Poverty due to Noncommunicable Diseases among Indian States using Human Development Survey Data

Mukul Das

makpar23@gmail.com

SRM University, Andhra Pradesh

Manish Kumar

SRM University, Andhra Pradesh

Research Article

Keywords: Non-communicable diseases, Out-of-pocket expenditure, borrowing, poverty, Sustainable Development

Posted Date: November 27th, 2025

DOI: https://doi.org/10.21203/rs.3.rs-7731507/v1

Additional Declarations: No competing interests reported.

Poverty due to Noncommunicable Diseases among Indian States using Human Development Survey Data

Mr. Mukul Das

Department of Economics, SRM University AP,

Mangalagiri -Mandal, Neeru Konda, Amaravati, Andhra Pradesh 522502

ORCID: 0009-0006-9615-6924

Corresponding author e-mail: makpar23@gmail.com

Dr. Manish Kumar

Department of Economics, SRM University AP,

Mangalagiri -Mandal, Neeru Konda, Amaravati, Andhra Pradesh 522502

ORCID:0009-0000-0040-1718

Contributing authors: manish.eco@gmail.com

Abstract

Background

Non-communicable Disease (NCDs) accounts for a large amount of Out-of-Pocket expenditure (OOPE) in India. In the absence of Universal Health Coverage (UHC), such health expenditure results in financial losses and can drive into poverty. Our study examines the effect of borrowing on the level of poverty, the contribution of each disease to poverty and the determinants of borrowing.

Method

Pre – OOPE poverty headcount was computed using Monthly Per Capita Consumption Expenditure (MPCE) against the national poverty line. For households relying on borrowing, Post – OOPE poverty was recalculated, and the difference was used to assess the impact of borrowing. The contribution of each NCDs was computed as the proportion of poverty cases attributable to each disease. Determinants of borrowings was computed through multivariate logistic regression model.

Results

In 2005, states reported high incidence of poverty due to NCDs includes Bihar (1.2 %; 95% CI: 0.3 – 2.0), Madhya Pradesh (0.9 %; 0.5 – 1.3), Uttar Pradesh (0.8%; 0.3 – 1.2). In 2012, Bihar (2.1%; 1.2 – 3.14), Uttar Pradesh (0.97%; 0.63 – 1.3), Haryana (0.87%; 0.32 – 1.4), reported the highest incidence. Asthma, Paralysis, Chronic-long term diseases and Multimorbidity has highest share in poverty. Males, less educated, individuals having health insurance, younger people and smaller households are more prone to borrowing for the NCDs.

Conclusion

Borrowing leads to significant proportion of people diagnosed with NCDs to fall into poverty. A Strong financial protection mechanism such as primary healthcare check-ups, NCDs specific health financing policies and its implementation, centre and state joint actions are essential factor to mitigate the burden.

Keywords: Non-communicable diseases, Out-of-pocket expenditure, borrowing, poverty, Sustainable Development

1. Introduction

The trajectory of demographic and epidemiological transitions, both globally and nationally, has fundamentally reshaped trends of mortality and morbidity. The epidemiological transition has also resulted in NCDs replacing infectious diseases as the primary disease burden in many parts of the world [1]. These changes are particularly evident in developing and emerging economics such as India, where rapid socio-economic changes have led to major health transition [2]. India's demographic transition is reflected most prominently through three trends: decreasing fertility rates across the country; increasing life expectancy for individuals through all age groups; and increasing child survival in all socioeconomic classes across multiple states. While India is approaching replacement-level fertility, life expectancy has also increased. These positive gains for health are now being challenged by increasing burden NCDs.

Over the last two decades, the burden of NCDs has increased in India, contributing heavily to country's health challenges [3]. As a result, NCDs have emerged as the primary cause of death, disability, and illness and are projected to increase [4, 5]. Between 1996 to 2016 morbidity rates increased by 20% and mortality rates associated with NCD's increased by 24% [6]. It was reported that there were around 4.7 million deaths in India in 2017 attributed to NCDs, which represented 49% of total mortality. In the absence of timely action NCDs pose a risk to economic growth with potential economic losses of $47 trillion estimated between 2010 and 2030 [7].

The increasing burden of NCDs imposes considerable costs on households, which includes direct costs such as healthcare and indirect costs such as lost wages, lost income, and time lost for patients and caregivers [8]. In low- and middle-income countries like India, healthcare is primarily funded via out-of-pocket payments, burdening households [9]. Such underfunded healthcare financing systems force many households to sell assets, borrow money, take on debt, or collect money from friends or relatives to cover healthcare payments [10, 11]. These out-of-pocket expenditures not only impose financial burden but also pushes household into poverty.

There is very limited amount of study which focuses on healthcare spending and its impact on poverty, particularly in the context of NCDs[12–14]. Existing study has largely estimated poverty level due to expenditure by subtracting monthly health expenditure on NCDs (total annual health expenditure by 12) from monthly per capita expenditure, but have not explored the mechanism such as borrowing by which they finance the expenditure and whether it leads them to poverty or not. This study aims to address this gap broadly by three objectives. First, estimating percentage of people falling into poverty due to borrowing for NCDs. Secondly, disease-specific share in poverty due to borrowing for NCDs. Thirdly, determinants of borrowings related to NCD expenditures. To our knowledge this is the first study in India, which looks into the role of borrowing explicitly with regards to NCDs related health expenditure and its effects on poverty. The findings will provide guide to improved health financing reforms,

strengthens financial risk protection and support progress toward Universal Health Coverage (UHC) and Sustainable Development Goals (SDG).

2. Method

2.1 Data source

We used two rounds of the India Human Development Survey (IHDS), a study by researchers from the University of Maryland, USA, and the National Council of Applied Economic Research (NCAER) in New Delhi, India. The first round, IHDS I (2004–2005), included 41,554 households from 1,503 villages and 971 urban areas in India. The second round, IHDS II (2011–2012), re-interviewed about 85% of these households (N = 42,152) and added new ones to keep the sample representative. Both data sets are publicly available through the Inter-University Consortium for Political and Social Research (ICPSR). The IHDS conducted two one-hour interviews per household on topics like caste, income, education, health etc. In both wave the data was collected using stratified random sampling. For both rounds, we used data from the household and individual questionnaire. We gathered information on costs of diseases for each household member with NCDs. We also collected details on various other demographics of the household such as caste, income, poverty line, Monthly per capita consumption, savings, loans etc. Although IHDS is a panel data, our focus is on state-level estimates and incidence measures, rather than household level change, we considered as repeated cross-section data.

2.2 Disease categories

In both the rounds of IHDS diseases were categorised into two broad categories, namely, short-term morbidities and long-term morbidities. Short-term morbidities consist of diseases like cough, diarrhoea etc. Long-term morbidities consist of Cataract, cancer and many others. We matched the diseases with ICD-10 disease classification to distinguish between NCDs and non-NCDs. The disease and classification are reported in Table 1.

Table 1 Disease Classification

Diseases		
Short term morbidities	**Long term morbidities**	
	Non-communicable diseases	**Other diseases**
Fever	Cataract	Leprosy
Cough	Tuberculosis	Polio
Cough with short Breath	High BP	HIV/STDS
Diarrhoea	Heart diseases	
Diarrhoea with blood	Diabetes	
	Cancer	
	Asthma	
	Paralysis	
	Epilepsy	
	Other Chronic disease	

2.3 Outcome variables

2.3.1 Poverty estimation

At first, we calculated OOPE related to NCDs, which is defined as direct payments made by individuals to healthcare providers at the time-of-service minus any reimbursements by medical insurance company or employer. IHDS provide data of both medical and non-medical expenses occurred. Medical cost consists of Service fee, diagnostic test, bed charges etc. Non-medical cost consists of travel cost and other cost.

Pre – poverty estimation – We defined the monthly per capita consumption (MPCE) of household i as $MPCE_i$, and the poverty line as PL (Tendulkar poverty line as defined by Planning Commission of India till 2014). The $OOPE_i$ incurred due to NCD treatment is denoted $OOPE_i$.

Poverty Headcount – A household is considered poor if its MPCE falls below the poverty line,

$$H_i^{Pre} = \begin{cases} 1, & if\ MPCE_i < PL \\ 0, & otherwise \end{cases}$$

Post – poverty estimation – It is assessed by adjusting Monthly Per Capita Consumption Expenditure (MPCE) to reflect the financial burden of healthcare spending. Previous studies have estimated the adjusted MPCE by subtracting one-twelfth of total out-of-pocket expenditure (OOPE) from the original MPCE[15]. However, during medical emergencies, households may finance healthcare through a combination of borrowing, utilizing current or past savings, or selling assets[16, 17]. Therefore, we calculated MPCE using two methods:

Model 1: We take total Health spending and divide it by 12, to compute monthly health spending and then subtract it from initial MPCE.

$$MPCE_i^{post} = MPCE_i - \left(\frac{HE}{12}\right)$$

Model 2: Here, we include only those who borrowed, also borrowings which were repaid through asset sales were excluded. Additionally, direct asset sales used to cover OOPE are not considered in our analysis. As our poverty measure is unidimensional, focusing solely on consumption-based poverty, and does not account for multidimensional poverty indicators such as asset depletion.

$$MPCE_i^{post} = MPCE_i - U_i$$

Where U_i, is the adjustment which depends on the financing mechanism (EMI from loans). Households originally above the poverty line ($MPCE_i$ > PL) are tracked to determine whether they fall below the poverty line post-OOPE.

We first identified households that reported “medical expenses” for financing NCDs and excluded those who repaid loans by selling assets (“Gold sold to pay loan” & “Land sold to pay loan”). Household those who have outstanding loan amount were retained

for the analysis ("loan paid off or not"). We then checked whether loan is greater than or not, if loan is greater than OOPE, we retained only OOPE amount for EMI analysis, it is done to single out the effect of OOPE. Again, if loan is less than OOPE, we took loan amount for EMI analysis, because the rest of the OOPE is paid through savings or assets selling. For each household, we classified loan based on whether loan carried any interest or not. In households where interest rate was present, the repayment was further subdivided into loan source. EMI was calculated using Simple Interest when source was reported as "*friend", "relative", "others"*, whereas loans from formal or institutional sources were calculated using compound interest. Since the dataset did not provide the exact repayment duration, we computed through proxy timeframes of 6 months, 12 months, 24 months, 60 months.

For Compound Interest - $EMI_i = \frac{loan.r.(1+r)^T}{(1+r)^T-1}$

For Simple Interest - $EMI_i = \frac{loan.(1+rT)}{T}$

For loan without Interest - $EMI_i = \frac{Loan_i}{T}$

After computing EMI, we adjusted MPCE.

Post- poverty metrics –

Poverty Head count –

$$H_i^{Post} = \begin{cases} 1, & if\ MPCE_i < PL \\ 0, & otherwise \end{cases}$$

Relative Change in Incidence -

Change in head count –

$$C_H = H_i^{pre} - H_i^{post}$$

After computing the change in the headcount and poverty gap, we estimate mean state wise headcount.

2.3.2 Disease-specific poverty –

After computing change in head count, we calculate disease specific poverty:

$$R_i = \frac{D_i}{C_H} * 100$$

Where, R_i = Percentage of specific disease i

C_i = Total head count of specific disease i

C_H = Total head count

2.3.3 Determinants of borrowing –

Determinants of borrowing those who were suffering from NCDs were determined by multivariate logistic regression model:

$$S_i = In\left(\frac{\hat{y}}{1-\hat{y}}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n$$

Where, dependent variable borrowing is dichotomous i.e. S_i take the value of 1, if an individual falls into poverty and 0 otherwise and X_1, X_2,….X_n are the legion of covariates subsuming socio-economic and demographic characteristic of the individual.

STATA 18 statistical package was used for statistical analysis of data and weighted estimates were considered for complex multistage sampling design of survey.

3. Results

3.1 State-wise profile of study population–

The number of NCD cases, their share as part of total sample population, the proportion of NCDs cases having health insurance and financing mechanism in 2005 and 2012 is shown in table 2 and table 3 respectively. In 2005, Kerala (11.87) and Pondicherry (12.05) had the highest share of NCDs. States of West Bengal (8.81), Tamil Nadu (8.70), Andra Pradesh (7.40), Bihar (7.32), Goa (7.80), and Jammu & Kashmir (7.09) also observed high proportions. A moderate share (4-6%) was observed in Chandigarh, Punjab, Gujrat, Karnatak, Maharashtra, Orissa, Delhi, Jharkhand, Chhattisgarh, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, while Meghalaya, Dadar & Nagar Haveli, Sikkim reported very low share of NCDs (<1%). Among these NCDs cases in India, Goa (14.7), Tripura (8.8), Delhi (8.46), Jharkhand (8.73), Uttarakhand (6.74) had the highest proportion of people with health insurance, while Chandigarh, Manipur and Pondicherry had the lowest. Additionally, Madhya Pradesh (18.21), Bihar (17.83), Uttar Pradesh (16.5), Chhattisgarh (16.24), Andhra Pradesh (15.84) had the highest number of people who borrowed money to finance NCDs, while Delhi, Assam, Goa, Manipur and Jammu & Kashmir reported the lowest. When Borrowing was further subdivided into interest seeking and non-interest seeking categories Madhya Pradesh, Bihar, Uttar Pradesh remained at top (Supplement Table 1).

Table 2 Total NCDs cases in states and their percentage with respect to sample population, Percentage of NCD cases having health insurance and their financial mechanism in 2005

2005					
States	**Total NCDs cases (N=11869)**	**Percentage w.r.t total sample population (N=215754)**	**Percentage of NCD cases having Health insurance (N=431)**	**Financing Mechanism for NCDs cases**	
				Borrowing (N=1081)	**Saving and others**
Karnataka	1059	5.33 (19859)	5.66 (60)	7.93 (84)	92.07
West Bengal	966	8.81 (10958)	4.65 (45)	7.04 (68)	92.96

Kerela	948	11.87 (7981)	5.48 (52)	3.59 (38)	96.41
Uttar Pradesh	915	4.26 (21465)	1.74 (16)	16.5 (151)	83.50
Maharashtra	882	5.31 (16602)	3.17 (28)	3.85 (34)	96.15
Andra Pradesh	789	7.40 (10661)	3.42 (27)	15.84 (125)	84.16
Tamil Nadu	744	8.70 (8546)	1.74 (13)	10.62 (79)	89.38
Madhya Pradesh	698	4.41 (15801)	3.00 (21)	18.21 (127)	81.81
Bihar	645	7.32 (8806)	0.77 (5)	17.83 (115)	82.17
Gujarat	596	5.86 (10160)	5.36 (32)	5.70 (34)	94.30
Rajasthan	571	3.94 (14468)	2.27 (13)	10.86 (62)	89.14
Orissa	546	5.15 (10596)	4.76 (26)	8.06 (44)	91.94
Punjab	545	6.03 (9033)	4.22 (23)	3.67 (20)	96.33
Himachal Pradesh	366	5.10 (7166)	1.36 (5)	6.01 (22)	93.99
Jammu & Kashmir	300	7.09 (4230)	1.33 (4)	0	100
Chhattisgarh	293	4.71 (6210)	0.68 (2)	10.24 (30)	89.76
Haryana	210	2.23 (9403)	2.85 (6)	7.14 (15)	92.86
Jharkhand	206	4.11 (5008)	8.73 (18)	4.37 (9)	95.63
Delhi	189	4.09 (4620)	8.46 (16)	0.53 (1)	99.47
Uttaranchal	89	3.56 (2493)	6.74 (6)	14.61 (13)	85.39
Assam	86	1.83 (4690)	1.16 (1)	0	100
Goa	61	7.80 (782)	14.7 (9)	0	100
Pondicherry	57	12.05 (473)	0	7.02 (4)	92.98
Tripura	34	3.37 (1008)	8.8 (3)	2.94 (1)	97.06
Chandigarh	24	6.26 (383)	0	0	100
Manipur	23	3.84 (598)	0	0	100
Mizoram	8	1.59 (502)	0	0	100
Daman & Diu	8	2.84 (281)	0	50.0 (4)	50.0
Meghalaya	6	0.79 (755)	0	0	
Sikkim	3	0.59 (505)	0	0	
Dadar & Nagar Haveli	2	0.63 (315)	0	1	
Arunachal Pradesh	0	0 (832)	0	0	
Nagaland	0	0	0	0	

In 2012, Kerala (21.04) reported the highest followed by Chandigarh (17.87), Himachal Pradesh (15.04), Punjab (13.79), Sikkim (13.71), Jammu & Kashmir (13.38), West Bengal (13.3), and Pondicherry (13.15). Other states with high shares (10-12%) include Uttar Pradesh, Tamil Nadu, Madhya Pradesh, Gujrat, Chhattisgarh, Uttarakhand, Dadar & Nagar Haveli, while Tripura, Manipur, Arunachal Pradesh, Meghalaya, Nagaland had very low proportion. Similarly, Andhra Pradesh (72.37), Chhattisgarh (30.16), Uttarakhand (29.23), Bihar (24.03), Himachal Pradesh (19.39), Madhya Pradesh (17.81) had the highest proportion of people with health insurance, while Pondicherry and Manipur had the lowest. Daman & Diu (37.50), Manipur (27.78), Bihar (23.48), Meghalaya (20.00), Uttar Pradesh (18.47), Chhattisgarh (15.81), Madhya Pradesh (15.42) had the highest proportions of people who borrowed money to finance NCDs, whereas Goa and Tripura had the lowest. Similar to 2005, When

borrowing was further divided Madhya Pradesh, Bihar, Uttar Pradesh remained at top (Supplement table 3).

Table 3 Total NCDs cases in states and their percentage with respect to sample population, Percentage of NCD cases having health insurance and their financial mechanism in 2012

2012					
States	**Total NCDs cases (N=20264)**	**Percentage w.r.t total sample population (N=204569)**	**Percentage of NCD cases having Health insurance (N=3078)**	**Financing Mechanism**	
				Borrowing (N=2243)	**Saving and others**
Karnataka	1734	9.53 (18190)	5.76 (100)	11.99(208)	88.01
West Bengal	1405	13.3 (10571)	6.54 (92)	14.31(201)	85.69
Kerela	1427	21.04 (6780)	40.64 (580)	4.90 (70)	95.10
Uttar Pradesh	2414	11.20 (21546)	11.43 (276)	18.47(446)	81.53
Maharashtra	879	5.49 (15984)	9.32 (82)	6.26 (55)	93.74
Andra Pradesh	789	8.66 (9104)	72.37 (571)	14.83(117)	85.17
Tamil Nadu	840	11.00 (7634)	1.78 (15)	10.48 (88)	89.52
Madhya Pradesh	1569	10.34 (15163)	17.33 (272)	15.42(242)	84.58
Bihar	690	8.12 (8495)	23.76 (164)	23.48(162)	76.52
Gujarat	947	10.11 (9364)	5.38 (51)	7.39 (70)	92.61
Rajasthan	960	6.69 (14340)	7.81 (75)	10.00 (96)	90.00
Orissa	821	8.19 (10023)	7.18 (59)	6.57 (54)	93.43
Punjab	1165	13.79 (8447)	3.94(46)	8.50 (99)	91.50
Himachal Pradesh	995	15.04 (6612)	18.89 (188)	5.13 (51)	94.87
Jammu & Kashmir	552	13.38 (4125)	3.26 (18)	4.71 (26)	95.29
Chhattisgarh	683	10.8 (6323)	30.01 (205)	15.81(108)	84.19
Haryana	775	8.09 (9568)	9.41 (73)	7.74 (60)	92.26
Jharkhand	289	6.50 (4442)	15.57 (45)	6.57 (19)	93.43
Delhi	396	8.54 (4636)	14.14 (56)	5.56 (22)	94.44
Uttaranchal	260	11.11 (2340)	29.23 (76)	5.77 (15)	94.23
Assam	283	6.08 (4651)	7.06 (20)	0.71 (2)	99.29
Goa	63	8.32 (757)	(0)	0	100
Pondicherry	55	13.15 (418)	(0)	14.55 (8)	85.45
Tripura	36	3.91 (919)	2.77 (1)	0	100
Chandigarh	64	17.87 (358)	7.81 (5)	3.13 (2)	96.87
Manipur	18	3.74 (481)	(0)	27.78 (5)	72.22
Mizoram	0	0.0 (347)	(0)	0	0
Daman & Diu	24	8.82 (272)	(0)	37.50 (9)	62.50
Meghalaya	5	0.72 (686)	20 (1)	0	80.00
Sikkim	69	13.71 (503)	8.69 (6)	10.14 (7)	89.86
Dadar & Nagar Haveli	33	10.5 (314)	(0)	3.03 (1)	100.00
Arunachal Pradesh	22	3.29 (668)	4.54 (1)	0	100.00
Nagaland	2	0.39 (508)	(0)	0	100.00

3.2 Poverty due to Out-of-pocket expenditure

The incidence of poverty due to health expenditure in 2005 and 2012 is estimated using two different model in 2005 and 2012, is shown in table 4 and table 5. Using the first model, Bihar (3.1; 95% CI: 1.7 – 4.5) and Kerala (3.1; 2.1 – 4.0) recorded highest rates of poverty in 2005. Rajasthan, Uttar Pradesh and Madhya Pradesh had fairly high poverty rates (2-3%). Most of all other states poverty rates fall between 1-2%, while North-eastern states reported the lowest. In 2012, Bihar (5.0; 3.4 – 6.6) had the highest rate of poverty, followed by Sikkim, Uttar Pradesh, Himachal Pradesh, Kerala, Manipur, and Karnataka. In most other states, poverty rates ranged between 1-3%. Delhi, Andra Pradesh and some North-eastern states had the least poverty percentages. A consistent upward trend was noted in most of the states in 2012 compared to 2005.

Table 4 State-wise poverty estimation due to NCDs in 2005

States	2005				
	Model 1	**Model 2.1[a]**	**Model 2.2[b]**	**Model 2.3[c]**	**Model 2.4[d]**
Jammu & Kashmir	1.1 (0.2 - 2.0)	0	0	0	0
Himachal Pradesh	1.4 (0.5 - 2.2)	0.3 (-0.03 - 0.06)	0.12 (-0.11 - 0.36)	0	0
Punjab	1.3 (0.1-2.5)	0	0	0	0
Chandigarh	0	0	0	0	0
Uttaranchal	1.3 (0.1 - 2.5)	0.3 (-0.18 - 0.8)	0.3 (-0.18 - 0.8)	0.3 (-0.18 - 0.8)	0.3 (-0.18 - 0.8)
Haryana	1.0 (0.4 - 1.6)	0.09 (-0.08 - 0.2)	0.08 (-0.08 - 0.27)	0	0
Delhi	0.09 (-0.10- 0.20)	0	0	0	0
Rajasthan	2.0 (1.2 - 2.9)	0.5 (0.2 - 0.9)	0.38 (0.10 - 0.65)	0.08 (0.01 - 0.16)	0.02 (-0.02 - 0.06)
Uttar Pradesh	2.2 (1.4 - 3.0)	0.8 (0.3 - 1.2)	0.36 (0.08 - 0.64)	0.2 (0.002 - 0.4)	0.16 (-0.04 - 0.3)
Bihar	3.1 (1.7 - 4.5)	1.2 (0.3 - 2.0)	0.9 (0.18 - 1.6)	0.6 (0.001 - 1.3)	0.6 (-0.04 - 1.2)
Sikkim	0	0	0	0	0
Manipur	0	0	0	0	0
Mizoram	1.0 (-0.09 - 2.9)	0	0	0	0
Tripura	0	0	0	0	0
Assam	0	0	0	0	0
West Bengal	1.4 (0.7 - 2.0)	0.1 (-0.04 - 0.3)	0.1 (-0.04 - 0.3)	0.1 (-0.06 - 0.28)	0.08 (-0.08 - 0.25)
Jharkhand	1.4 (0.04-2.4)	0	0	0	0
Orissa	1.7 (1.0-2.4)	0.2 (-0.02 - 0.5)	0.2 (-0.06 - 0.5)	0.19 (-0.08 - 0.4)	0.03 (-0.01 - 0.08)
Chhattisgarh	0.9 (0.4-1.5)	0.03 (-0.03 - 0.11)	0.03 (-0.03 - 0.11)	0.03 (-0.03 - 0.11)	0
Madhya	2.2	0.9	0.48	0.33	0.19

Pradesh	(1.5 - 2.9)	(0.5 - 1.3)	(0.20 - 0.76)	(0.10 - 0.56)	(0.01 - 0.36)
Gujarat	0.9 (0.4-1.4)	0.07 (-0.07 - 0.22)	0	0	0
Daman & Diu	1.3 (-1.9 - 4.6)	0	0	0	0
Dadar & Nagar Haveli	0	1.4 (-0.09 - 3.8)	0	0	0
Maharashtra	1.4 (0.9-1.8)	0.09 (0.001 - 0.19)	0.02 (-0.02 - 0.08)	0.02 (-0.02 - 0.08)	0.02 (-0.02 - 0.08)
Andhra Pradesh	0.4 (0.1 - 0.6)	0.46 (0.18 - 0.74)	0.04 (-0.02 - 0.1)	0.04 (-0.02 - 0.1)	0.04 (-0.02 - 0.11)
Karnataka	2.1 (1.6-2.7)	0.34 (0.13 - 0.55)	0.15 (0.01 - 0.30)	0.09 (-0.01 - 0.19)	0.04 (-0.01 - 0.10)
Goa	0.4 (-0.5-1.4)	0	0	0	0
Kerala	3.1 (2.1-4.0)	0.03 (-0.03 - 0.1)	0	0	0
Tamil Nadu	1.2 (0.07-1.7)	0.6 (0.13 - 1.1)	0.04 (-0.04 - 0.13)	0.04 (- 0.04- 0.13)	0.04 (- 0.04 - 0.13)
Pondicherry	0	0	0	0	0

Model 2.1[a] - 6 months; Model 2.2[b] -12 months; Model 2.3[c]- 24 Months; Model 2.4[d] – 60 months

Using the second model, Bihar (1.2), Madhya Pradesh (0.9), Uttar Pradesh (0.8), Rajasthan (0.5) reported the highest share on poverty in 2005, with long term effects, while Maharashtra (0.09) had the lowest. In 2012, the number of states falling into poverty had increased to 15 and also the intensity had increased. Bihar (2.1), Madhya Pradesh (1.1), Uttar Pradesh (0.89) continued to report the highest poverty level with had long term effects, while Maharashtra (0.27) remained at bottom.

Table 5 State-wise poverty estimation due to NCDs in 2012

States	**2012**				
	Model 1	**Model 2.1[a]**	**Model 2.2[b]**	**Model 2.3[c]**	**Model 2.4[d]**
Jammu & Kashmir	2.16 (0.6 - 3.6)	0.48 (-0.25 - 1.21)	0.37 (-0.34 - 1.09)	0	0
Himachal Pradesh	3.6 (2.4 - 4.7)	0.65 (0.12 - 1.1)	0.10 (-0.09 - 0.30)	0	0
Punjab	1.9 (1.1 - 2.8)	0.49 (0.15 - 0.83)	0.05 (-0.04 - 0.15)	0.05 (-0.04 - 0.15)	0.05 (-0.04 - 0.15)
Chandigarh	2.2 (-2.1 - 6.6)	0	0	0	0
Uttaranchal	1.7 (0.6 - 2.8)	0.18 (-0.08 - 0.40)	0.12 (-0.12 - 0.38)	0	0
Haryana	2.8 (1.7 - 4.0)	0.87 (0.32 - 1.4)	0.14 (-0.02 - 0.32)	0.11 (-0.05 - 0.28)	0.03 (-0.03 - 0.11)
Delhi	1.2 (0.01 - 2.4)	0.32 (-0.04 - 0.69)	0	0	0
Rajasthan	1.8 (1.2 - 2.3)	0.50 (0.19 - 0.81)	0.31 (0.08 - 0.53)	0.11 (-0.01 - 0.25)	0.11 (-0.01 - 0.25)
Uttar Pradesh	3.6 (2.7 - 4.6)	0.97 (0.63 - 1.3)	0.44 (0.20 - 0.69)	0.22 (0.05 - 0.39)	0.12 (0.001 - 0.24)
Bihar	5.0 (3.4 - 6.6)	2.1 (1.2 - 3.14)	0.9 (0.49 -1.49)	0.51 (0.10 - 0.91)	0.16 (-0.08 - 0.40)
Sikkim	4.2 (2.6 - 5.9)	0	0	0	0
Manipur	3.2 (1.0 - 5.5)	0	0	0	0

Mizoram	0	0	0	0	0
Tripura	0.4 (-0.04 - 1.4)	0	0	0	0
Assam	2.2 (0.6 - 3.8)	0	0	0	0
West Bengal	2.6 (1.7 - 3.4)	0.77 (0.31 - 1.2)	0.49 (0.08 - 0.90)	0.18 (-0.03 - 0.39)	0.09 (-0.03 - 0.23)
Jharkhand	2.5 (1.2 - 3.7)	0.4 (-0.06 - 1.0)	0.31 (-0.14 - 0.76)	0.23 (-0.20 - 0.67)	0.23 (-0.20 - 0.67)
Orissa	1.9 (1.2 - 2.5)	0.4 (0.10 - 70)	0.12 (-0.01 - 0.27)	0.03 (-0.03 - 0.09)	0
Chhattisgarh	2.7 (1.4 - 4.0)	0.49 (0.15 - 0.83)	0.24 (-0.006 - 0.50)	0.09 (-0.08 - 0.20)	0
Madhya Pradesh	2.6 (1.9 - 3.4)	1.1 (0.66 - 1.5)	0.40 (0.15 - 0.65)	0.22 (0.03 - 0.40)	0.09 (-0.01 - 0.20)
Gujarat	2.4 (1.3 - 3.4)	0.38 (0.08 - 0.68)	0.27 (0.004 - 0.54)	0.16 (-0.06 - 0.38)	0.16 (-0.06 - 0.38)
Daman & Diu	0.7 (-0.9 - 2.4)	1.7 (-1.4 - 5.06)	0	0	0
Dadar & Nagar Haveli	0	0.26 (-0.37 - 0.90)	0	0	0
Maharashtra	2.0 (1.3 - 2.8)	0.27 (0.07 - 0.48)	0.09 (-0.04 - 0.24)	0.07 (-0.06 - 0.21)	0.07 (-0.06 - 0.21)
Andhra Pradesh	1.4 (0.6 - 2.1)	0.8 (0.34 - 1.34)	0.14 (-0.01 - 0.30)	0.07 (-0.04 - 0.19)	0.07 (-0.04 - 0.19)
Karnataka	3.0 (2.1 - 3.9)	0.7 (0.4 - 1.1)	0.39 (0.14 - 0.6)	0.19 (0.00 - 0.39)	0.10 (-0.06 - 0.27)
Goa	0.8 (-0.5 - 2.1)	0	0	0	0
Kerala	3.5 (2.0 - 5.1)	0.47 (-0.06 - 1.01)	0.02 (-0.02 - 0.07)	0.02 (-0.02 - 0.07)	0
Tamil Nadu	2.7 (1.1 - 4.3)	0.72 (0.27 - 1.18)	0.32 (0.05 - 0.58)	0.21 (0.007 - 0.41)	0.21 (0.007 - 0.41)
Pondicherry	0.4 (-0.5 - 1.4)	0	0	0	0

Model 2.1[a] - 6 months; Model 2.2[b] -12 months; Model 2.3[c]- 24 Months; Model 2.4[d] – 60 months

3.3 Disease specific-poverty –

Table 6 Presents the share of poverty occurrence due to specific NCDs. In 2005, the major contributors were long-term diseases (41.39), Multimorbidity (18.29), mental illness (8.54), Paralysis (7.21) and heart disease (6.54), whereas cataract (1.87) and high blood pressure (2.27) had the lowest. Apart from high blood pressure and cancer, all other diseases had the long-term effects.

Similarly in 2012, the major contributors were Multimorbidity (41.36), long-term diseases (34.98), heart disease (4.60), Paralysis (4.18), whereas Epilepsy (0.89) and mental illness (1.23) had the lowest. Cataract and cancer had short term effects, whereas all other diseases had long-term effects.

Table 6 Disease specific share in poverty

	2005	**2012**
Disease	**Share in poverty**	**Share in poverty**

	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]
Cataract	1.87	1.28	2.09	3.29	2.26	0	0	0
High blood pressure	2.27	0.51	0	0	1.44	0.61	1.36	2.27
Heart disease	6.54	10.77	9.62	11.18	4.60	2.72	2.04	3.41
Diabetes	4.54	4.36	1.26	0	1.65	1.21	1.02	0
Cancer	3.87	4.36	0	0	2.95	2.57	0	0
Asthma	6.41	7.44	7.53	7.24	4.46	4.39	6.12	6.82
Paralysis	7.21	7.69	7.53	3.29	4.18	6.05	8.50	7.39
Epilepsy	4.67	1.54	2.51	3.95	0.89	1.21	2.04	3.41
Mental illness	2.94	3.59	1.67	0	1.23	0.61	1.36	2.27
Other Chronic-term diseases	41.39	34.36	44.35	47.37	34.98	37.22	30.61	30.68
Multimorbidity	18.29	24.10	23.43	23.68	41.36	43.42	46.94	43.75

Model 1[a] - 6 months; Model 2[b] -12 months; Model 3[c]- 24 Months; Model 4[d] – 60 months

3.4 Determinants of borrowings

The socio-economic and demographic factors associated with borrowing of individuals suffering from NCDs are given in table 7. Gender was reported to be significant factor of borrowing, females had lesser odds with respect to males in 2005 and 2012. Larger households (6-10, 10 +) had lower odds of borrowing in 2012 (OR:0.81 $p<0.05$; OR:0.62 $p<0.10$). Younger individuals (0-18) have higher odds of borrowing than older groups. In 2005, individuals aged 36-60 (OR=0.62, $p<0.01$) and 61 + (OR=0.57, $p<0.01$) reported lower borrowing, and this continued in 2012 (36–60: OR=0.45, $p<0.01$; 61+: OR=0.35, $p<0.01$). Individuals having higher education reported lower odds of borrowing. Individuals with graduate and above education had the lowest odds (2005: OR=0.21, $p<0.01$; 2012: OR=0.28, $p<0.01$). In 2012, daily wage workers were more likely to borrow as compared to permanent worker (OR=0.72, $p<0.05$) or those who did not work (OR=0.81, $p<0.01$).

Table 7 Determinants of borrowing with people suffering from NCDs

Variables	2005 (Adjusted OR)	2012 (Adjusted OR)
Gender		
Male	Ref	Ref
Female	0.62***(0.062)	0.82***(0.058)
No. of persons in household		
0-5	Ref	Ref
6-10	0.82(0.106)	0.81**(0.778)
10+	0.62(0.182)	0.62*(0.152)
Age group		
0-18	Ref	Ref
19-35	1.18(0.183)	0.94 (0.111)
36-60	0.62***(0.087)	0.45***(0.053)
61+	0.57***(0.106)	0.35***(0.045)
Education		
No education	Ref	Ref
Primary	0.62***(0.082)	0.65***(0.055)
Secondary	0.61***(0.079)	0.48***(0.044)
Higher secondary	0.38***(0.099)	0.46***(0.078)
Graduate and above	0.21***(0.070)	0.28***(0.060)
Occupation		

Daily wage labour	Ref	Ref
Regular/Permanent/Longer contract	0.76(0.181)	0.72* (0.126)
Not working	0.92 (0.117)	0.81***(0.062)
Residence		
Rural	Ref	Ref
Urban	0.93 (0.111)	1.05(0.093)
Caste		
OBC	Ref	Ref
SC	1.39**(0.230)	0.99(0.098)
ST	0.71(0.172)	1.02(0.238)
Others	0.81(0.122)	0.83*(0.079)
MPCE Quintile		
Lowest	Ref	Ref
Low	0.77(0.155)	0.94 (0.144)
Middle	0.59**(0.139)	0.88 (0.145)
High	0.59*(0.160)	0.75 (0.156)
Very High	0.56*(0.174)	0.67 (0.149)
Type of treatment		
Public	Ref	Ref
Private	1.55***(0.248)	1.01(0.883)
Traditional	0.82(0.829)	0.62*(0.164)
Treatment not required	2.06(1.27)	1.13(0227)
Borrowing type		
Without interest	Ref	Ref
With interest	6.61***(0.938)	2.37***(0.197)
Health insurance		
No	Ref	Ref
Yes	0.46**(0.160)	1.25**(0.117)
Constant	0.104***(0.028)	0.388***(0.078)

*p <0.1, **p<0.05, ***p<0.01

Economic status (MPCE) is also a significant factor, poorer people in 2005 reported more likely to borrow than those of Middle class (OR=0.59, p<0.01), high class (OR=0.59, p<0.01), and very high class (OR=0.56, p<0.01). In 2005, those seeking treatment in private facilities have higher odds of borrowing (OR=1.55, p<0.01). Similarly, health insurance is also a significant factor, in 2005, insurance coverage reduced the odds of borrowing (OR=0.46, p<0.01). But in 2012, insured household were likely to borrow more (OR=1.25, p<0.05). Individuals reported higher odds of borrowing with interest with respect to without interest both in 2005 and 2012 (OR=0.46, p<0.01; OR=1.25, p<0.05).

4 Discussion

Our findings suggest that the proportion of people with NCDs who had health insurance increased in almost all states from 2005 to 2012, except for Punjab and Tripura. However, the absolute number has increased in all states. Following health insurance, we checked the proportion of people opted for borrowing in each state. We observed that even though health insurance increased in all the states during this period, borrowing to finance NCDs expenditure increased in most states, except some states like Andhra Pradesh, Madhya Pradesh, Rajasthan, Orissa, Himachal Pradesh and Uttarakhand, where borrowing decreased. Furthermore, we also observed that

high borrowing states were experiencing high poverty level both in 2005 and 2012. Several states who were under short-term poverty (smaller or equal to 6 months) in 2005 moved to long term poverty (greater than 6 months) in 2012. Additionally, Orissa, Punjab, Himachal Pradesh and Haryana moved into short term poverty in 2012. States such as Uttar Pradesh, Bihar, Madhya Pradesh, Rajasthan reported high percentage of borrowing and long-term poverty both in 2005 and 2012. Delhi, Jharkhand, Kerela, Jammu & Kashmir, Andhra Pradesh, North-eastern and smaller states reported very low level of poverty. When we used the exiting method, we found elevated level of poverty level in every state both in 2005 and 2012.

Even though there is rise in the health insurance in all the states, the rise in OOPE has led states like Uttar Pradesh, Bihar, Madhya Pradesh, Rajasthan to rely heavily on borrowing and likely due to this they are pushed into poverty [13]. High poverty levels on these states also may be attributed to increasing dependence on private facilities with better infrastructure and facilities, where NCD treatment is met with higher cost [18–20]. This also suggests that insurance coverage in these states may not be enough to cover the expenditure of NCDs[21] . However, some states exhibited very low poverty level. In Kerela, even though the incidence of NCDs has increased, poverty level is very negligible, can be linked to high investment in public infrastructure, utilization of public facilities and high literacy levels [22]. Andhra Pradesh with improved healthcare access, utilization of public infrastructure, integration of regional social protection schemes (Rajiv Aarogyasri Scheme) with central Schemes (Rashtriya Swasthya Bima Yojana) may be associated to low poverty levels [23, 24]. Delhi reported lower level both years, possibly because economic growth, urbanization, access to public facilities offset the expenses associated with NCDs. The low poverty level in Jharkhand and Jammu & Kashmir may be attributed to lack of private facilities, traditional lifestyles, higher enrolment under insurance schemes which led to lower borrowings. The incidence and poverty level of NCDs in north-eastern states and smaller states of India is lower, may be due to factors such as low access to health services, under-diagnosis or lower detection in surveys [25, 26].

Beside these, national and state policy structure also influence the extent to which households are able to cope with healthcare costs. After the independence, various national and state level schemes have been launched with the aim of alleviating financial suffering and OOPE on health such as Employees' State Insurance Scheme (1948), Janashree Bima Yojana (2000), Rashtriya Arogya Nidhi Scheme (1997), Rashtriya Swasthya Bima Yojana (2008), Deen Dayal Upchar Yojana (Madhya Pradesh), but none of them are related to NCDs except one National Programme for Prevention and Control of Non-Communicable Diseases (NP-NCD) in 2010, but has serious implementation gap [27–29]. Recently, government of India has launched Jan Aushadhi Scheme (JAS) and Ayushman Bharat–Pradhan Mantri Jan Arogya Yojana (2018) to provide generic medicine affordable and Health cover of Upto 5 lakhs to BPL households respectively. Though the aim of the schemes is to minimize impoverishment effect of OOPE of diseases but inconsistent utilization, lack of

awareness, lack of Outpatient care, exclusion of some important NCDs, difficulty in obtaining health cards cause a significant backward shift in impoverishment. [30–34]. And as a result, borrowing and poverty level also increased over the years [13, 35].

Additionally, our result also indicate that all NCDs including Multimorbidity has been the main cause a household living below poverty for long duration as these diseases require long term care in the form of regular consultation, Diagnosis test etc. [36–38]. Significant decrease in cataract was observed as it did not cause long-term poverty as compared to 2005. This changes may be attributed to successful cataract surgery not only improves vision but it also improves quality of life, increases income and raises income level of households [39].

Socio-economic disparities are also evident in borrowing for financing NCDs expenditure. Males those who are diagnosed with NCDs in a household are more likely borrow, potentially due to gender disparities in healthcare access and expenditure, with household preferring male healthcare needs with respect to their counterparts [40]. Household size also influences borrowing behaviour, smaller households (1-5) tend to borrow more than larger households, this may be due to the fact that large households are able to make intra-household adjustment to finance expenditure. Though, existing literature does not enough evidence if household size is associated with borrowing, future empirical findings are required to validate these observations. Younger individuals also tend to borrow more than older categories, this possibly shows households prioritizing the health of younger individuals as a long-term investment, whereas older adults and older individuals may have stable income, savings and access to pensions[41]. Household with lower MPCE and daily wage workers are tends to borrow more due to inability to absorb medical expenses and catastrophic expenditure they face from OOPE for NCDs [42, 43]. Individual seeking services in Private facilities tend to borrow more, because the expenditure in these facilities is high [44–46].In 2012, it was observed that even individuals having insurance tends to borrow, likely due to the fact that these schemes does not cover all the cost and gaps in public sector facilities which forces individuals to go to private facilities [47–49]. Also during medical emergency, people borrow from informal sources with higher interest which leads them to poverty [21]. Our findings also indicate that higher education was associated with lower odds of borrowing. However, existing literature does not provide evidence that education provide a shield to borrowing. While higher education is generally linked to greater health literacy, relative more access to information, good income but prior studies did not clearly provide sufficient evidence that education is linked with borrowing [50–52]. So, future empirical findings are required to validate these observations.

Overall, our findings revealed that there is lower percentage of people falling into poverty due to NCDs as compared to previous studies which can be due to the fact that dynamics of borrowing was not considered. But still the poverty level is higher and rising and a greater number of states are falling into poverty. Our findings also suggests that India faces significant challenges to achieve Sustainable Development

Goal (SDG) 3.8 [53] which focuses on impoverishment, as part of the overall aim of poverty reduction. As per report by United Nations Sustainable Development Goals, solely Individual determinant is not responsible for the NCDs but structural, Socio-economic, environmental determinants are also responsible on the occurrence of NCDs [54]. A multi-level strategy is needed to enhance the quality and equity of health services for NCDs while decreasing financial hardships for patients. Policy Level: There should be sufficient funding of NCD services, better public infrastructure, continuing increase in taxes on unhelpful goods, including tobacco, alcohol and sugary foods. The central and state government need to work together in a coordinated fashion both to leverage funding and staff and to address local inequities. Regularisation of private sector hospitals. Service Delivery Level: There needs to be innovative approaches developed in order to provide support to high-risk, resource-constrained, and marginalized populations. Supporting early detection and delivering follow-up for NCDs, ensuring an adequate doctor-to-patient ratio, and providing regular training for healthcare workers on NCD care should be prioritized. Securing quality medications and logistics support for NCD treatment and screening programs, in addition to leveraging capacity across many sectors, will also add to efficiencies, and avoid duplicating services or resources. Beneficiary Level: Elevating awareness regarding NCD risk factors, awareness of the importance of regular screening and follow-up care, awareness of government health insurance schemes and options, medication adherence (including drug development, pricing and distribution), and general self-care, are all critical to improving health outcomes. However, this study has some limitation. First, IHDS data is a panel data but we derived the state level poverty estimates using cross-sectional Analysis. Second, there is no information about the duration of the loan, so we used proxy for the duration as 6 months, 12 months, 24 months and 60 months. Third, we did not consider asset depreciation as we focused only on one-dimensional poverty. Finally, this study does not account for economic improvements at the household like new employment opportunities, or for change in macroeconomic factor like change in inflation rates or growth trends etc.

5 Conclusion

This study shows out of pocket expenditure on NCDs causes a significant portion of people to fall into poverty in India. There is significant rise in poverty from 2005 to 2015.There is significant interstate differences in poverty level due to education, centre-state joint initiatives, good public infrastructure and economic growth. Diseases such as heart diseases, mental illness, other long-term diseases, multimorbidity, continues to push people into long-term poverty. Moreover, Males, less educated, individuals having health insurance, younger people and smaller households are more prone to borrowing for the NCDs. Our findings reveal that current financial protection plan is not specifically targeted towards NCDs and suffer from implementation challenges. Strengthening these schemes with proper funding, effective implementation, regulation of private providers, expansion of outpatient care for early detection for the NCD patient is crucial. Addressing these gaps will not only ensure

household to come out of poverty but also pushes India toward SDG on health and poverty reduction.

Ethical Statement

IHDS datasets used for analysis were publicly available with no information that discloses the identity of the respondents. Thus, there is no need for prior ethical approval. The data may be obtained from the Inter-university Consortium for Political and Social Research (ICPSR) data repository.

Clinical Trail Number

Not applicable

Funding Statement

Authors did not receive any funding to carry out this research.

References

1. Rajaratnam JK, Marcus JR, Levin-Rector A, Chalupka AN, Wang H, Dwyer L, Costa M, Lopez AD, Murray CJ (2010) Worldwide mortality in men and women aged 15–59 years from 1970 to 2010: a systematic analysis. The Lancet 375:1704–1720

2. Wagner K-H, Brath H (2012) A global view on the development of non communicable diseases. Preventive Medicine 54:S38–S41

3. Vos T, Lim SS, Abbafati C, et al (2020) Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet 396:1204–1222

4. (2019) SRS-cause of death.

5. (2020) SRS-statistical report.

6. Dandona L, Dandona R, Kumar GA, et al (2017) Nations within a nation: variations in epidemiological transition across the states of India, 1990–2016 in the Global Burden of Disease Study. The Lancet 390:2437–2460

7. Bloom DE, Cafiero-Fonseca ET, Candeias V, Adashi E, Gurfein L (2014) Economics of Non-Communicable Diseases in India.

8. Wang Q, Fu AZ, Brenner S, Kalmus O, Banda HT, De Allegri M (2015) Out-of-Pocket Expenditure on Chronic Non-Communicable Diseases in Sub-Saharan Africa: The Case of Rural Malawi. PLoS ONE 10:e0116897

9. Su TT (2004) Catastrophic household expenditure for health care in low-income society: a study from Nouna District, Burkina Faso. Bull World Health Organ 84:21–27

10. Xu K, Evans DB, Kawabata K, Zeramdini R, Klavus J, Murray CJ (2003) Household catastrophic health expenditure: a multicountry analysis. The Lancet 362:111–117

11. Xu K, Evans DB, Carrin G, Aguilar-Rivera AM, Musgrove P, Evans T (2007) Protecting Households From Catastrophic Health Spending. Health Affairs 26:972–983

12. Singh P, Kumar V (2017) The Rising Burden of Healthcare Expenditure in India: A Poverty Nexus. Soc Indic Res 133:741–762

13. Verma VR, Kumar P, Dash U (2021) Assessing the household economic burden of non-communicable diseases in India: evidence from repeated cross-sectional surveys. BMC Public Health 21:881

14. Yadav J, Allarakha S, Menon GR, John D, Nair S (2021) Socioeconomic Impact of Hospitalization Expenditure for Treatment of Noncommunicable Diseases in India: A Repeated Cross-Sectional Analysis of National Sample Survey Data, 2004 to 2018. Value in Health Regional Issues 24:199–213

15. Wagstaff A, Doorslaer EV (2003) Catastrophe and impoverishment in paying for health care: with applications to Vietnam 1993–1998. Health Economics 12:921–933

16. Kastor A, Mohanty SK (2018) Disease-specific out-of-pocket and catastrophic health expenditure on hospitalization in India: Do Indian households face distress health financing? PLoS ONE 13:e0196106

17. Mohd Hassan NZA, Mohd Nor Sham Kunusagaran MSJ, Zaimi NA, Aminuddin F, Ab Rahim FI, Jawahir S, Abdul Karim Z (2022) The inequalities and determinants of Households' Distress Financing on Out-off-Pocket Health expenditure in Malaysia. BMC Public Health 22:449

18. Behera S, Pradhan J (2021) Uneven economic burden of non-communicable diseases among Indian households: A comparative analysis. PLoS ONE 16:e0260628

19. Shukla SK, John P, Khemani S, Nair AS, Singh N, Sadanandan R (2025) Assessing the financial burden of multimorbidity among patients aged 30 and above in India. BMC Health Serv Res 25:86

20. Verma VR, Kumar P, Dash U (2021) Assessing the household economic burden of non-communicable diseases in India: evidence from repeated cross-sectional surveys. BMC Public Health 21:881

21. Kiranmayi V, Venkateswara Kumar KS, Naik V S (2023) Non-communicable Diseases in India: The Growing Public Health Challenge and the Role of Health Insurance. Health Behav and Policy Rev 1422–1433

22. Menon J, Vijayakumar N, Joseph JK, David PC, Menon MN, Mukundan S, Dorphy PD, Banerjee A (2015) Below the poverty line and non-communicable diseases in Kerala: The Epidemiology of Non-communicable Diseases in Rural Areas (ENDIRA) study. International Journal of Cardiology 187:519–524

23. Rao M, Kadam S, Sathyanarayana T, et al (2012) A rapid evaluation of the Rajiv Aarogyasri community health insurance scheme in Andhra Pradesh, India. BMC Proc 6:O4

24. Vellakkal S, Subramanian SV, Millett C, Basu S, Stuckler D, Ebrahim S (2013) Socioeconomic Inequalities in Non-Communicable Diseases Prevalence in India: Disparities between Self-Reported Diagnoses and Standardized Measures. PLoS ONE 8:e68219

25. Bramhankar M, Dhar M (2024) Morbidity transition at the national and sub-national level and their determinants over the past and contemporary period in India. PLoS ONE 19:e0304492

26. Dandona L, Dandona R, Kumar GA, et al (2017) Nations within a nation: variations in epidemiological transition across the states of India, 1990–2016 in the Global Burden of Disease Study. The Lancet 390:2437–2460

27. Dubey S, Deshpande S, Krishna L, Zadey S (2023) Evolution of Government-funded health insurance for universal health coverage in India. The Lancet Regional Health - Southeast Asia 13:100180

28. Pandey M, Dilip TR (2023) Health Insurance as a Tool for Selecting Private Hospitalization and Mitigating Financial Burden in India: An Analysis of National Sample Survey Data. Glob Soc Welf. https://doi.org/10.1007/s40609-023-00320-8

29. Shukla P, Priya H, Meena J, Singh S, Bairwa M, Saini A (2023) Readiness and Motivation of ASHAs towards Their Participation in Non-Communicable Disease Control Programmein North India:A Cross Sectional Study. Asian Pac J Cancer Prev 24:3235–3241

30. Gopichandran V (2019) Ayushman Bharat National Health Protection Scheme: an Ethical Analysis. ABR 11:69–80

31. Lahariya C (2018) 'Ayushman Bharat' Program and Universal Health Coverage in India. Indian Pediatr 55:495–506

32. Mukherjee K (2017) A Cost Analysis of the Jan Aushadhi Scheme in India. Int J Health Policy Manag 6:253–256

33. Pandey N, Jha S, Rai V (2021) Ayushman Bharat: Service Adoption Challenges in Universal Healthcare System. South Asian Journal of Business and Management Cases 10:35–49

34. Sriee G.V VP, Maiya GR (2021) Coverage, utilization, and impact of Ayushman Bharat scheme among the rural field practice area of Saveetha Medical College

and Hospital, Chennai. Journal of Family Medicine and Primary Care 10:1171–1176

35. Behera S, Pradhan J (2024) Distress financing associated with out-of-pocket expenditure for non-communicable diseases in India. International Journal of Healthcare Management 1–13

36. Beghi E (2016) Addressing the burden of epilepsy: Many unmet needs. Pharmacological Research 107:79–84

37. Han YH, Yoo SH, Lee SY, Hwang IY, Kim KH, Cho B, Kim MS, Choi W, Kim Y (2022) The Medical Needs and Characteristics of Cancer and Progressive Neurologic Disease Patients Who Use Home-Based Medical Care in Korea: A Retrospective Study for 2011-2020. Journal of the American Medical Directors Association 23:1634-1641.e2

38. Schmidt ME, Goldschmidt S, Hermann S, Steindorf K (2022) Late effects, long-term problems and unmet needs of cancer survivors. Intl Journal of Cancer 151:1280–1290

39. Finger RP, Kupitz DG, Fenwick E, Balasubramaniam B, Ramani RV, Holz FG, Gilbert CE (2012) The Impact of Successful Cataract Surgery on Quality of Life, Household Income and Social Status in South India. PLoS ONE 7:e44268

40. Moradhvaj, Saikia N (2019) Gender disparities in health care expenditures and financing strategies (HCFS) for inpatient care in India. SSM - Population Health 9:100372

41. Engelgau MM, Karan A, Mahal A (2012) The Economic impact of Non-communicable Diseases on households in India. Global Health 8:9

42. Kastor A, Mohanty SK (2018) Disease-specific out-of-pocket and catastrophic health expenditure on hospitalization in India: Do Indian households face distress health financing? PLoS ONE 13:e0196106

43. Shukla V, Arora R (2023) The Economic Cost of Rising Non-communicable Diseases in India: A Systematic Literature Review of Methods and Estimates. Appl Health Econ Health Policy 21:719–730

44. Engelgau MM, Karan A, Mahal A (2012) The Economic impact of Non-communicable Diseases on households in India. Global Health 8:9

45. Kastor A, Mohanty SK (2018) Disease-specific out-of-pocket and catastrophic health expenditure on hospitalization in India: Do Indian households face distress health financing? PLoS ONE 13:e0196106

46. Rajpal S, Kumar A, Joe W (2018) Economic burden of cancer in India: Evidence from cross-sectional nationally representative household survey, 2014. PLoS ONE 13:e0193320

47. Behera S, Pradhan J (2021) Uneven economic burden of non-communicable diseases among Indian households: A comparative analysis. PLoS ONE 16:e0260628

48. Jan S, Laba T-L, Essue BM, et al (2018) Action to address the household economic burden of non-communicable diseases. The Lancet 391:2047–2058

49. Yadav J, Allarakha S, Menon GR, John D, Nair S (2021) Socioeconomic Impact of Hospitalization Expenditure for Treatment of Noncommunicable Diseases in India: A Repeated Cross-Sectional Analysis of National Sample Survey Data, 2004 to 2018. Value in Health Regional Issues 24:199–213

50. Hussain I, Das RC (2024) Interlink between human capital and income in Indian States: an empirical investigation for the period 1998-2019. Reg Stat 14:229–257

51. Raj J, Gupta V, Shrawan A (2024) Interlinkages Between Economic Growth and Human Development in India: A State-Level Analysis. IPPR 5:113–155

52. Rosário R, Silva MJ, Duarte A, Martins J, Martins S, Lopes C, Augusto C (2023) Is the education of the parents differently associated with their children health literacy? European Journal of Public Health 33:ckad160.1430

53. United Nation (2015) Transforming our world: The 2030 agenda for sustainable development. UN Publishing.

54. United Nation (2023) Sustaible Development Goal. United Nation

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- additionalfile.docx