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Regular Article

Economic burden of infectious diseases and its equity implications in Indian households: Estimates from a nationally representative household survey (2017–18)

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ABSTRACT

Infectious diseases remain one of the major causes of health and economic burden for Indian households. Furthermore, the magnitude of economic losses on account of infectious disease episodes varies widely across rich and poor households. The primary objective of this research is to estimate the equity impact of infectious disease episodes on out-of-pocket expenditure (OOPE) and wage losses among Indian households. We analysed the Social Consumption: Health (SCH) data from the 75th round (2017–18) of India's National Sample Survey (NSSO). The sample included approximately 113,823 households and 555,352 individuals through a multistage stratified sampling process. We report i) the prevalence of infectious disease and healthcare utilisation rate by levels of care; ii) medical and non-medical OOPE per episode; iii) OOPE and wage loss as a share of households' monthly non-medical consumption expenditure (non-medical MPCE) across wealth quintiles. We adopted a microeconomic cost of illness approach to estimate the OOPE on infectious disease episodes for outpatient care and hospitalization. We also estimated potential wage losses due to a reduction in effective labour supply at the household level because of infectious disease using a production function approach. The overall prevalence of infectious diseases and hospitalization rate were 31 and 9 per thousand persons, respectively. Per capita medical OOPE was more in higher wealth quintiles for outpatient care and hospitalization. However, OOPE as a share of non-medical MPCE was higher in the poorest 20% households (outpatient: 14%; hospitalization: 153%) in comparison to the richest 20% households (outpatient: 5.5%; hospitalization: 96%). Similarly, the wage losses as a share of non-medical MPCE were higher among the poorest 20% households (outpatient: 21%; hospitalization:38%) in comparison to the richest 20% households (outpatient: 15%; hospitalization:11%). Furthermore, the proportion of households reporting the sale of assets and borrowing to finance hospitalization was higher in the poorest (24%) compared to the richest (12.5%). To our knowledge, this is the first paper which contributes to developing an understanding of the equity impact of infectious disease on households in India. We recommend improved targeting and coverage of publicly funded health insurance schemes among socially disadvantaged populations.

1. Introduction

Global efforts to prevent and control infectious diseases have led to a significant reduction in morbidity and mortality caused by infectious diseases in high-income countries (Diseases & Injuries, 2020). However, infectious diseases remain a major cause of morbidity, mortality and economic losses in Low and middle-income (LMI) countries. Furthermore, there is an increasing burden of emerging and re-emerging infections such as coronavirus disease (COVID-19). Recent research has indicated that COVID-19 may persist as an endemic disease with seasonal epidemic peaks because of susceptible population, waning immunity, and changes in the virus (Telenti et al., 2021) which will add to

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an already high disease and economic burden of infectious diseases.

In India, the contribution of infectious and associated diseases as a proportion of the total disease burden has decreased from 61% in 1990 to 33% by 2016. However, in comparison to other geographies with a similar level of economic development, this infectious disease burden is around 2.5 to 3.5 times higher in India indicating a higher prevalence of risk factors and limited access to healthcare. Furthermore, there are disparities in the distribution of infectious disease burden across Indian states and population groups. As per the India State-Level Disease Burden Initiative report, among Indian states, the range of disease burden was 9-fold for diarrhoeal disease, 7-fold for lower respiratory infections, and 9-fold for tuberculosis (ICMR et al., 2017.). It may be noted that disease transmission is determined not only by an interplay between risk factors such as overcrowding, poor nutritional status, poor water supply, and sanitation but also by the household's ability to pay for preventive and curative services (Cash & Patel, 2020).

Recent research has also indicated that, in India, infectious diseases remain highly prevalent among those residing in rural areas, females, 0–14 age groups, Muslims, illiterates, scheduled tribes (STs), large family households, and economically poor. Furthermore, the study also reported that scheduled castes (SCs), illiterates, and poor households resorted to borrowings, sale of assets, and other distressed sources of financing to take care of infectious disease-related expenditures (Ram & Thakur, 2022). During the last two decades, the hospitalization rates have doubled particularly in children because of infectious diseases in India (Kastor & Mohanty, 2018a). This increase in hospitalization and consequent expenditure on treatment and care is leading to an increase in the economic burden of infectious diseases. Another study reported that out-of-pocket expenditure (OOPE) on childhood infection-related hospitalization as a share of total consumption expenditure (TCE) was disproportionately higher for the poorest 20% households compared to the richest 20% households (Farooqui et al., 2022).

Not only do infectious diseases cause morbidity and mortality, but they also lead to financial catastrophe at the household level and economic burden at the societal level. Hence, robust estimates on the distributional impact of infectious disease-related economic burden are important to identify the target population and implement policy intervention related to financial risk protection and social security. Though previous global research has reported the cost of treatment, out-of-pocket expenditure, and wage losses for infectious diseases such as pneumonia (Zhang et al., 2016), diarrhoea (Baral et al., 2020; Rheingans et al., 2012), tuberculosis (Tanimura et al., 2014), malaria (Gupta & Chowdhury, 2014; Sachs & Malaney, 2002), dengue (Lee et al., 2017), and others (Yadav et al., 2022)' (Kastor & Mohanty, 2018b) most of these published estimates lack generalizability because of the small sample sizes, weak methodological approaches, or restricted definition of economic consequences. In addition, previous research only reported OOPE on individual infectious disease conditions such as pneumonia, diarrhoea, malaria, etcetera, but not the overall economic burden of all infectious diseases at the country level in totality. Furthermore, previous studies also did not report the distributional aspect of infectious diseases-related financial burden and its equity impact at the population level. To measure the distributional impact of the economic consequences of infectious disease a comprehensive assessment of the infectious disease-related OOPE and wage loss at the household level is needed. To our knowledge, this is the first paper which contributes to developing an understating of the equity impact of infectious disease on households in India. The overall aim of this research is to assess the equity impact of economic consequences of infectious disease on households in India by estimating the magnitude of infectious disease episodes and consequent out-of-pocket expenditure, productivity losses and coping mechanisms at the household level across wealth quintiles.

1.1. Background and research context

The core characteristic of infectious disease is its transmission potential i.e., the ability of a pathogen to infect and cause disease in a susceptible person. This can be thought of as an externality in terms of an economic concept. An early diagnosis and treatment of infectious disease in the households prevent further transmission and yield positive externalities, whereas an undertreatment may lead to more infections and antimicrobial resistance leading to negative externalities (Laxminarayan & Malani, 2011). The literature on the relationship between infectious disease transmission and self-protection suggests that early diagnosis and treatment slows the spread of infections but also reduces the incentives to invest in interventions to slow the disease transmission. Hence, the population-level prevalence of infectious diseases is affected by the demand for treatment for the infected and vaccination to prevent infections (Laxminarayan & Malani, 2011), (Hauck, 2018).

Theoretical modelling has also suggested pathways explaining how individual behaviour and household characteristics affect the prevalence of infectious disease and consequently the economic burden. The economic burden of infectious disease at the household level is driven by direct expenditure incurred on the prevention and treatment and reduced household labour supply and earnings because of hospitalization or premature death (Bloom et al., 2020). Furthermore, income inequality and the ability to pay for prevention and treatment (Hauck, 2018; Laxminarayan & Malani, 2011) further accentuate inequity and the likelihood of infectious disease acquisition.

1.2. Conceptual framework

A conceptual framework of the differential economic impact of the economic burden of infectious diseases on account of out-of-pocket expenditure on treatment and wage losses because of reduced labour supply is presented in Fig. 1. Several empirical studies have demonstrated that poor households in low and middle-income countries face a greater health and economic burden of infectious diseases. Infectious disease disproportionately affects poor households because of the high prevalence of risk factors (Semenza et al., 2016; Weiss & McMichael, 2004), such as unsafe drinking water, poor nutrition, poor sanitation, high vector densities, in the environment they live (Cash & Patel, 2020; Jung et al., 2021) and lack of general access to quality health care. (Bloom et al., 2020). In the absence of universal health coverage, poor households incur disproportionately higher out-of-pocket expenditures for treatment and care compared to their richer counterparts. These expenditures limit their ability to invest in preventive measures such as

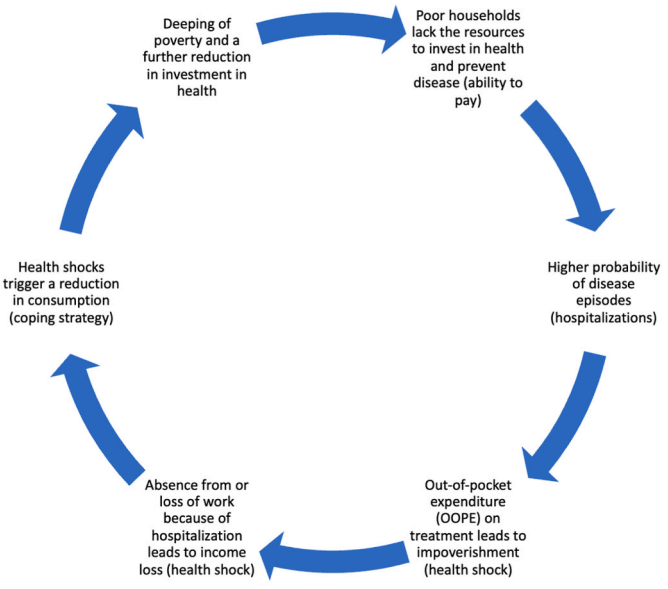

Fig. 1. Conceptual framework of the economic impact of infectious diseases-related OOPE and wage losses on households.

safe water, nutrition, and vaccination. We investigated the equity impact of OOPE on account of infectious disease episodes in households by estimating OOPE as a share of non-medical monthly per capita consumption expenditure (non-medical MPCE) across the wealth quintiles.

In addition to OOPE on treatment and care, another dimension of economic burden is wage losses at the household level because of reduced labour supply because of hospitalization and deaths. Poor households face larger economic consequences because of both a higher probability of falling sick and consequently a higher probability of catastrophic expenditure on treatment and livelihood and income loss (Dang et al., 2020; Palomino et al., 2020) due to limited ability to pay and limited savings. We estimated the wage losses on account of infectious disease-related episodes at the household level by estimating mincer equations as well proportional contribution of wage losses to the overall economic burden at the household level across wealth quintiles.

Furthermore, to cope with health and economic shock because of OOPE and wage losses, households resort to distress coping strategies such as borrowing, using loans or mortgages, and selling assets (Alam & Mahal, 2014). These negative health shocks push poor households into economic distress and a poverty trap (Alam & Mahal, 2014) As a result, these populations remain trapped in the vicious cycle of poor health and poor productivity resulting in poor income (Gallup & Sachs, 2001; Sachs & Malaney, 2002). We estimated the impact of the health and economic shock in terms of households reporting the sale of assets or loans due to meet expenditures incurred because of infectious disease-related episodes across wealth quintiles.

The primary objective of this research is to estimate the equity impact of out-of-pocket expenditures and wage losses because of infectious disease episodes on Indian households.

2. Material and methods

2.1. Data source and sample

We analysed the 'Social Consumption: Health' (SCH) data from India's National Sample Survey Office (NSSO) 75th round (NSSO 2017–18). Nationally, ~113,823 households (64,552 in rural areas and 49,271 in urban areas) covering 555,352 individuals (326,033 in rural and 229,319 in urban) were included in the survey through a multistage stratified sampling process. The NSSO provides full details on the sampling strategy (NSSO, 2017b), and the final sample weights at the household level are available in the database. We have applied the household-level sample weights in all our estimations using the Stata codes available for "frequency weight," "sample weight," and "analytical weight" for the relevant outcomes.

The information from sample households was collected using a questionnaire (Schedule 25.0). The survey provides detailed information on self-reported morbidity (classified into 60 different health conditions), mortality, utilisation of health care by levels of care, and the related out-of-pocket expenditure (OOPE) in outpatient and hospitalization settings separately. Self-reporting of ailment was collected with a reference period of 15 days, and the information related to healthcare utilisation for outpatient and hospitalization was collected for a reference period of 15 days and 365 days, respectively. Information on hospitalization episodes with a reference period of 15 days is also available. Accordingly, information on episode-level OOP expenditures (disaggregated by 6–7 items of expenditure) was collected for outpatient and hospital care for the respective reference periods (Appendix Table A-I presents details about types of morbidity covered, healthcare utilisation, expenditure items along with recall period).

Infectious diseases for each ailing individual can be identified from the different health conditions. We matched the disease condition in the surveys to broad ICD-10 disease classification to distinguish between infectious diseases and non-communicable disease (NCD) categories (including injuries). We categorized individuals into infectious health conditions categories if the individuals reported ailing and/or utilizing healthcare for those conditions (Appendix Table A-II for the health conditions included within an infectious disease category). We considered all predefined infectious disease conditions reported in the NSSO survey. These include fever with loss of consciousness or altered consciousness, fever due to diphtheria, whooping cough, fever with rash, malaria, tuberculosis, typhoid, filariasis, tetanus, HIV/AIDS, sexually transmitted diseases, jaundice, diarrhoeas, dysentery, worms infestation, acute upper respiratory infections, fevers of unknown origin and all specific fevers that do not have a confirmed diagnosis. The number of households reporting any infectious disease-related outpatient care was 14,287 for outpatient care and 22,233 for hospitalization.

In addition, the survey provides information on a range of socio-economic and demographic indicators of each individual covered in the survey (Appendix Table A-III). Households' total consumption expenditure during a reference period of 1 month is recorded in the survey as 'usual monthly consumption expenditure' (UMCE). Although not specifically mentioned in the survey, a detailed examination of the data reflected that UMCE only included non-medical usual consumption expenditure of households. We estimated non-medical monthly per capita consumption expenditure (non-medical MPCE) by dividing UMCE by household size and used non-medical MPCE to generate quintile groups (5 equal divisions) of population-weighted by sample weights of each household. We also used additional weights of household size, levels of consumption expenditure and number of episodes of illness/utilisation of healthcare in the analyses whenever needed.

2.2. Outcome measures

Our outcome measures include i) prevalence of disease and healthcare utilisation rate by levels of care; ii) medical and non-medical OOPE per episode, disaggregated by the public and private sector; iii) OOPE and wage loss as a share of household's non-medical MPCE disaggregated by economic status of population, measure in terms of non-medical MPCE.

In the context of the NSSO survey data, we defined formal treatment as treatment taken at a public or private health care facility/clinic (including the indigenous system) and not through unregistered practitioners, traditional healers, or direct over-the-counter purchase of medicines. However, OOPE included all kinds of expenditure incurred on formal and informal care.

OOPE is defined as the total cost of treatment separately for medical (including consultation fee, purchase of drugs and diagnostic services, and any other related medical costs) and non-medical (transportation, food, and lodging costs for patients and escorts) for outpatient and hospitalization episodes for their respective recall periods.

Literature suggests several methods to estimate the economic burden of diseases such as the cost of illness, the value of statistical life, convergence regression, and human capital augmented production function (Bloom et al., 2020). We adopted a microeconomic cost of illness approach to estimate the household-level economic burden of infectious diseases. We further improvised our analytical framework by adding a production function approach to estimate potential wage losses due to a reduction in effective labour supply at the household level.

2.3. Estimation of wage loss

The Social Consumption: Health' (SCH) survey does not collect information on the wage/income of an individual. The SCH survey however collected information on "loss of household income due to hospitalization/illness" on account of each episode of hospitalization/illness. This information included the total wage loss of household members who are employed in the labour market for wage earning. However, this excluded income loss of self-employed individuals and any economic loss of individuals who are out of the labour force (mainly children below the age of 15 years and adult women engaged only in household work) including unemployed (NSSO, 2017a). In general, the

available data on income loss in the SCH is likely to underestimate the income/productivity loss of households.

Hence, for estimating the wage/income loss of individuals, we imputed wage data in the SCH survey using the Periodic Labour Force Survey (PLFS) 2017–18, which was also conducted by the NSSO (NSSO, 2017c). The PLFS 2017–18 provides information on the monthly earnings for the self-employed, monthly wage earnings for the regular wage-paid workers, and daily wage earnings for casual wage earners. We estimated the Mincer earnings function using PLFS 2017–18 to identify the socio-economic indicators that are potential predictors of an individual's wage/income (Mincer, 1958). The results of the Mincer equation are reported in Appendix Table A-IV. Separate equations were estimated for men and women (in rural and urban areas) and by employment status to reflect potentially different conditions in their respective labour markets. Since, SCH too collected information on the labour market status (self-employed, regular wage-earning and casual wage-earning worker, unemployed and out-of-labour force status) of each individual, using the socioeconomic predictors and labour market status of individuals from PLFS 2017–18 and wage/income earnings as an outcome, we predicted wage/earnings for self-employed, regular wage-earning and casual wage-earning worker in the SCH data.

To estimate the total 'wage loss' on account of infectious diseases, the imputed daily wage/earnings for each individual reporting infectious disease was multiplied by (a) the number of days reported as ill for each episode during the last 15 days, and (b) the number of days stayed in the hospital alternatively for 15-day and 365-day reference period. This calculation was undertaken for all persons reporting ill in the preceding 15 days or hospitalized because of infectious diseases (including the deceased individuals on account of infectious diseases). This provided an estimate of income loss on account of illness for each individual.

We assumed caregiving time as being roughly half the time a person reported ill in the reference period. The wage loss value of this time was taken to be the average (imputed) wage of *all* individuals reporting an infectious condition (Mahal et al., 2010). In addition, for adult persons who reported not being part of the labour market (whether they reported being hospitalized or not), the estimated income foregone was considered to be 0.5 times their imputed daily wage to account for home-based production or caregiving. Carr et al. reported that individuals are more likely to stop working who provided care within the household, compared to those not providing care. Another research indicated that caregiving has a significant deterrent effect on caregivers' employment. (Carr et al., 2018; Nguyen & Connelly, 2014). Hence, to account for the opportunity cost of caregiving, i.e. the caregivers would have been compensated in the labour market if they were not engaged in home-based caregiving, the assumption of home-based production is considered. In addition, as a robustness check, we also analysed the data on "loss of household income due to hospitalization/illness" available in the SCH (Appendix Table A-V).

2.4. Empirical strategy

Estimating the relationship between infectious disease episodes and both OOPE and wage loss is complex. We first reported unadjusted mean and confidence intervals (CI) of main outcome indicators disaggregated by consumption expenditure quintile groups of the population. The economic burden of illness on households because of infectious disease, is reported as mean per person OOPE and wage loss, both in terms of absolute amount and as a share of households' non-medical monthly consumption expenditure (non-medical MPCE).

Nonetheless, as a robustness check and to reflect on adjusted estimates of economic burden, we also used a regression framework, separately for OOPE and wage loss. All estimates of the financial burden are reported for those households who reported any infectious disease condition separately for outpatient and hospitalization care. In short, the mean estimates are conditional on expenditure incurred by households on infectious diseases.

We estimated the economic burden on account of infectious diseases using a linear equation (Equation 1), which controlled for household-level socioeconomic observable characteristics. We also controlled for any state-level heterogeneity arising because of factors such as state-level policy related to infectious disease and/or other such factors.

$$y_{ij} = \alpha_i + \beta_1 infectious_i + \beta_2 quintile_i + \gamma X_{ij} + \eta_j + \varepsilon_i$$

Where y_{ij} is the outcome of interest (either OOPE or wage loss or share of OOPE or wage loss) for household *i* living in state *j*; *Infectious i* is an indicator variable equal to 1 if any member in household *i* reported an infectious disease and 0 otherwise; *Quintile i* is the households *i*'s economic quintile (per capita expenditure distribution) and X_{ij} stands for a set of socio-economic covariates for households '*i*' living in state '*j*'. The two error terms represent state-level fixed effects (n_j) and an independently distributed error term (ε) respectively.

Stata software V.17.0 (StataCorp LP, College Station, Texas, USA) was used for data analysis and *p*-values of less than 0.05 were considered statistically significant. All analyses were carried out using sampling weight.

3. Results

3.1. Disease prevalence and healthcare utilisation

The overall prevalence of self-reported infectious diseases was 31.5 per thousand persons (15-day reference period) out of which 78.5% sought any formal treatment. The hospitalization rate was 9.4 per thousand persons (365-day reference period) in the year 2017–18 (Table 1). The prevalence and hospitalization were the highest in children under 5 years, 77.8 and 16.8 per thousand persons, respectively. Furthermore, there was a higher number of infectious disease episodes per household as the household size increased (Appendix Figure A-I)

Among those who sought formal care (78.5%), only 27.7% and 47.9% reported seeking care in the public sector for outpatient care and hospitalization, respectively (Table 1). The private sector was the preferred place of outpatient treatment irrespective of gender, education level, social class, income quintile and geographic location whereas for hospitalization public sector was the preferred place for females, Schedule Caste and Schedule Tribe populations and poor income groups. Furthermore, around 1.27% didn't seek any treatment either because they did not consider the disease serious enough or because of their inability to pay. The population groups which were less likely to seek care were females (1.5%), illiterate (1.4%), Scheduled Tribe (5.5%), and rural population (1.4%) (Appendix Table A-VI). Detailed information on healthcare utilisation for non-communicable diseases, injuries, and other diseases and the participant's preferred place for treatment are provided in Appendix Table Table A-VII.

3.2. Level of OOPE and wage loss burden

Fig. 2 presents per episode OOPE on medical, non-medical expenditures and total expenditures for outpatient care and hospitalization by public and private sectors. It may be noted that for hospitalization, the highest total expenditure value in the public sector is lower than the median total expenditure estimates in the private sector. In outpatient care, the total median expenditure estimate in the public sector is much lower than in the private sector. In general, medical expenditures were higher than non-medical expenditures in both the public and private sectors but medical expenditures in the private sector were much higher for both outpatient care and hospitalization.

Table 2 reflects the level of the economic burden of infectious diseases on households, in terms of per capita OOPE and wage loss (in absolute value in INR) for outpatient care and hospitalization by consumption expenditure quintile groups of the population.

Table 1
Prevalence of self-reported infectious diseases in outpatient and hospital settings.

Age groups (in years)	Outpatient care* (15-day reference)			Hospitalization (365-days reference)	
	Prevalence (CI) per 1000 persons	% sought formal care*	% treatment in public sector	Hospitalization (CI) per 1000 persons	% treatment in public sector
0–5	77.8 (75.8–79.8)	78.7 (78.6–78.7)	24.9 (24.8–24.9)	16.8 (15.9–17.8)	36.7 (36.7–36.8)
6–19	35.1 (34.1–36.1)	78.7 (78.6–78.7)	25.0 (25.0–25.1)	7.6 (7.1–8.1)	42.4 (42.4–42.5)
20–59	22.4 (22.0–23.0)	77.5 (77.5–77.5)	29.8 (29.7–29.8)	8.3 (8.0–8.7)	49.6 (49.6–49.7)
60 & above	38.0 (36.1–39.7)	83.2 (82.1–83.2)	33.7 (33.7–33.8)	15.7 (14.6–16.9)	48.0 (47.96–48.13)
Overall	31.5 (31.1–32.0)	78.5 (78.50–78.53)	27.7 (27.7–22.7)	9.4 (9.1–9.6)	47.9 (47.8–48.0)

Notes: * excluding informal care, self-medication and no care; Source: Authors' estimate using SCH, NSSO 2017-18; Figures in brackets represent 95% confidence interval.

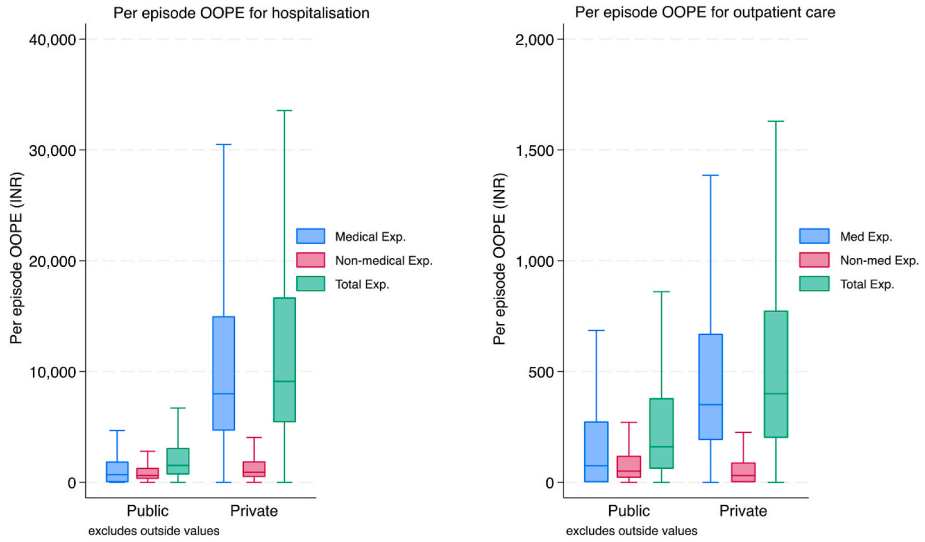

Fig. 2. Per episode OOPE on medical, non-medical and total expenditures for outpatient care and hospitalization by public and private sectors.

Table 2
Per capita mean out-of-pocket expenditure and wage loss by income quintiles for outpatient care and hospitalization among the households reporting infectious diseases.

	Per capita OOPE (INR)		Per capita wage loss (INR)	
	Outpatient (15 days recall)	Hospitalization (365 days recall)	Outpatient (15 days recall)	Hospitalization (365 days recall)
Poorest	123.9 (112.5–135.3)	1435.5 (1291.1–1580.0)	170.7 (160.9–180.5)	255.8 (234.5–277.1)
2nd poorest	119.7 (111.3–128.1)	2047.3 (1802.0–2292.7)	206.9 (194.4–219.3)	249.0 (236.4–261.7)
Middle	142.0 (133.4–150.5)	1714.9 (1593.7–1836.2)	287.9 (272.4–303.4)	277.6 (262.8–292.4)
2nd Richest	198.0 (183.9–212.1)	2075.7 (1953.1–2198.4)	426.8 (404.1–449.5)	352.0 (337.2–366.8)
Richest	257.0 (237.3–276.7)	4184.2 (3864.8–4503.6)	691.8 (646.6–737.0)	453.7 (433.3–474.0)
Overall	155.3 (149.8–160.8)	2220.9 (2129.6–2312.1)	308.8 (298.9–318.6)	313.3 (305.8–320.8)

Source: Authors' estimates using SCH, NSSO 2017-18; Figures in brackets represent 95% confidence interval.

In general, the level (magnitude) of per capita OOPE and wage loss reflect a positive relationship with households' consumption expenditure, i.e., higher OOPE and wage loss for households higher in the economic status ladder. The per capita mean OOPE on outpatient care was around 2 times in the richest 20% households in comparison to the poorest 20% households (INR 124 vs INR 257). For hospitalization, per capita mean OOPE was around 3 times in the richest 20% in comparison to the poorest 20% (INR 1345 vs INR 4184) reflecting the household's ability to pay. Similarly, the per capita mean wage loss on outpatient care and hospitalization was around 4 times (INR 170 vs INR 691) and around 2 times (INR 255 vs 453) in the richest 20% households in comparison to the poorest 20% households (Table 2). The average number of hospitalization days for infectious diseases was 5 days whereas for non-communicable diseases and injuries were 7.3 and 8.3 days, respectively. Appendix Table A-VIII presents the average number of hospitalization days and days of illness/restricted activity during outpatient care.

3.3. *Share of OOP in household expenditure and distress financing*

Although the level of per capita OOPE and wage loss reflect a positive relationship with households' consumption expenditure, the share of OOPE and wage loss to households' consumption expenditure reflects a higher burden on poorer households compared to that for richer households. Table 3 presents OOPE and wage loss as a percentage of non-medical monthly consumption expenditure (non-medical MPCE) and the percentage of households reporting distress financing across quintile groups. The poorest 20% households spent 14% and 153% of their monthly non-medical consumption expenditure on outpatient care and hospitalization, respectively, as compared to the richest 20%

Table 3
OOPE and wage loss as a percentage of households' monthly non-medical consumption expenditure among the households reporting infectious diseases across quintile groups.

	Outpatient (15 days recall)	Hospitalization (365 days recall)	Outpatient (15 days recall)	Hospitalization (365 days recall)	Households reporting at least one episode of hospitalization (365 days recall)
	OOPE as share of household non-medical MPCE (%)	OOPE as share of household non-medical MPCE (%)	Wage loss as share of household monthly non-medical MPCE (%)	Wage loss as share of household non-medical MPCE (%)	Households reporting borrowings and sale of assets (%)
Poorest	13.9 (12.7–15.1)	152.9 (138.5–167.2)	20.7 (19.5–22.0)	37.8 (33.2–42.4)	24.1 (22.4–25.8)
2nd poorest	9.3 (8.7–9.9)	147.6 (129.0–166.2)	16.1 (15.2–17.1)	19.5 (18.4–20.5)	25.6 (24.0–27.1)
Middle	8.3 (7.7–8.8)	97.1 (90.6–103.6)	16.9 (16.0–17.8)	16.9 (16.0–17.8	27.6 (26.0–29.0)
2nd Richest	8.8 (8.0–9.5)	87.5 (81.5–93.5)	18.6 (17.7–19.6)	16.0 (15.3–16.7)	19.9 (18.7–21.1)
Richest	5.5 (5.0–5.8)	96.4 (90.6–102.1)	15.4 (14.5–16.4)	11.1 (10.6–11.6)	12.5 (11.4–13.5)
Overall	8.1 (7.8–8.4)	103.5 (99.5–107.4)	17.1 (16.6–17.5)	15.8 (15.3–16.4)	19.0 (18.4–19.6)

Note: Households reporting single episodes of hospitalization in the last 365 days; Source: Authors' estimate using SCH, NSSO 2017-18; Figures in brackets represent 95% confidence interval

households, who spent only 5.5% and 96% on outpatient care and hospitalization, respectively. Furthermore, this OOPE resulted in distress financing (such as the sale of assets and borrowing) reported by the households. The level of distress as measured by the proportion of households reporting borrowing or sales of assets was almost two times in the poorest 20% of households (24%) as compared to the richest 20% of households (12.5%). Furthermore, the level of distress financing was higher for households belonging to Schedule Caste, casual labour and rural locations. (Appendix Table A-X provide further details on OOPE, wage loss and distress financing across social groups and labour classes).

Similarly, as observed for OOPE, the poorest households incurred a disproportionate burden of wage loss. The poorest 20% households (outpatient: 21%; hospitalization: 38%) incurred much higher wage losses as a proportion of households' monthly non-medical consumption expenditure in comparison to the richest 20% of households (outpatient: 15%; hospitalization: 11%) for outpatient care and hospitalization, respectively. In terms of total economic burden (i.e., OOPE and wage loss taken together), the poorest 20% bear around 239% of the household's monthly non-medical consumption expenditure for hospitalization while the richest bear around 150%. (Appendix Table A-IX presents total financial loss (combined OOPE and wage loss at the household level as a share of household monthly non-medical MPCE).

As part of the sensitivity analysis, we also estimated income loss/wage loss using information on income loss from NSSO data for hospitalization. We observed almost similar results with a lower magnitude of income loss (Appendix Table A-V).

Table 4 and Table 5 present adjusted estimates (using Equation 1) on per capita OOPE, OOPE as a share of non-medical MPCE, per capita wage loss and wage loss as a share of non-medical MPCE for outpatient care and hospitalization across consumption expenditure quintiles. The adjusted estimates reflect that although the magnitude of differences in the levels and share of OOPE and wage loss across the quintile groups are larger compared to those for unadjusted estimates, the direction of

Table 4
Adjusted estimates on per capita OOPE, OOPE as a share of households' monthly non-medical consumption expenditure, per capita wage loss and wage loss as a share of households' monthly non-medical consumption expenditure for outpatient care among the households reporting infectious diseases.

	Per capita OOPE (INR)	OOPE as share of household non-medical MPCE (%)	Per capita wage loss (INR)	Wage loss as share of household non-medical MPCE (%)
Quintile 1	−145.53 (−172.82, –118.24)	6.16 (4.61, 7.70)	−387.17 (−433.23, –341.11)	10.4 (8.27, 12.5)
Quintile 2	−139.99 (−166.16, –113.83)	2.41 (1.05, 3.76)	−347.70 (−391.87, –303.52)	6.32 (4.46, 8.19)
Quintile 3	−106.14 (−131.66, –80.61)	2.03 (0.80, 3.26)	−286.28 (−329.37, –243.19)	5.26 (3.56, 6.95)
Quintile 4	−56.35 (−80.48, –32.22)	2.31 (1.30, 3.32)	−225.55 (−266.29, –184.82)	3.43 (2.03, 4.82)
Constant	165.50 (106.22 224.78)	19.64 (−15.19, 5.44)	383.95 (283.88 484.02)	1.54 (−3.25, 6.35)
Adjusted for	SES	SES	SES	SES
Fixed effects	State dummy	State dummy	State dummy	State dummy
R2/ pseudo R2	0.0311	0.0357	0.1471	0.0776
N	9178	9178	9178	9178

Adjusted for household level socio-demographic, economic, and healthcare access related covariates. Note: Figures in brackets represent 95% confidence interval.

Table 5
Adjusted estimates on per capita OOPE, OOPE as a share of households' monthly non-medical consumption expenditure, per capita wage loss and wage loss as a share of households' monthly non-medical consumption expenditure for hospitalization among the households reporting infectious diseases.

	Per capita OOPE (INR)	OOPE as share of household non-medical MPCE (%)	Per capita wage loss (INR)	Wage loss as share of household non-medical MPCE (%)	Households reporting borrowings and sale of assets
Quintile 1	−2873.22 (−3343.91, −2402.52)	34.82 (11.51, 58.1)	−271.01 (−306.63, −235.40)	23.02 (19.61, 26.42)	5.55 (2.36, 8.74)
Quintile 2	−1922.02 (−2363.80, −1480.25)	60.26 (41.35, 79.17)	−242.20 (−275.63, −208.77)	6.75 (3.99, 9.51)	8.66 (6.07, 11.25)
Quintile 3	−2157.22 (−2585.52, −1728.92)	11.33 (−5.37, 28.04)	−209.40 (−241.81, −176.99)	3.87 (1.43, 6.31)	8.99 (6.70, 11.27)
Quintile 4	−1893.61 (−2285.42, −1501.81)	−4.62 (−17.88, 8.64)	−124.65 (−154.30, −95.01)	3.35 (1.42, 5.29)	4.29 (2.48, 6.11)
Constant	2130.75 (835.08, 3426.42)	4.80 (−54.34, 63.9)	529.66 (431.62, 627.70)	26.24 (17.60, 34.88)	14.5 (6.41, 22.60)
Adjusted for	SES	SES	SES	SES	Adjusted for
Fixed effects	State dummy	State dummy	State dummy	State dummy	Fixed effects
R2/pseudo R2	0.0377	0.0222	0.0392	0.0435	0.0659
N	12,237	12,237	12,237	12,237	12,237

Adjusted for household level socio-demographic, economic, and healthcare access related covariates. Note: Figures in brackets represent 95% confidence interval.

differences in per capita OOPE and wage loss across the quintile groups remained the same as in the unadjusted estimates for both outpatient care and hospitalization.

Both per capita OOPE and per capita wage loss for outpatient care were lower by around INR 145 and INR 387, respectively in the poorest households (Q1) in comparison to the richest households (Q5). The coefficient estimates of quintile groups reflect increasing levels of OOPE and wage loss with an increase in the economic status of households. However, OOPE and wage loss as a share of household non-medical MPCE were 6.2% and 10.4% higher in the poorest households in comparison to the richest households for outpatient care (Table 4). Similarly, both per capita OOPE and wage loss for hospitalization were lower for the poorest households by INR 2873 and INR 271 in comparison to the richest households. However, OOPE and wage loss as a share of households non-medical MPCE were 34.8% and 23.0% higher for the poorest households in comparison to the richest households (Table 5). Furthermore, a gradient of disproportionate economic burden was observed across consumer expenditure quintiles for both outpatient care and hospitalization in terms of OOPE and wage loss as a share of non-medical MPCE.

4. Discussion

There is a lack of literature on the economic burden of infectious diseases and their equity impact on households in low and middle-income countries. Previous research has focused either on disease-specific financial burden limited to the OOPE (Baral et al., 2020; Kastor & Mohanty, 2018b; Le et al., 2014; Lee et al., 2017) or on wage losses limited to the hospitalization (Alam & Mahal, 2014; Alonso et al., 2019; Rheingans et al., 2012) but not on the overall burden of all infectious using nationally representative data.

The core contribution of our research is the integration of infectious disease transmission, consequent OOPE and wage losses, and their equity impact on households using the latest nationally representative population-level data. We also contribute to the literature on the unit cost of treatment of infectious diseases. We demonstrate an increase in infectious disease transmission within a household as the household size increases (Appendix Figs. A–I).

We also observed that households preferred the private sector over the public sector for outpatient care and hospitalization. Previous research has indicated that the improvement in infrastructure and service provisioning in public facilities appears to have benefited the poor (Selvaraj et al., 2021), however, the preference for the private sector as observed in our analysis indicates the scope for further improvements in access to public sector services. Furthermore, households incurred a higher medical OOPE in the private sector in comparison to the public sector. The major cost drivers of medical expenditure in the private sector are expenditures on medicines (Selvaraj et al., 2018) and diagnostics (Veesa et al., 2018) whereas a higher non-medical OOPE may be explained by longer travel times and higher costs to reach health facilities as they are primarily located in urban areas. Also, a longer treatment duration resulting in increased accommodation and food-related expenditures (Balarajan et al., 2011) cannot be ruled out. It may be noted that the treatment cost for households in the public sector is lower mainly because all the services are fully subsidized. For example, essential drugs and diagnostics are provided free or partially free in public sector health facilities (Selvaraj et al., 2021).

Though per capita OOPE for outpatient care and hospitalization are lower for the poorest households in comparison to the richest households, because of their limited ability to pay, we observed that the poorest households bear a disproportionately high burden when OOPE as a share of households' monthly non-medical consumption expenditure is considered. These observations are consistent with the published literature on the economic burden of infectious disease in India (Farooqui et al., 2022; Ram & Thakur, 2022; Shrinivas et al., 2023). Universal health coverage and health insurance can protect vulnerable households from catastrophic OOPE in the event of hospitalization. In India, a publicly funded health insurance scheme for poor households - Pradhan Mantri Jan Arogya Yojana (PM-JAY) (Angell et al., 2019) which covers hospitalization expenses up to a ceiling of INR 500,000 (US $ 7813) per family per year has been introduced by the government. However, its impact on the reduction of OOPE is yet to be demonstrated (Garg et al., 2020). Previous research suggests a limited impact of publicly financed health insurance schemes on the reduction of OOPE by poor households (Prinja et al., 2017). It may be noted that health insurance can counterintuitively increase the OOPE. Karan et al. reported that Rashtriya Swasthya Bima Yojana (RSBY) – a health insurance scheme for the poor - increased the probability of incurring OOPE by 30% while non-medical expenditure of households increased by 6% among the households enrolled in the RSBY scheme (Karan et al., 2017).

In addition to medical and non-medical OOPE, households are adversely impacted by wage loss. We observed a disproportionate burden of wage loss in the poorest households compared to the richest households. Previous research has also indicated that the magnitude of the OOPE on treatment and wage loss is large enough to cause catastrophe and impoverishment (Ram & Thakur, 2022; Shrinivas et al., 2023). One of the reasons for the higher magnitude of wage loss in poor households is their employment situations. For example, in the absence of the provision of sick leave, any absence from work because of hospitalization of the earning member himself or hospitalization of children

and elderly members of the household requiring caregiving, results in wage loss. Our findings are consistent with Shrinivas et al. who reported that wage loss accounts for more than 80% of the total economic burden of illness among the poorest households whereas it was only around 20% of the economic burden of illness among the most affluent (Shrinivas et al., 2023). Our estimates on wage loss for hospitalization were higher in magnitude than those reported in the NSSO data as income loss because we incorporated full distribution of wage loss as a function of per capita wage and days of ill health and hospitalization using Mincer's approach, whereas NSSO only captured the reported income loss by the respondent.

We also observed that infectious disease-related economic shock disproportionately affects poor households which is reflected higher percentage of poor households reporting the sale of assets and borrowing. Previous research has also reported distress financing by households in the event of hospitalization (Engelgau et al., 2012; Kastor & Mohanty, 2018b). One of the reasons for distressed financing could be the small size of savings in poorer households (Alam & Mahal, 2014). However, we argue that the economic shock caused by hospitalization and associated expenditure and wage loss compounded by the household's inability to smoothen consumption expenditure results in asset sales or borrowing. Furthermore, it may be possible that the poorest of the poor households forego treatment because of the inability to pay.

One of the major strengths of our research is the estimation of wage loss for each infectious disease episode. While other studies reported wage loss using a recall method of workdays/wage loss, we estimated the wage losses using separate Mincer equations for males and females across rural and urban areas. We used a national representative labour force survey (PLFS 2017–18) to create a full distribution of wage losses for all types of employment categories across all households. We also report the equity impact of OOPE and wage loss as a share of households' monthly non-medical consumption expenditure and the magnitude of the distress financing by the income quintiles. Our methodological approach can be further applied to estimate the national-level economic burden for specific infectious diseases such as pneumonia, diarrhoea, meningitis, TB and other vaccine-preventable diseases not only to estimate the unit cost of treatment (Farooqui et al., 2022) but also to generate national-level economic burden when combined with the latest infectious disease burden. These estimates can then be used to make investment decisions, and design strategies to improve financial risk protection and social security to address health inequities.

Our research has a few limitations. Though the SCH survey is nationally representative, the information about disease status, healthcare utilisation, and expenditures are self-reported. There is a possibility of underreporting of illness episodes as the disease perception varies with the households' socioeconomic status. Similarly, the possibility of recall bias on disease-related OOPE cannot be ruled out. However, since we estimated OOPE either as per episode OOPE or as a share of households' monthly non-medical consumption expenditure, our main findings are not likely to be affected by any underreporting of disease prevalence. Also, a small proportion of households who don't access care because of their inability to pay might have created selection bias and may have biased our OOPE estimates upwards. We also recognize that our estimates of wage loss may be upward biased because the prevailing wage data is derived only from the working wage-earning population.

5. Conclusion

Understanding the pathways and magnitude of infectious diseases related to differential economic burdens is important for designing a financial risk protection package that contributes to reducing inequalities. Through better targeting and increased coverage, the existing government-sponsored health insurance scheme Pradhan Mantri Jan Arogya Yojana can potentially reduce out-of-pocket expenditure at the household level. Individuals are predominantly employed in the informal sector in India, employers are required to be sensitized about the magnitude of wage loss on account of illness to make provision for sick leave.

Ethical approval

Ethical approval for this study was not needed. The study only used anonymized data from secondary sources.

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CRediT authorship contribution statement

Habib Hasan Farooqui: Writing – original draft, Validation, Formal analysis, Data curation, Conceptualization. **Anup Karan:** Writing – review & editing, Validation, Methodology, Formal analysis, Data curation, Conceptualization. **Giridhar R. Babu:** Writing – review & editing, Validation, Supervision. **Suhaib Hussain:** Visualization, Software, Investigation, Data curation. **Onno C.P. van Schayck:** Writing – review & editing, Validation, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssaho.2024.101013.

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