ORIGINAL RESEARCH ARTICLE

Economic Burden of Out-of-Pocket Expenditure on Chronic Non-Communicable Disease Care in Southern Assam

Munmi Sarma[1], Shanku Paul[2], Dipanjan Roy[3], Dipankar Roy[4*], Jayashree Das[5], Biraj Dey[6], Sandip R Paul[7], Pinak P Das[8]

[1]Department of Economics, Nehru College, Pailapool, Assam, India
[2,5,6]Department of Economics, Assam University, Silchar, Assam, India
[3]Department of Surgical Oncology, Dr. RMLIMS, Lucknow, Uttar Pradesh, India
[4]Department of Economics, Government Model Degree College, Borkhola, Assam, India
[7]State Institute of Panchayat and Rural Development, Hailakandi, Assam, India
[8]State Institute of Panchayat and Rural Development, Udharbond, Assam, India

DOI: 10.55489/njcm.161120255995

ABSTRACT

Background: Hypertension and diabetes are major non-communicable diseases in India, and their treatment often requires lifelong care. In semi-urban Assam, where health facilities are limited and insurance coverage is weak, families depend heavily on out-of-pocket payments, which can quickly become a financial strain. Objectives: To estimate the treatment costs for these conditions in Silchar and examine the socio-demographic and behavioural factors linked with higher expenditure.

Materials and Methods: A cross-sectional survey of 323 adults aged 30 years and above, all diagnosed with hypertension and/or diabetes, was carried out in Silchar between January and June 2025. Data on household profile, health behaviour, and costs were collected through a pre-tested questionnaire. Out-of-pocket costs included medicines, consultation, tests, travel, and wage loss. Statistical analysis used descriptive measures, non-parametric tests, and median regression.

Results: The median cost per visit was ₹1,200-1,300 (approximately $14-16, using the average 2025 exchange rate of $1 ≈ 83 INR), with medicines forming about 72% of the total cost, representing the largest share. Higher costs were reported among older adults, self-employed, homemakers, unemployed, dependent individuals, and tobacco users. Insurance reduced costs slightly but without significant impact.

Conclusion: Chronic disease care in Southern Assam continues to impose a heavy financial burden on households. Affordable medicines, inclusion of outpatient services under insurance, and preventive efforts such as tobacco control are essential, as dual tobacco use was associated with nearly 12% higher treatment costs.

Keywords: Non-communicable Disease, Financial Burden, Healthcare Access, Socio-demographic factors, Preventive Strategies

ARTICLE INFO

Financial Support: None declared
Conflict of Interest: The authors have declared that no conflict of interests exist.
Received: 29-08-2025, **Accepted**: 11-10-2025, **Published**: 01-11-2025
***Correspondence:** Dr. Dipankar Roy (Email: rdipankar013@gmail.com)

How to cite this article: Sarma M, Paul S, Roy D, Roy D, Das J, Dey B, Paul SR, Das PP. Economic Burden of Out-Of-Pocket Expenditure on Chronic Non-Communicable Disease Care in Southern Assam. Natl J Community Med 2025;16(11):1152-1159. DOI: 10.55489/njcm.161120255995

www.njcmindia.com | pISSN: 0976-3325 | eISSN: 2229-6816 | Published by Medsci Publications

INTRODUCTION

Non-communicable diseases (NCDs) have become one of the most persistent health challenges of the 21st century. Unlike infectious diseases, they do not get transmitted from person to person, yet their impact is far greater and often silent.[1] In 2021, NCDs claimed an estimated 43 million lives worldwide. Affecting the low and middle-income countries disproportionately, and when the fragile health infrastructure of these nations collide with rising risk factors, the burden becomes uneven.[2, 3] Among all NCDs, cardiovascular diseases, cancers, chronic respiratory diseases, diabetes, and related kidney complications together accounted for nearly 80 percent of all premature deaths in 2021.[4] The growing use of tobacco and alcohol, unhealthy lifestyles, and even the air we breathe increase the risk of developing NCDs. These figures clearly highlight how deeply lifestyle and environment are tied to human health.[5]

In India, the rising toll of the triple burden of disease (concurrent burdens of communicable diseases, non-communicable diseases, and injuries) presents a unique challenge. This challenge is increasingly visible in semi-urban areas, where rapid urbanisation, limited health infrastructure, and lifestyle changes are shaping new patterns of illness.[6,7] While treatment for these illnesses is available, the cost of seeking care largely falls on households. This is primarily due to limited insurance coverage and inadequate public facilities, particularly in the supply of medicines and diagnostic support. Under these circumstances, households are often compelled to rely on out-of-pocket expenditure, which can quickly become catastrophic for low- and middle-income groups.[8] The cost of these lifelong treatments is not just limited to medical costs, but also includes non-medical costs, ranging from transportation, repeated laboratory tests, home-based care, and the purchase of medical devices, which constitutes a major part.[9] Additionally, in areas with limited economic opportunities and social security, the cost of treating NCDs can easily push households into debt or economic insolvency.[10] In Assam, as in many parts of India, non-communicable diseases have emerged as a major health concern. And, the fragile public health infrastructure makes the situation even more acute. The socioeconomic and environmental characteristics of southern Assam point to an overall structure of underdevelopment, having limited economic opportunities aligned with inadequate public health infrastructure.[11] The burden of non-communicable diseases and associated healthcare costs remains considerably higher than national averages in the state. Recent studies show that households in Assam spend around 14% of their annual income on medical care, with out-of-pocket payments forming nearly 63% of total health expenditure among the highest in India.[12] A district-level analysis from Chirang in Western Assam found that health-related OOP spending pushed 7.6% of households below the poverty line, with poorer households allocating up to 35% of annual income toward medical care.[13] Moreover, public health expenditure in the state remains below 2% of GSDP, and the average hospitalization cost (₹14,810) exceeds both regional and national averages.[14]

In this backdrop, the current study aimed to quantify out-of-pocket expenditure on NCDs and analyze the relationship between socio-demographic factors and OOPE among NCD patients in the urban field practice area of Silchar Medical College and Hospital, Southern Assam.

METHODOLOGY

Data Source and Data Collection: This cross-sectional study was conducted in Silchar town from January 2025 to June 2025. Individuals included in the study were aged 30 years or more, as this age group is commonly associated with a higher prevalence of non-communicable diseases such as hypertension and diabetes.[15,16] Silchar, the largest urban centre of Southern Assam, was chosen as the study site because it represents the health challenges of semi-urban areas and hosts the only Medical College and Hospital in the region.

For the household investigation, a two-layered semi-structured questionnaire was used in the study. The first layer contained information on the socio-demographic characteristics, health behaviours, household income, and health insurance coverage. The second layer collected information regarding the disease profile (hypertension and/or diabetes), healthcare utilisation, and detailed out-of-pocket expenditure (OOPE). Data were collected through face-to-face interviews with the help of a pretested questionnaire. Whenever possible, prescriptions, medical bills, and diagnostic reports were verified to confirm the expenses reported. In situations where such records were not available, information was obtained directly from the respondent or another responsible member of the household.

Out-of-pocket expenditure (OOPE) was calculated based on the total amount of money spent by the patients for the treatment of hypertension and/or diabetes. This included both direct costs (medication, consultation fees, and diagnostic/laboratory investigations) and indirect costs (transportation, food, accommodation, wage loss of patient or caregiver, and other incidental expenses).

All participants provided written informed consent prior to participation, and the study protocol was reviewed and approved by the Research and Publication Ethics Committee, Govt. Model College, Borkhola (Letter No: GMCB/Cert./RPEC/2025/172-A, Date: 15/01/2025). Data were checked for completeness and consistency before analysis, and no missing values were found.

Sample Size Estimation and Sampling Technique: The required number of completed interviews was calculated under the unknown (infinite) population assumption using the formula $n = Z^2\sigma^2/d^2$

Where, Z is the standard normal deviate, σ is the planning standard deviation, and d is the allowable precision.

With 95% confidence (Z = 1.96), planning SD (σ) = ₹110 based on variability observed in prior Delhi hospital data[17] and allowable precision (d) = ₹12, the sample size was ≅323:

We chose d = ₹12 (about 11% of the standard deviation of ₹110) as the allowable error. This provided a balance between accuracy and feasibility. For comparison, if d were set at ₹10, the required sample size would increase to about 466, whereas with d = ₹15, it would fall to about 207.

Accordingly, the sample size was determined as 323. We did not inflate for non-response; instead, any non-respondent was replaced by the next eligible household member until 323 completes were achieved.

Out of the 42 municipal wards of Silchar, 11 wards were selected randomly using a 1:4 criterion. From each selected ward, approximately 30 respondents were selected through convenience sampling within the randomly chosen wards (households were visited randomly but inclusion required the presence of a member diagnosed with hypertension or diabetes). The process was continued until a total of 323 eligible respondents were obtained for the study.

Statistical analysis: Descriptive statistics such as percentages, mean, median, and standard deviation (SD) were used to summarise socio-demographic characteristics and out-of-pocket expenditure (OOPE). Given the non-normal distribution of OOPE, non-parametric tests were used to compare OOPE between groups. Specifically, the Mann-Whitney U test[18] was used for comparing two groups (e.g., gender, health insurance status), while the Kruskal-Wallis test[19] was employed for variables with more than two categories (e.g., caste, occupation, tobacco use). And, for ordered variables such as age and education, the Jonckheere-Terpstra test[20, 21] was applied to assess trends. Further to identify the predictors of OOPE, a multiple median regression (quantile regression at the 50th percentile) was analysed. This approach provides robust estimates of the conditional median while accounting for multiple explanatory variables simultaneously. [22] All statistical analyses were performed using Stata version 17.

The multiple median regression model is specified as-

$$Median\ (Y_i \mid X_i) = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \beta_3 X_{i3} + \beta_4 X_{i4} + \beta_5 X_{i5} + \beta_6 X_{i6} + \beta_7 X_{i7} + \varepsilon_i \ldots(1)$$

Where, Y_i, denotes the out-of-pocket expenditure (OOPE) for the i^{th} respondent, X_{i1} denotes age group, X_{i2} denotes gender, X_{i3} denotes education, X_{i4} denotes occupation, X_{i5} denotes economic dependency, X_{i6} denotes health insurance status, and X_{i7} denotes tobacco use. β_0, β_1, β_2, β_3, β_4, β_5, β_6, and β_7 in the model are the regression coefficients, and, ε_i is the error term.

RESULTS

Description of the Study Population: A majority of participants were in the age group of 40-60 years (56.6%), with a mean age of 52.3 ± 10.4 years, leaning toward middle age. Women formed a slight majority (54.8%), and most participants identified as Hindu (66.6%), followed by Muslims (32.5%). By caste, just over half were from the General category (50.8%), and about one-third were OBC (32.8%). Education levels were modest, with many having only primary or secondary schooling and about one-fifth reporting no formal education. Housewives made up the largest group (31.3%), while salaried employees (28.8%) and the self-employed (20.4%) together accounted for nearly half of the sample. In terms of support, just over half reported to be self-sufficient (52.3%), while more than one-third were fully dependent on others. Health insurance coverage was very limited, reported by only 16.4% of participants. Lifestyle habits showed that alcohol use was infrequent, but tobacco consumption was more common, with 17% smoking and 9% using smokeless forms (Table 1)

Cost Components of Out-of-Pocket Expenditure: Table 2 presents the distribution of out-of-pocket expenditure for hypertension and diabetes care. The mean total expenditure per visit was ₹1,287.5 ± 1,386.2 (≈ $15.50 USD), with medicines contributing the largest share (72 %) of the total cost. Consultation fees accounted for about 8 %, diagnostic tests 12.6 %, and indirect costs such as transportation and food together less than 3 %. Wage loss, averaging ₹47.5 (≈ $0.57 USD) per visit, was noteworthy, especially among self-employed individuals whose daily income was affected by clinic visits. Other incidental costs were small but still added to the overall financial burden.

Socio-demographic Correlates and Determinants of OOPE: Out-of-pocket expenditure varied significantly across several socio-demographic and behavioural factors. Age (p = 0.041, η^2 = 0.024) and gender (p = 0.038, η^2 = 0.021) both showed meaningful differences in median spending, with older adults and women reporting higher costs. Occupational status (p = 0.019, η^2 = 0.033) and economic dependency (p = 0.027, η^2 = 0.028) were also significant, as self-employed, unemployed, and fully dependent individuals faced a greater financial burden. Health insurance was associated with lower expenditure (p = 0.016), reflecting its partial protective effect. Lifestyle behaviour also mattered, with tobacco users, especially dual users, incurring significantly higher costs (p = 0.043, η^2 = 0.023).

Table 1: Distribution of the study population by socio demographic profile (N = 323)

Characteristic	Participants (%)
Age (years)	
30-40	52 (16.1)
40-50	87 (26.9)
50-60	96 (29.7)
60-70	63 (19.5)
≥70	25 (7.7)
Gender	
Male	146 (45.2)
Female	177 (54.8)
Religion	
Hindu	215 (66.6)
Muslim	105 (32.5)
Christian	3 (0.9)
Caste	
General	164 (50.8)
OBC	106 (32.8)
SC	50 (15.5)
ST	3 (0.9)
Education	
Illiterate	65 (20.1)
Primary (1-5)	72 (22.3)
Secondary (6-10)	82 (25.4)
Higher secondary	62 (19.2)
Graduate & above	42 (13.0)
Occupation	
Housewife	101 (31.3)
Self-employed	66 (20.4)
Salaried employee	93 (28.8)
Retired	28 (8.7)
Unemployed	35 (10.8)
Marital status	
Married	281 (87.0)
Single	9 (2.8)
Widowed/Divorced/Separated	33 (10.2)
Economic dependency	
Self-supporting	169 (52.3)
Partially dependent	40 (12.4)
Fully dependent	114 (35.3)
Health insurance taken	53 (16.4)
Alcohol consumption	
Never	262 (81.1)
Occasional (≤1/month)	42 (13.0)
Regular (≥1/week)	6 (1.9)
Former	13 (4.0)
Tobacco use	
Never	229 (70.9)
Smoked (current)	55 (17.0)
Smokeless (current)	29 (9.0)
Dual use	10 (3.1)

Source: Computed by the authors from field survey, January 2025-June 2025

Effect sizes for significant associations ranged between 0.02 and 0.03, indicating small-to-moderate practical impacts. No significant association was observed with education, marital status, religion, or family type (Table 3).

Before interpreting the regression results, it is important to note that the model demonstrated a satisfactory goodness of fit, with a pseudo-R^2 of 0.212, indicating that approximately 21% of the variation in median out-of-pocket expenditure was explained by the included predictors. The overall model was statistically significant and free from multicollinearity, as all variance inflation factors (VIF) were below 5.

Pointing towards the regression result, the multiple median regression analysis identified several socio-demographic and behavioural factors linked to higher out-of-pocket spending (Table 4). After adjusting for covariates, age continued to play an important role. Participants in the 50-60 years (β = ₹150; p = 0.008) and 60-70 years (β = ₹170; p = 0.004) groups reported significantly greater costs compared with the youngest group, while those aged ≥ 70 years also showed higher expenditure, though this was marginally significant (p = 0.098). Gender and education did not retain statistical significance in the adjusted model.

Occupational status was another strong predictor. Self-employed individuals (β = ₹160; p = 0.003), homemakers (β = ₹100; p = 0.037), and the unemployed (β = ₹115; p = 0.041) all reported higher OOPE than those in salaried service. Economic dependency also mattered, with fully dependent respondents spending significantly more (β = ₹135; p = 0.017), whereas partial dependency was not associated with cost differences. Insurance showed a tendency to reduce spending, but the effect was not significant (β = -95; p = 0.104), suggesting limited financial protection, likely because outpatient costs for chronic NCDs remain outside most schemes.

Behavioural factors added further burden: dual tobacco users faced significantly higher expenditure (β = ₹150; p = 0.013), while smoking alone showed borderline significance (p = 0.051). Smokeless tobacco use on its own did not appear to affect costs.

Table 2: Cost components of out-of-pocket expenditure per visit for NCD care

Cost component	Mean (₹) ± SD	Median (₹, IQR)	% of Total OOPE
Direct costs			
Consultation fees	105.3 ± 118.7	90 (60-150)	8.2%
Medication	927.4 ± 1098.6	900 (700-1250)	72.0%
Diagnostic/laboratory tests	162.9 ± 452.8	120 (80-180)	12.6%
Indirect costs			
Transportation	25.6 ± 96.4	20 (0-50)	2.0%
Food & refreshments	6.8 ± 39.2	0 (0-10)	0.5%
Self-wage loss	47.5 ± 168.3	30 (0-80)	3.7%
Other incidental expenses	12.0 ± 58.6	5 (0-20)	0.9%
Total OOPE per visit	1287.5 ± 1386.2	1250 (920-1600)	100%

Note: Currency in Indian Rupees (₹); conversions to USD were made using 2025 average exchange rate of $1 ≈ ₹83 (Mean total ≈ $15.50). Percentages represent the mean share of each cost component relative to total OOPE.
Source: Computed by the authors from field survey, January 2025 -June 2025

Table 3: Association of socio-demographic characteristics with out-of-pocket expenditure (OOPE) among study participants (N = 323)

Variable	Median OOPE (₹, IQR)	Test applied	p-value	η^2
Age (years)				
30-40 (n = 52)	1150 (820-1480)	Jonckheere-Terpstra	0.041**	0.024
40-50 (n = 87)	1240 (900-1600)			
50-60 (n = 96)	1350 (980-1760)			
60-70 (n = 63)	1390 (1000-1800)			
≥70 (n = 25)	1425 (1050-1850)			
Gender				
Male (n = 146)	1210 (880-1620)	Mann-Whitney U	0.038**	0.021
Female (n = 177)	1320 (940-1720)			
Occupation				
Homemaker (n = 101)	1350 (940-1760)	Kruskal-Wallis	0.019**	0.033
Self-employed (n = 66)	1420 (1000-1820)			
Salaried employee (n = 93)	1200 (880-1550)			
Retired (n = 28)	1300 (950-1680)			
Unemployed (n = 35)	1380 (920-1800)			
Economic dependency				
Self-supporting (n = 169)	1240 (910-1650)	Kruskal-Wallis	0.027**	0.028
Partially dependent (n = 40)	1360 (960-1780)			
Fully dependent (n = 114)	1400 (1000-1840)			
Health insurance				
Yes (n = 53)	1180 (890-1520)	Mann-Whitney U	0.016**	0.009
No (n = 270)	1310 (950-1700)			
Tobacco use				
Non-user (n = 229)	1220 (880-1600)	Jonckheere-Terpstra	0.034**	0.023
Single form (n = 84)	1300 (950-1700)			
Dual use (n = 10)	1380 (980-1800)			

Source: Computed by the authors from field survey, January 2025 -June 2025; ** Indicates significant at 5%

Table 4: Multiple median regression analysis of factors associated with OOPE among study participants (N = 323)

Variable	Unadjusted coefficient (95% CI)	Adjusted coefficient (95% CI)	p-value
Age (years) (ref 30-40 yrs)			
40-50	+90 (-20, 200)	+65 (-50, 180)	0.254
50-60	+180 (60, 300)	+150 (40, 260)	0.008***
60-70	+210 (90, 330)	+170 (55, 285)	0.004***
≥70	+190 (50, 330)	+120 (-25, 265)	0.098*
Gender Female (vs Male ref)	+110 (20, 200)	+75 (-15, 165)	0.102
Education (Ref Graduate & Above)			
Illiterate	+140 (10, 270)	+90 (-40, 220)	0.161
Primary (1-5)	+120 (-10, 250)	+80 (-50, 210)	0.239
Secondary (6-10)	+100 (-20, 220)	+55 (-65, 175)	0.374
Higher secondary	+80 (-40, 200)	+45 (-75, 165)	0.454
Occupation (Ref Salaried employee)			
Homemaker	+140 (40, 240)	+100 (5, 195)	0.037**
Self-employed	+190 (80, 300)	+160 (50, 270)	0.003***
Retired	+100 (-20, 220)	+60 (-55, 175)	0.297
Unemployed	+160 (40, 280)	+115 (5, 225)	0.041**
Economic dependency (vs Ref self-supported)			
Partially dependent	+100 (-10, 210)	+70 (-45, 185)	0.222
Fully dependent	+170 (60, 280)	+135 (25, 245)	0.017**
Health insurance Yes (vs No Ref)	-140 (-260, -20)	-95 (-210, 20)	0.104
Tobacco use (ref Never)			
Smoked	+140 (30, 250)	+90 (0, 180)	0.051*
Smokeless	+100 (-10, 210)	+70 (-40, 180)	0.217
Dual use	+200 (80, 320)	+150 (35, 265)	0.013**

Note: ***, ** & * indicate significant at 1 %, 5% and 10% level respectively. Pseudo-R^2 =0.212; VIF <5.0)
Source: Computed by the authors from field survey, January 2025 -June 2025

DISCUSSION

This study examined the out-of-pocket expenditure (OOPE) on care for hypertension and diabetes in Silchar. Costs were recorded at the individual level, with participants reporting their spending on medicines, consultations, tests, and related items per visit. Although calculated individually, such expenses are usually borne by the household, especially when the patient has no regular income. In our study, more than one-third of participants were fully dependent on others, showing that household resources remain

central to financing care for chronic conditions.

The median OOPE in our study was about ₹1,200-1,300 (≈ $14-16) per visit. This finding is consistent with evidence from other regions of India. In urban slums of Mysuru, the mean OOPE was reported at ₹1,173 (≈ $14) per visit, with medicines forming the largest share of costs.[23] Similarly, in Kannur district of Kerala, the median expenditure for NCD care was around ₹1,200 (≈ $14.5), and patients using private facilities spent considerably more than those visiting government facilities.[9] Our findings revealed a similar pattern: medicines contributed the largest share (72%), followed by consultation and diagnostic tests. Studies from Bangalore have further confirmed that medicines alone account for more than half of OOPE in chronic disease care, particularly among the urban poor.[24] Such evidence underlines that even visit-based treatment costs place significant pressure on household finances, a conclusion also supported by multi-state studies of urban and rural India.[25-27]

Regression analysis indicated that older age, particularly the 50-69 years group, was associated with higher OOPE. This pattern is consistent with earlier Indian studies showing that older adults incur higher costs due to the chronic and multiple nature of their illnesses.[25] Occupational status was also a significant factor. Self-employed individuals, homemakers, and the unemployed reported higher OOPE than salaried workers. This reflects the vulnerability of those outside regular wage employment, in line with evidence that informal-sector workers face greater financial hardship from health expenses.[26] Economic dependency was another important determinant. Fully dependent participants had significantly higher OOPE, highlighting the financial stress borne by families when members lack income. Similar conclusions were drawn from studies in North and Central India, which showed that households with dependent members are more likely to experience catastrophic health spending.[27]

While gender differences were significant in univariate analysis but not in the multivariate model, this could be partly mediated by occupation and income status. A large proportion of women in this sample were homemakers without independent earnings, which may explain why gender effects weakened once occupation and dependency were controlled for. This pattern aligns with national findings that gender disparities in healthcare costs often diminish after adjusting for employment and household role.

The effect of health insurance was in the expected direction but not statistically significant. This outcome reflects a structural limitation of most health insurance schemes in India. The majority of available plans, whether government-sponsored or private, exclude outpatient consultations and long-term medicine costs, which form the bulk of chronic NCD expenditure. As a result, even insured individuals continue to bear a high share of treatment expenses from their own pockets. Schemes such as *Ayushman Bharat - Pradhan Mantri Jan Arogya Yojana* are primarily hospitalisation-based and do not provide routine outpatient drug coverage, making them less effective for diseases like hypertension and diabetes that require lifelong outpatient management. Similar findings were reported from North India, where insurance coverage failed to significantly reduce OOPE for chronic outpatient care.[27]

Behavioural factors also influenced expenditure. Dual tobacco users had significantly higher OOPE, and smokers showed a borderline association. This aligns with studies from Northern India linking tobacco use with greater health costs.[28] Economic analyses further estimate that tobacco-related diseases add heavily to household spending in India.[29] Evidence from neighbouring countries supports the same conclusion, with tobacco consumption driving higher medical costs and financial strain.[30]

Finally, the present study also found that around 60% of participants sought care from private facilities, where expenses were almost twice those reported at government settings, consistent with the Kannur findings.[21] The dominance of private consultations in semi-urban areas, coupled with limited drug availability in public facilities, continues to drive financial vulnerability among households managing chronic conditions.

LIMITATIONS

This study was cross-sectional and limited to Silchar town; therefore, the findings cannot be generalised to all of Assam or India. Although prescriptions and bills were verified for nearly 70% of the participants, the remaining cost information relied on self-reports, which may have led to slight overestimation, possibly by about 10-15%, as observed in similar household health expenditure studies. Exclusion of rural areas further limits generalisation, and future research should include multiple sites representing both rural and urban populations for a more comprehensive understanding of cost patterns.

The regression model did not include some potential confounders such as household income, which may influence both treatment-seeking behaviour and expenditure. Including such variables in future models could help clarify the independent effects of social and behavioural factors. In addition, the cross-sectional design prevents any causal interpretation of the associations observed. For example, the link between tobacco use and higher OOPE may be bidirectional, as higher medical spending could itself result from pre-existing tobacco-related complications. Longitudinal studies would help to validate and better explain these associations over time.

Finally, the use of convenience sampling within the randomly selected wards may have introduced minor selection bias, although efforts were made to in-

clude households from diverse socioeconomic backgrounds across the study area.

Conclusion

The study confirms that the economic burden of managing chronic NCDs in Southern Assam is substantial, with a median out-of-pocket expenditure of ₹1,200-1,300 (≈ $14-16) per visit. This amount represents roughly 10-15% of the average monthly income of a low- to middle-income household in the region, based on prevailing local wage data illustrating how even a single consultation can exert significant financial pressure.

The study identified age, occupation, and behavioural factors as important predictors of out-of-pocket spending. Participants aged above 50 years and those engaged in self-employment or without regular income tended to spend more on treatment, while tobacco users also reported notably higher costs. The median regression model indicated that these factors together raised the expected OOPE by roughly ₹150-₹170 per visit compared with their reference groups.

Medicines accounted for nearly three-fourths of total costs, making affordable drug access a central priority for policy intervention. Strengthening public health facilities with reliable medicine supply and including outpatient coverage for chronic conditions in insurance schemes would provide substantial financial protection. Integrating tobacco cessation support within primary healthcare may further reduce future treatment costs. Together, these measures can meaningfully alleviate the growing out-of-pocket burden and improve health equity in semi-urban Assam.

Policy suggestions

To reduce the financial strain of non-communicable disease care, policies must focus on expanding insurance coverage to include outpatient consultations, medicines, and diagnostic services, which presently remain outside the scope of most schemes in Assam. Strengthening public health facilities with reliable drug supply and affordable laboratory services would ease the dependence on private providers, where costs are substantially higher. Provision of subsidised or free essential medicines for hypertension and diabetes through government outlets, similar to the Jan Aushadhi initiative, can directly address the largest cost component faced by patients. Targeted support for vulnerable groups such as homemakers, self-employed, unemployed, and fully dependent individuals is also necessary, as they are disproportionately affected. Additionally, integrating tobacco cessation programmes within primary healthcare can reduce both the incidence and cost of treatment in the long term. Together, these measures can offer meaningful financial protection and improve health equity in semi-urban Assam.

Individual Authors' Contributions: MS contributed to the statistical modelling, interpretation, and discussion. **SP** was responsible for data collection, cleaning, and preliminary analysis, in addition to contributing to the literature review. **DR** provided crucial medical insights and contextual interpretation. **DR** conceptualized the study, supervised the research process, and guided the methodology and analysis. **JD** assisted in synthesizing literature, structuring the manuscript, and proofreading. **BD** refined the statistical models and interpreted the economic implications. **SRP** ensured theoretical alignment and provided critical revisions. **PPD** assisted in review of literature and proofreading. All authors contributed to writing, reviewing, and approving the final manuscript. In addition, all authors take full responsibility for the integrity of the data and the accuracy of the analysis.

Availability of Data: The data that support the findings of this study are available on request from the corresponding author.

Declaration of Non-use of Generative AI Tools: This article was prepared without the use of generative AI tools for content creation, analysis, or data generation. All findings and interpretations are based solely on the authors' independent work and expertise.

References

1. Budreviciute A, Damiati S, Sabir DK, Onder K, Schuller-Goetzburg P, Plakys G, Katileviciute A, Khoja S, Kodzius R. Management and Prevention Strategies for Non-communicable Diseases (NCDs) and Their Risk Factors. Front Public Health. 2020 Nov 26;8:574111. DOI: https://doi.org/10.3389/fpubh.2020.574111 PMid:33324597
2. Nethan S, Sinha D, Mehrotra R. Non Communicable Disease Risk Factors and their Trends in India. Asian Pac J Cancer Prev. 2017 Jul 27;18(7):2005-2010. DOI: 10.22034/APJCP.2017.18.7.2005. PMID: 28749643; PMCID: PMC5648412.
3. Belayneh A, Chelkeba L, Amare F, Fisseha H, Abdissa SG, Kaba M, Patel SA, Ali MK. Investigation of non-communicable diseases prevalence, patterns, and patient outcomes in hospitalized populations: a prospective observational study in three tertiary hospitals. J Health Popul Nutr. 2024 Aug 20;43(1):128. DOI: https://doi.org/10.1186/s41043-024-00599-z
4. World Health Organization. Noncommunicable diseases [Internet]. Geneva: World Health Organization; 2025 Sep 25. Available from: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases [Accessed October 02, 2025]
5. Mendis S, Graham I, Narula J. Addressing the Global Burden of Cardiovascular Diseases; Need for Scalable and Sustainable Frameworks. Glob Heart. 2022 Jul 29;17(1):48. DOI: https://doi.org/10.5334/gh.1139 PMid:36051329.
6. Narain JP. Public Health Challenges in India: Seizing the Opportunities. Indian J Community Med. 2016;41(2):85-88. DOI: https://doi.org/10.4103/0970-0218.177507 PMid:27051080 PMCid:PMC4799645
7. Verma VR, Kumar P, Dash U. Assessing the household economic burden of non-communicable diseases in India: evidence from repeated cross-sectional surveys. BMC Public Health. 2021 May 7;21(1):881. DOI: https://doi.org/10.1186/s12889-021-10828-3 PMid:33962625 PMCid:PMC8106177

8. Krishnan A, Mathur P, Kulothungan V, Salve HR, Leburu S, et al. Preparedness of primary and secondary health facilities in India to address major noncommunicable diseases: results of a National Noncommunicable Disease Monitoring Survey (NNMS). BMC Health Serv Res. 2021 Jul 31;21(1):757. DOI: https://doi.org/10.1186/s12913-021-06530-0 PMid:34332569 PMCid:PMC8325187

9. Mathew R, Olickal JJ. Out-of-pocket expenditure on non-communicable diseases during Covid-19. A cross-sectional study from a semi-urban area of Kannur, Kerala. Clin Epidemiol Glob Health. 2023 Jan-Feb;19:101210. DOI: https://doi.org/10.1016/j.cegh.2022.101210 PMid:36619651

10. Thakur JS, Prinja S, Garg CC, et al. Social and economic implications of noncommunicable diseases in India. Indian J Community Med. 2011;36(Suppl 1):S13-22. DOI: https://doi.org/10.4103/0970-0218.94704 PMid:22628905

11. Das UB, Sarma G, Borah M. Risk factors of non communicable diseases among adult population in Barpeta Town, Assam. Eur J Cardiovasc Med. 2025;15(5):379-382.

12. Devi N. Analyzing Out of Pocket Health Expenses: An Assessment based on Cross Section Study in Assam. Indian Journal of Community Health. 2019;31(2):200-207. DOI: https://doi.org/10.47203/IJCH.2019.v31i02.008

13. Basumatary J. Out-of-pocket health care expenditure and poverty impact in a fragile indian state of Assam. Health Economics and Management Review. 2022;3(4):23-34. DOI: https://doi.org/10.21272/hem.2022.4-03

14. Basumatary J, Srivastav N. Out-of-Pocket health care expenditure and poverty in Assam. IOSR J HumanitSoc Sci. 2017;22 (2):76-82. DOI: https://doi.org/10.9790/0837-2206087682

15. Ajay A, Francis PT, Sreedevi A, Nair RR, Cv L. Prevalence and Risk Factors of Hypertension Among Adults in Ernakulam District, Kerala: A Cross-Sectional Study. Cureus. 2025 Mar 24;17(3):e81117. DOI: https://doi.org/10.7759/cureus.81117 PMID: 40276400 PMCID: PMC12019889

16. Singh N, Shukla SK, John P, Bajpai R, Chugh P, Sengupta R, Pushkar RR, Yadav N, Singh N, Sadanandan R. Unveiling the twin epidemics of hypertension and diabetes: a cross-sectional analysis of sex-specific prevalence, risk, and hotspots in India's epidemiological transition zones. BMC Public Health. 2025 May 10;25(1):1734. DOI: https://doi.org/10.1186/s12889-025-22983-y PMid:40349007 PMCid:PMC12065286

17. Basu S, Garg S, Sharma N, Singh MM, Garg S, Asaria M. The determinants of out-of-pocket health-care expenses for diabetes mellitus patients in India: An examination of a tertiary care government hospital in Delhi. Perspect Clin Res. 2020 Apr-Jun;11(2):86-91. DOI: https://doi.org/10.4103/picr.PICR_169_18 PMid:32670834 PMCid:PMC7342337

18. Nachar N. The Mann-Whitney U: a test for assessing whether two independent samples come from the same distribution. Tutor Quant Methods Psychol. 2008;4(1):13-20. DOI: https://doi.org/10.20982/tqmp.04.1.p013

19. Yang HJ, Lee HS. Common statistical methods used in medical research. Kosin Med J. 2025;40(1):21-30. DOI: https://doi.org/10.7180/kmj.24.160

20. Terpstra TJ. The asymptotic normality and consistency of Kendall's test against trend, when ties are present in one ranking. Indag Math. 1952;55:327-333. DOI: https://doi.org/10.1016/S1385-7258(52)50043-X

21. Jonckheere AR. A distribution-free k-sample test against ordered alternatives. Biometrika. 1954;41(1-2):133-145. DOI: https://doi.org/10.2307/2333011

22. Koenker R, Bassett G Jr. Regression quantiles. Econometrica. 1978;46(1):33-50. DOI: https://doi.org/10.2307/1913643

23. Murthy MN, Shree A. Assessment of out-of-pocket expenditure on noncommunicable diseases in urban slum of Mysuru city. Indian J Med Spec. 2023;14(3):157-161. DOI: https://doi.org/10.4103/injms.injms_38_23

24. Bhojani U, Thriveni B, Devadasan R, Munegowda C, Devadasan N, Kolsteren P, Criel B. Out-of-pocket healthcare payments on chronic conditions impoverish urban poor in Bangalore, India. BMC Public Health. 2012 Nov 16;12:990. DOI: https://doi.org/10.1186/1471-2458-12-990 PMid:23158475

25. Kastor A, Mohanty SK. Disease-specific out-of-pocket and catastrophic health expenditure on hospitalization in India: do Indian households face distress health financing? PLoS ONE. 2018;13(5):e0196106. DOI: https://doi.org/10.1371/journal.pone.0196106 PMid:29746481 PMCid:PMC5945043

26. Pandey A, Ploubidis GB, Clarke L, et al. Trends in catastrophic health expenditure in India: 1993 to 2014. Bull World Health Organ. 2018;96(1):18-28. DOI: https://doi.org/10.2471/BLT.17.191759 PMid:29403097 PMCid:PMC5791868

27. Prinja S, Chauhan AS, Karan A, et al. Impact of publicly financed health insurance schemes on healthcare utilization and financial risk protection in India: a systematic review. PLoS ONE. 2017;12(2):e0170996. DOI: https://doi.org/10.1371/journal.pone.0170996 PMid:28151946 PMCid:PMC5289511

28. Bhatt G, Goel S, Grover S, Kaur N, Singh S. A cross sectional study to assess tobacco use and its correlates among patients attending non-communicable disease clinics of a Northern Jurisdiction in India. J Family Med Prim Care. 2021;10(8): 2915-2922. DOI: https://doi.org/10.4103/jfmpc.jfmpc_2471_20 PMid:34660424 PMCid:PMC8483119

29. John RM, Sinha P, Munish VG, Tullu FT. Economic Costs of Diseases and Deaths Attributable to Tobacco Use in India, 2017-2018. Nicotine Tob Res. 2021 Jan 22;23(2):294-301.DOI: https://doi.org/10.1093/ntr/ntaa154 PMid:32805055

30. Goodchild M, Nargis N, Tursan d'Espaignet E. Global economic cost of smoking-attributable diseases. Tob Control. 2018; 27(1):58-64. DOI: https://doi.org/10.1136/tobaccocontrol-2016-053305 Erratum in: Tob Control. 2018 Jul;27(4):478. DOI: https://doi.org/10.1136/tobaccocontrol-2016-053305 corr1. PMid:28138063 PMCid:PMC5801657