | 12.0 | 368 | 12.3 | 465 | 15.4 | 386 | 12.7 |
| Others | 383 | 11.5 | 463 | 13.1 | 688 | 17.7 | 475 | 13.5 |

(Continues)

TABLE 2 (Continued)

| Socioeconomic characteristics | Households with no old-age dependency | | Households with low old-age dependency | | Households with high old-age dependency | | All households Members (aged 45+) | |
|---|---|---|---|---|---|---|---|---|
| | Monthly per capita health expenditure in rupees | Monthly per capita health expenditure as % share of MPCE | Monthly per capita health expenditure in rupees | Monthly per capita health expenditure as % share of MPCE | Monthly per capita health expenditure | Monthly per capita health expenditure as % share of MPCE | Mean monthly per capita health expenditure in rupees | Monthly per capita health expenditure as % share of MPCE |
| Religion of head of household | | | | | | | | |
| Hindu | 333 | 11.8 | 342 | 12.4 | 525 | 16.7 | 372 | 13.0 |
| Muslim | 420 | 12.5 | 495 | 13.2 | 455 | 16.1 | 454 | 13.2 |
| Christian | 287 | 9.6 | 259 | 10.5 | 425 | 13.7 | 306 | 10.8 |
| Others | 427 | 12.6 | 445 | 11.6 | 686 | 17.1 | 486 | 13.1 |
| **Total** | **349** | **11.9** | **364** | **12.5** | **521** | **16.6** | **386** | **13.0** |

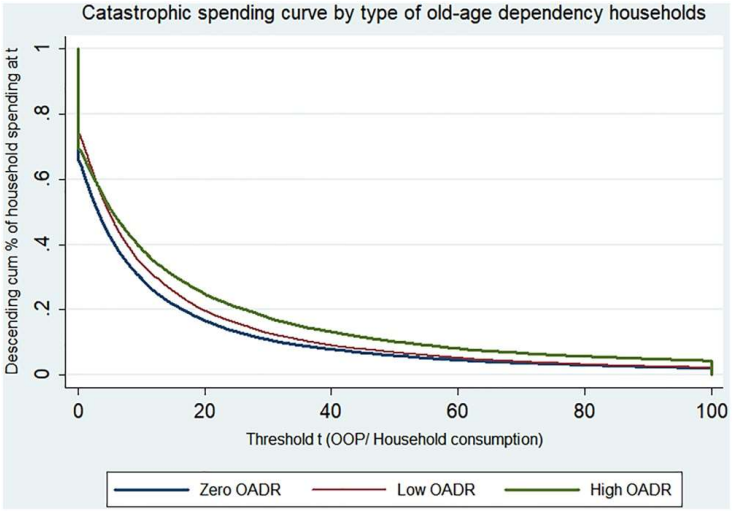


**FIGURE 1** Catastrophic spending curve (Out-of-pocket [OOP] payment as a share of household consumption expenditure) at varying thresholds (t) by type of old-age dependency households in India, 2017–18

## 3.2 | Incidence and intensity of catastrophic health expenditure by socioeconomic characteristics

Table 3 presents the incidence and intensity of CHE by socioeconomic characteristics for all three types of dependency households. For most of the socioeconomic characteristics, the incidence of CHE was the highest among households with high old-age dependency, followed by households with low old-age dependency and households with no old-age dependency. For instance, across households whose source of income was non-agriculture or engagement in self-employment, 28.3% of high old-age dependency households incurred CHE compared to 20.5% of those with low old-age dependency and 12.2% of those with no old-age dependency. Among households with high old-age dependency, the extent of CHE was the highest (31.7%) in households with a pension as the main source of income. Households with or without health insurance did not differ significantly in CHE incidence. The consumption gradient of CHE was strong across all the three types of old-age dependency households, particularly in the poorest households with high old-age dependency (66.3%). Caste and religion differentials in CHE did not show any systematic pattern.

The intensity of CHE showed similar patterns for most of the characteristics. CHE intensity was higher among the poorest and poorer MPCE quintiles than the other quintiles, irrespective of the type of old-age dependency household. In the case of households with high old-age dependency, the intensity of CHE was higher among those with health insurance. There were variations in most of the characteristics within households of each type of old-age dependency. For instance, the intensity of CHE among households with low old-age dependency was higher among female-headed households. While in the case of households with no old-age dependency and high old-age dependency, it was higher among male-headed households. Households headed by individuals with less than 6 years of schooling experienced a higher intensity of CHE in low old-age dependency households. Overall, households with low old-age dependency incurred OOP 5.4 times their CTP.

## 3.3 | State pattern of incidence and intensity of catastrophic health expenditure

Table 4 presents the state pattern of incidence of CHE by type of household old-age dependency in India. The incidence of CHE was higher among households with high old-age dependency than those with no old-age dependency across all the states. Among households with high old-age dependency, the incidence of CHE was the highest in Maharashtra (43.3%), followed by Kerala (43.3%) and Telangana (43.2%), and the lowest in Nagaland (10.9%), followed by

**TABLE 3** Incidence and intensity of catastrophic health expenditure (CHE) by socioeconomic characteristics across household old age dependency status in India, 2017–18

| Socioeconomic characteristics | Incidence of CHE (%) | | | Intensity of CHE | | |
|---|---|---|---|---|---|---|
| | Households with no old age dependents | Households with low old age dependents | Households with high old age dependents | Households with no old age dependents | Households with low old age dependents | Households with high old age dependents |
| Place of residence | | | | | | |
| Rural | 25.1 | 27.8 | 36.7 | 3.8 | 6.4 | 2.3 |
| Urban | 10.7 | 13.5 | 24.5 | 1.0 | 0.9 | 1.4 |
| MPCE quintile | | | | | | |
| Poorest | 41.2 | 42.8 | 66.3 | 8.8 | 13.0 | 4.4 |
| Poorer | 20.0 | 22.1 | 34.4 | 1.1 | 0.9 | 2.3 |
| Middle | 16.8 | 16.5 | 29.3 | 0.9 | 0.7 | 1.4 |
| Richer | 13.4 | 13.6 | 17.7 | 0.6 | 0.5 | 0.8 |
| Richest | 7.8 | 7.4 | 16.6 | 0.5 | 0.4 | 0.6 |
| Household size | | | | | | |
| 1–3 | 20.7 | 22.7 | 37.1 | 4.4 | 1.1 | 2.2 |
| 4–6 | 19.2 | 22.1 | 25.8 | 3.4 | 4.6 | 1.3 |
| 7+ | 23.5 | 25.1 | 28.3 | 1.5 | 7.8 | 2.9 |
| Household income source | | | | | | |
| Agriculture | 22.2 | 30.2 | 31.7 | 1.7 | 1.1 | 1.8 |
| Non-agriculture/Self employed | 12.2 | 20.5 | 28.3 | 0.5 | 0.6 | 0.8 |
| Wage or salary | 20.0 | 23.2 | 30.0 | 4.1 | 4.5 | 2.2 |
| Pension | 19.6 | 18.9 | 31.7 | 1.2 | 1.3 | 1.7 |
| Other | 22.5 | 21.5 | 38.7 | 1.4 | 20.9 | 2.3 |
| Household insurance coverage | | | | | | |
| No | 21.2 | 23.6 | 33.7 | 3.9 | 6.6 | 2.0 |
| Yes | 18.4 | 21.7 | 31.9 | 1.6 | 1.2 | 2.3 |
| Sex of head of household | | | | | | |
| Male | 20.0 | 23.6 | 30.6 | 3.6 | 3.7 | 2.2 |
| Female | 21.9 | 20.7 | 40.8 | 2.1 | 16.2 | 1.7 |
| Education of head of household | | | | | | |
| No education | 22.9 | 27.2 | 38.1 | 5.5 | 5.6 | 2.5 |
| less than 6 years of schooling | 21.9 | 25.8 | 34.9 | 2.2 | 11.2 | 2.5 |
| 6–11 years of schooling | 18.6 | 20.8 | 28.8 | 1.4 | 1.2 | 1.3 |
| 11+ years of schooling | 14.1 | 16.0 | 19.4 | 0.7 | 3.9 | 0.8 |
| Marital status of head of household | | | | | | |
| Currently married | 20.1 | 23.3 | 30.8 | 3.5 | 6.4 | 2.1 |
| Widowed | 21.5 | 22.5 | 40.1 | 2.5 | 1.6 | 2.1 |
| Others | 23.4 | 23.3 | 32.9 | 1.6 | 6.5 | 2.3 |
| Caste of head of household | | | | | | |
| Schedule tribe (ST) | 19.1 | 23.6 | 32.9 | 1.7 | 29.8 | 2.5 |

TABLE 3 (Continued)

| Socioeconomic characteristics | Incidence of CHE (%) | | | Intensity of CHE | | |
|---|---|---|---|---|---|---|
| | Households with no old age dependents | Households with low old age dependents | Households with high old age dependents | Households with no old age dependents | Households with low old age dependents | Households with high old age dependents |
| Schedule caste (SC) | 24.5 | 26.8 | 37.2 | 4.6 | 12.2 | 3.5 |
| Other backward class (OBC) | 19.6 | 22.0 | 33.3 | 3.9 | 1.3 | 1.8 |
| Others | 18.6 | 22.3 | 30.4 | 1.2 | 1.6 | 1.5 |
| Religion of head of household | | | | | | |
| Hindu | 21.0 | 23.2 | 33.5 | 3.8 | 6.3 | 2.1 |
| Muslim | 17.7 | 23.2 | 32.2 | 1.3 | 1.2 | 1.3 |
| Christian | 17.3 | 22.2 | 26.7 | 1.7 | 1.0 | 1.2 |
| Others | 19.5 | 21.8 | 37.1 | 1.0 | 1.3 | 3.6 |
| **Total** | **20.4** | **23.1** | **33.2** | **3.3** | **5.4** | **2.1** |

Andaman and Nicobar Islands (11.3%) and Mizoram (14.6%). Among households with low old-age dependency, the highest incidence of CHE was found in the state of Jammu and Kashmir (34.3%), followed by Rajasthan (31.3%) and Arunachal Pradesh (30%), and the lowest incidence was found in Andaman and Nicobar Islands (7.8%), followed by Karnataka (9.7%) and Delhi (11.7%). In the case of households with no old-age dependency, the incidence of CHE was the highest in the state of Rajasthan (30.1%), followed by Uttar Pradesh (25.9%) and Jammu & Kashmir (25.8%), and the lowest in Puducherry (7.4%), followed by Karnataka (8.9%) and Nagaland (10.6%).

Figure 2 presents the concentration curves of CHE by type of household old-age dependency in India. The concentration curves above the diagonal line suggest that the CHE was higher among the poor across all the three types of old-age dependency households. The negative sign of Erreygers concentration indices also confirms that the inequality in the incidence of CHE was concentrated among the relatively poor across all types of old-age dependency households (Appendix 2). For instance, the Erreygers concentration index for all middle-aged and elderly households was −0.139 (SE: 0.005). It was −0.186 (SE: 0.009) for households with high old-age dependency, −0.132 (SE: 0.008) for households with low old-age dependency, and −0.119 (SE: 0.005) for households with no old-age dependency. Thus, the higher value of the negative Erreygers concentration index reveals that the extent of inequality in the incidence of CHE was higher in high old-age dependency households.

## 3.4 | Socioeconomic predictors of catastrophic health expenditure

Table 5 presents the odds of incurring CHE by socioeconomic characteristics in the form of adjusted odds ratio (AOR) and confidence interval (CI). Controlling for the co-variates, the odds of incurring CHE were higher among households with high old-age dependency (AOR:1.52; 95% CI: 1.36–1.69) and those with low old-age dependency (AOR: 1.14; 95% CI: 1.04–1.25) compared to households with no old-age dependency. Urban households were less likely to incur CHE (AOR: 0.31; 95% CI: 0.27–0.35) than rural households. Households with a pension as the main source of income were more likely to incur CHE (AOR: 1.33; 95% CI: 1.07–1.66) compared to those whose income came from agriculture. Health insurance was insignificantly associated with the reduction of CHE in India. Households that belonged to the richest MPCE quintile were less likely to incur CHE (AOR: 0.06; 95% CI: 0.05–0.07) than those that belonged to the poorest MPCE quintile. Households belonging to OBC were more likely to incur CHE (AOR: 1.73; 95% CI: 1.45–2.06) compared to the scheduled tribe ones.

**TABLE 4** State pattern of incidence of catastrophic health expenditure (CHE) by household old age dependency status in India, 2017–18

| States | Household old age dependency | | | |
|---|---|---|---|---|
| | No | Low | High | All households |
| Maharashtra | 22.8 | 26.4 | 43.3 | 29.7 |
| Kerala | 22.8 | 27.6 | 43.3 | 30.7 |
| Rajasthan | 30.1 | 31.3 | 43.2 | 34.2 |
| Telangana | 23.9 | 26.6 | 38.8 | 29.2 |
| Uttar Pradesh | 25.9 | 29.4 | 37.4 | 29.8 |
| Arunachal Pradesh | 21.6 | 30.0 | 36.8 | 25.2 |
| Meghalaya | 23.0 | 24.4 | 35.4 | 25.2 |
| West Bengal | 24.7 | 29.5 | 34.7 | 28.5 |
| Madhya Pradesh | 21.8 | 19.5 | 33.9 | 24.3 |
| Odisha | 17.3 | 20.9 | 33.6 | 22.8 |
| Tamil Nadu | 16.9 | 21.5 | 33.0 | 23.8 |
| Himachal Pradesh | 18.6 | 20.3 | 30.8 | 21.9 |
| Jammu & Kashmir | 25.8 | 34.3 | 30.6 | 30.3 |
| Manipur | 20.4 | 20.9 | 30.3 | 23.2 |
| Andhra Pradesh | 17.5 | 22.6 | 30.1 | 22.4 |
| Lakshadweep | 11.2 | 13.0 | 29.6 | 15.0 |
| Bihar | 24.2 | 28.5 | 29.1 | 27.1 |
| Jharkhand | 19.5 | 20.6 | 27.7 | 21.7 |
| Haryana | 19.3 | 17.2 | 27.5 | 20.2 |
| Punjab | 23.2 | 24.0 | 26.6 | 24.3 |
| Tripura | 19.4 | 19.6 | 26.2 | 20.9 |
| Assam | 21.9 | 24.5 | 24.8 | 23.2 |
| Goa | 12.1 | 18.0 | 24.3 | 16.8 |
| Karnataka | 8.9 | 9.7 | 24.1 | 12.4 |
| Chandigarh | 11.1 | 13.7 | 23.5 | 14.7 |
| Uttarakhand | 20.2 | 19.4 | 22.6 | 20.6 |
| Gujarat | 12.8 | 13.3 | 22.1 | 15.2 |
| Dadra & Nagar Haveli | 15.2 | 17.5 | 21.8 | 17.1 |
| Delhi | 10.9 | 11.7 | 21.8 | 12.8 |
| Chhattisgarh | 11.4 | 12.4 | 20.4 | 13.6 |
| Puducherry | 7.4 | 7.3 | 19.0 | 11.2 |
| Daman & Diu | 11.0 | 18.4 | 15.3 | 14.2 |
| Mizoram | 15.1 | 23.6 | 14.6 | 17.7 |
| Andaman & Nicobar Islands | 13.2 | 7.8 | 11.3 | 11.2 |
| Nagaland | 10.6 | 24.2 | 10.9 | 12.9 |
| **India** | **20.4** | **23.1** | **33.2** | **24.6** |

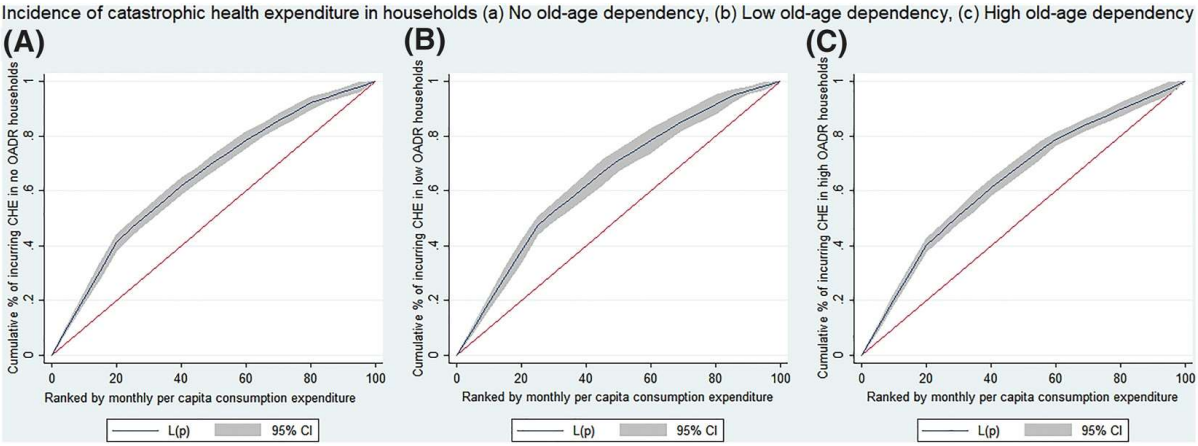


**FIGURE 2** Concentration curves for incurring catastrophic health expenditure (CHE) by type of old-age dependency of households in India, 2017–18

Table 6 presents the logistic regression results for each type of old-age dependency of households. Across all the three types of old-age dependency of households, urban households were less likely to incur CHE compared to rural households. The odds of incurring CHE declined consistently with an increase in the living standard (MPCE quintiles) for all households. Household health insurance was not significantly associated with CHE. No consistent pattern was observed in terms of education across all three types of households. Compared to households headed by individuals who were currently married, those headed by widowed individuals were less likely to incur CHE in no old-age dependency households. While caste was a significant predictor across all households, religion was not significant in any old-age-dependent households.

## 4 | DISCUSSION

An increasing number of studies have documented high OOP expenditure and CHE in India.[2,22,30] But the risk of incurring CHE is not uniform across households. Middle-aged adult and elderly households are vulnerable to financial catastrophe due to the high disease burden and reduced income. This paper estimated the incidence and intensity of CHE among middle-aged adults and the elderly using the household old-age dependency approach. Data from the recently conducted Longitudinal Ageing Study of India was used in the analyzes. The paper investigated the role of age composition by classifying households into three mutually exclusive groups: households with no old-age dependency, households with low old-age dependency, and households with high old-age dependency.

The following are the salient findings of the study. We estimated the incidence of CHE at 24.6% among middle-aged adult and elderly households and found a strong age gradient in the incidence and intensity of CHE in India. The incidence of CHE was the highest (33.2%) among households with a high old-age dependency, followed by households with a low dependency ratio (23.1%) and was the lowest (20.4%) among households with no old-age dependency. The findings were similar when the estimates were derived using a CHE curve (based on OOP expenditure as a share of the household consumption expenditure). Our estimates of the CHE curve demonstrated the role of old-age dependency in financial catastrophe at all threshold levels. These findings were robust across the states of India. We found that the demographically advanced and poorer states showed a higher incidence of CHE. The high CHE in Kerala and Maharashtra may be attributed to the higher proportion of the elderly population in the states and the high prevalence of NCDs. Our findings also suggest that CHE decreased monotonically with the consumption quintile, as measured by the MPCE, across all three types of old-age dependent households. The robust Erreygers concentration indices confirmed the higher concentration of catastrophic health spending among the poor. Health insurance coverage did not necessarily reduce CHE among elderly households in India. We also found that household size, place of residence,

TABLE 5 Results of logistic regression of incurring catastrophic health expenditure (CHE) by socioeconomic characteristics in India, 2017-18

| Socioeconomic characteristics | AOR | 95% CI |
|---|---|---|
| Household old age dependency | | |
| No ® | | |
| Low | 1.14*** | (1.04–1.25) |
| High | 1.52*** | (1.36–1.69) |
| Place of residence | | |
| Rural ® | | |
| Urban | 0.31*** | (0.27–0.35) |
| MPCE quintile | | |
| Poorest ® | | |
| Poorer | 0.26*** | (0.24–0.30) |
| Middle | 0.18*** | (0.15–0.20) |
| Richer | 0.11*** | (0.097–0.13) |
| Richest | 0.060*** | (0.051–0.070) |
| Household size | | |
| 1–3 ® | | |
| 4–6 | 0.52*** | (0.47–0.58) |
| 7+ | 0.38*** | (0.33–0.43) |
| Income source of household | | |
| Agriculture ® | | |
| Non-agriculture/Self employed | 0.92 | (0.69–1.23) |
| Wage or salary | 0.87** | (0.77–0.98) |
| Pension | 1.33** | (1.07–1.66) |
| Other | 1.04 | (0.89–1.22) |
| Household covered insurance | | |
| No ® | | |
| Yes | 1.08 | (0.98–1.20) |
| Sex | | |
| Male ® | | |
| Female | 1.13 | (0.98–1.30) |
| Education | | |
| No education ® | | |
| less than 6 years of schooling | 1.04 | (0.92–1.16) |
| 6–11 years of schooling | 0.96 | (0.87–1.06) |
| 11+ years of schooling | 1.05 | (0.89–1.24) |
| Marital status | | |
| Currently married ® | | |
| Widowed | 0.96 | (0.83–1.10) |
| Others | 0.88 | (0.67–1.14) |
| Caste | | |
| Schedule tribe (ST) ® | | |

TABLE 5 (Continued)

| Socioeconomic characteristics | AOR | 95% CI |
|---|---|---|
| Schedule caste (SC) | 1.55*** | (1.31–1.83) |
| Other backward class (OBC) | 1.67*** | (1.41–1.98) |
| Others | 1.73*** | (1.45–2.06) |
| Religion | | |
| Hindu ® | | |
| Muslim | 0.93 | (0.81–1.08) |
| Christian | 0.77** | (0.62–0.96) |
| Others | 0.94 | (0.69–1.29) |

*Note*: $N$ = 42,593; state fixed effect is applied; log pseudolikelihood = −80505710; Wald chi2(60) = 2871.50; Prob > chi2 = 0.0000; Pseudo $R^2$ = 0.1650

*** $p < 0.01$, ** $p < 0.05$.

income source, and caste of household head were significant predictors of CHE among middle-aged adults and the elderly in India.

Our results suggest that CHE incidence was at least twice higher among middle-aged adults and the elderly (45+) than in the overall population. A recent study covering the overall population and using a similar methodology estimated CHE incidence in India at 9.1%.[22] Another Indian study provided a comprehensive estimate of the incidence of CHE by the age composition of household members over seven data points using the National sample survey (NSS)'s health and consumption survey.[2] The study concluded that CHE was significantly higher among elderly households than non-elderly households. Our estimates of CHE among elderly households were higher than those made by earlier studies that primarily used elderly and non-elderly classifications of households.[2,39] This is possibly due to our distinct approach of using the concept of household old-age dependency, estimating CHE using the capacity-to-pay approach, and excluding health expenditure from the household consumption basket.

It may be noted that the NSS consumption surveys include health expenditure in the computation of household consumption expenditure.[22] A household that spends more on medicine and hospitalisation will naturally show a higher consumption expenditure and will likely underestimate the incidence of CHE. The earlier estimates derived from health survey data used a single question or/or few questions on consumption expenditure, which may have led to underestimating household consumption. This approach is therefore not recommended in literature.[40,41]

We put forward the following explanations in support of our results. The high incidence of CHE among households with high old-age dependency is possibly due to their low-income level, higher disease burden, high cost of treatment, lack of access to quality health services, low insurance coverage, and lower reimbursement. A higher prevalence of chronic diseases among the elderly possibly increases the use of health care services,[42–44] leading to higher OOP and risk of CHE in old-age-dependent households even if they avail of health insurance. We also found that the per capita cost of hospitalisation was significantly higher among households with high old-age dependency than in other households. Treating chronic diseases is expensive and takes a long time, especially for rural residents with lower medical opportunities whose families have to move to cities for better facilities. Such situations can aggravate high OOP payments and catastrophic health spending, even in low-old-age-dependent households. Moreover, with the early onset of NCDs, middle-aged adults and the elderly are at an increased health risk, leading to higher OOP payments in households with low old-age dependents. In the present study, the likelihood of CHE decreased with the increasing household size. This might be possible due to the high inclusion of elderly members in small households who frequently need health services. On the other hand, large households include not just the elderly but also children and different age-group adults who can earn and reduce the burden of health spending by family. Though we believe we have estimated the CHE with precision, it may have under-estimated CHE because of forgone health care. Accessibility to quality health services for NCDs is limited in rural areas, small towns, many public health centres and in few

**TABLE 6** Results of logistic regression of incurring catastrophic health expenditure (CHE) by household old age dependency with socioeconomic characteristics in India, 2017–18

| | Household old-age dependency | | | | | |
|---|---|---|---|---|---|---|
| | No | | Low | | High | |
| **Socioeconomic characteristics** | **AOR** | **95% CI** | **AOR** | **95% CI** | **AOR** | **95% CI** |
| Place of residence | | | | | | |
| Rural ® | | | | | | |
| Urban | 0.28*** | (0.23–0.34) | 0.29*** | (0.24–0.36) | 0.36*** | (0.29–0.44) |
| MPCE quintile | | | | | | |
| Poorest ® | | | | | | |
| Poorer | 0.27*** | (0.23–0.32) | 0.30*** | (0.25–0.36) | 0.20*** | (0.16–0.25) |
| Middle | 0.18*** | (0.15–0.22) | 0.19*** | (0.16–0.24) | 0.13*** | (0.099–0.17) |
| Richer | 0.13*** | (0.11–0.16) | 0.15*** | (0.12–0.19) | 0.058*** | (0.045–0.076) |
| Richest | 0.065*** | (0.051–0.083) | 0.068*** | (0.050–0.092) | 0.039*** | (0.029–0.051) |
| Household size | | | | | | |
| 1–3 ® | | | | | | |
| 4–6 | 0.55*** | (0.47–0.65) | 0.61*** | (0.49–0.77) | 0.43*** | (0.36–0.52) |
| 7+ | 0.38*** | (0.31–0.47) | 0.47*** | (0.36–0.60) | 0.29*** | (0.22–0.39) |
| Income source of household | | | | | | |
| Agriculture ® | | | | | | |
| Non-agriculture/Self employed | 0.75 | (0.49–1.12) | 0.86 | (0.53–1.40) | 1.18 | (0.72–1.93) |
| Wage or salary | 0.99 | (0.82–1.20) | 0.76*** | (0.62–0.93) | 0.82 | (0.65–1.04) |
| Pension | 1.26 | (0.89–1.78) | 0.88 | (0.68–1.15) | 1.79*** | (1.20–2.66) |
| Other | 1.13 | (0.88–1.45) | 0.77** | (0.59–1.00) | 1.15 | (0.90–1.48) |

TABLE 6 (Continued)

| | Household old-age dependency | | | | | |
|---|---|---|---|---|---|---|
| | No | | Low | | High | |
| Socioeconomic characteristics | AOR | 95% CI | AOR | 95% CI | AOR | 95% CI |
| Household covered insurance | | | | | | |
| No ® | | | | | | |
| Yes | 1.12 | (0.97–1.31) | 1.09 | (0.91–1.30) | 1.06 | (0.89–1.26) |
| Sex | | | | | | |
| Male ® | | | | | | |
| Female | 1.26** | (1.00–1.58) | 0.91 | (0.71–1.18) | 1.33** | (1.02–1.72) |
| Education | | | | | | |
| No education ® | | | | | | |
| Less than 6 years of schooling | 0.99 | (0.84–1.17) | 1.06 | (0.89–1.26) | 1.03 | (0.81–1.32) |
| 6–11 years of schooling | 0.99 | (0.84–1.16) | 0.83** | (0.69–0.99) | 1.18 | (0.95–1.47) |
| 11+ years of schooling | 1.09 | (0.87–1.38) | 0.99 | (0.77–1.27) | 1.02 | (0.69–1.50) |
| Marital status of head of household | | | | | | |
| Currently married ® | | | | | | |
| Widowed | 0.79** | (0.63–0.99) | 1.00 | (0.82–1.23) | 0.95 | (0.75–1.22) |
| Others | 0.99 | (0.74–1.31) | 1.11 | (0.64–1.92) | 0.63 | (0.39–1.02) |
| Caste | | | | | | |
| Schedule tribe (ST) ® | | | | | | |
| Schedule caste (SC) | 1.74*** | (1.38–2.19) | 1.3 | (1.00–1.69) | 1.59*** | (1.18–2.14) |
| Other backward class (OBC) | 1.66*** | (1.35–2.04) | 1.47*** | (1.14–1.89) | 1.92*** | (1.40–2.62) |
| Others | 1.63*** | (1.30–2.04) | 1.61*** | (1.22–2.12) | 1.97*** | (1.44–2.71) |

(Continues)

TABLE 6 (Continued)

| | Household old-age dependency | | | | | |
|---|---|---|---|---|---|---|
| | No | | Low | | High | |
| Socioeconomic characteristics | AOR | 95% CI | AOR | 95% CI | AOR | 95% CI |
| Religion | | | | | | |
| Hindu ® | | | | | | |
| Muslim | 1.00 | (0.82–1.23) | 0.93 | (0.74–1.18) | 0.91 | (0.70–1.18) |
| Christian | 0.79 | (0.59–1.05) | 0.84 | (0.56–1.25) | 0.66** | (0.44–0.97) |
| Others | 0.68 | (0.44–1.04) | 0.83 | (0.57–1.20) | 1.62 | (0.95–2.76) |
| N (No. of Observations) | 19,625 | | 13,052 | | 9916 | |
| Log pseudolikelihood | −31,135,150 | | −26,153,773 | | −22,453,276 | |
| Wald chi2 (58) | 1085.10 | | 794.07 | | 1023.08 | |
| Prob > chi2 | 0.0000 | | 0.0000 | | 0.0000 | |
| Pseudo R2 | 0.1454 | | 0.1494 | | 0.1984 | |

*Note*: state fixed effect is applied; *** $p < 0.01$, ** $p < 0.05$.

socially disadvantaged groups. Besides, low income and poor social support systems may force many older adults and elderly to foregone health care.

In the present study, health insurance did not reduce the CHE among middle-aged adults and the elderly. It may be mentioned that insurance coverage increased from 4.8% in 2005%–2006% to 41% in 2019–2021 in India.[28,45] The increase has largely been due to increasing publicly funded insurance schemes like the Rashtriya Swasthaya Bima Yojana (RSBY) and other state-sponsored insurance schemes. While RSBY/state-specific/community health insurance schemes cover households within the gambit of insurance plans,[46] they do not guarantee treatment in tertiary or private health centres. Studies suggest that the RSBY and many other state-sponsored schemes introduced prior to the Ayushman Bharat Yojana (ABY) have increased hospital admission and CHE.[47,48] Among other things, targeted intervention of individuals below the poverty line (BPL) as beneficiaries, service coverage in secondary and tertiary health centres, and unavailability of funds in state-sponsored schemes are some of the probable reasons for the failure of these programs.[48] Many empanelled public health centres are poorly equipped with lack the infrastructure to treat patients with NCDs.[49] The ABY introduced in 2018 provides insurance coverage up to INR 5 lakh on account of annual hospitalisation for any family member. The central and state governments fund the scheme, and the health services can be availed from any health centre identified by a state government. It may be mentioned that the LASI data was collected just before the implementation of ABY, and hence, we could not analyse the effect of ABY on CHE. Besides, treatment costs and catastrophic health expenditures are higher in private health centres.[50] This might be the reason that households with high old-age dependency have a higher intensity of CHE even if they avail of health insurance.

We put forward the following limitations of the study. First, we used the number of members in the working-age group due to the non-availability of the working members in the data set. Also, our classification of low and high old-age dependency was normative. Second, our estimates did not capture the foregone health care due to financial constraints and classified all such households as not incurring CHE. Third, we did not include the indirect treatment cost in the present study due to data limitations. Fourth, CHE may be affected by the type of insurance coverage available to the households, which we could not consider due to data unavailability. Despite these limitations, we believe that this paper provides empirical evidence of financial catastrophe among middle-aged adults and the elderly in India.

The current COVID-19 crisis has crippled the health care system of the country. The surge in infection, pre-mature death, and post-COVID-19 complications have considerably affected the country's middle-aged adults and the elderly. This crisis may have increased OOP expenditure and CHE among middle-aged adults and the elderly manifolds.

## 5 | CONCLUSION

Based on our findings, we make the following recommendations. We suggest strengthening the primary health cent across all the regions of India to provide preventive and curative services for NCDs. Currently, PHCs primarily cater to maternal and child health needs and have a limited component of NCDs.[49] Many of the PHCs lack staff and infrastructure and are not equipped to treat most NCDs, especially in middle-aged adults and the elderly. We also suggest increasing public awareness of ABY, a comprehensive targeted scheme for the poor and the elderly which addresses many of the shortcomings of earlier social health insurance schemes. Future research is required to understand the effect of ABY on catastrophic health spending in India, especially among socially disadvantaged groups. Finally, private health centres across the country need to be regulated with regard to pricing and treatment to reduce the burden of CHE among older adults and the elderly in India.

## AUTHOR CONTRIBUTIONS

**Sanjay K. Mohanty** and **Umakanta Sahoo**: Conceptualisation of the study; **Sanjay K. Mohanty**, **Umakanta Sahoo** and **Rashmi Rashmi**: formal analysis and interpretation; **Sanjay K. Mohanty**, **Umakanta Sahoo** and **Rashmi Rashmi**: drafting the manuscript; **Sanjay K. Mohanty**, **Umakanta Sahoo** and **Rashmi Rashmi**: critical revision of the manuscript for important intellectual content; The authors read and approved the final manuscript.

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## CONFLICT OF INTEREST

The authors declare that they do not have any competing interest.

## DATA AVAILABILITY STATEMENT

The dataset used for analysis of the current study are available for public use by a data request to the International Institute for Population Sciences, Mumbai, India. The data request form is available at the following link, https://iipsindia.ac.in/sites/default/files/LASI_DataRequestForm_0.pdf.

## ETHICS STATEMENT

Not applicable as this study is based on secondary data source.

## ORCID

*Sanjay K. Mohanty* https://orcid.org/0000-0001-9041-5952
*Rashmi Rashmi* https://orcid.org/0000-0003-4709-3569

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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