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Faiyaz Al Muhaimen
Shahjalal University of Science and Technology
Md Jamal Uddin
jamal-sta@sust.edu
Shahjalal University of Science and Technology

Research Article

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Posted Date: September 9th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10617947/v1

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Additional Declarations: No competing interests reported.

Ageing, Chronic Disease Burden, and Household Health Expenditure in Bangladesh: Evidence from HIES 2022

Faiyaz Al Muhaimen[1] and Md Jamal Uddin[1]*

[1] Department of Statistics, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh

*Correspondence:

Md Jamal Uddin*

Department of Statistics, Shahjalal University of Science and Technology, Sylhet-3114,

Email of corresponding author: jamal-sta@sust.edu

Author email addresses:

Faiyaz Al Muhaimen: faiyaz50@student.sust.edu

Md Jamal Uddin: jamal-sta@sust.edu

ORCID iD:

Md Jamal Uddin: https://orcid.org/0000-0002-8360-3274

Abstract

Background: Household health expenditure is a major concern in Bangladesh because many medical costs are paid directly by families, especially where older members or chronically ill members are present. This study examines the association between ageing, chronic disease burden and household health expenditure using nationally representative Household Income and Expenditure Survey (HIES) 2022 data.

Methods: Household-level analysis was conducted using 14,395 households. The outcome was monthly household health expenditure constructed from the COICOP-based consumption-expenditure schedule, with annual illness/treatment-based health expenditure used for robustness. Elderly population share was measured as the proportion of members aged 60 years or above, and chronic disease burden share as the proportion reporting chronic illness or disability. Survey-weighted descriptive statistics, group comparisons and regression models were applied, adjusting for household income, household size, residence, household-head education and division.

Results: The constructed dataset closely reproduced official HIES 2022 benchmarks. Weighted mean monthly household health expenditure was Tk. 2,101.34 nationally, Tk. 1,896.25 in rural areas and Tk. 2,537.21 in urban areas. Mean elderly share was 11.25%, while mean chronic disease burden share was 31.38%. In the main survey-weighted log-linear model, chronic disease burden share was strongly associated with higher monthly health expenditure (coefficient = 2.725; 95% CI: 2.498 to 2.952; $p < 0.001$). Elderly share was positive but not statistically significant after adjustment (coefficient = 0.099; 95% CI: -0.117 to 0.315; $p = 0.370$). Households with both elderly and chronically ill members had the highest descriptive mean spending.

Conclusions: Chronic disease burden was the most consistent predictor of household health expenditure. Ageing remained relevant descriptively, but its independent association weakened after adjustment. The findings support stronger financial protection for repeated chronic-care costs, particularly medicines, diagnostics, consultations and follow-up care.

Contributions to the Literature

- Population ageing and long-term illness are often studied separately, even though they commonly overlap within families and can jointly shape healthcare costs.
- Using nationally representative HIES 2022 data, this study examines both pressures together in Bangladesh, where families pay much of the cost of healthcare directly.
- The study separates regular household health spending from illness- and treatment-based spending, showing the choice of measure matters when assessing financial pressure.
- It provides evidence for population-health policies focused on repeated chronic-care costs and households facing overlapping age, illness, income, and access disadvantages.

Keywords: Bangladesh; HIES 2022; household health expenditure; ageing; chronic disease burden; out-of-pocket expenditure; health financing.

Background

Background and rationale

In Bangladesh, household health expenditure remains a major concern because many medical costs are still paid directly by families. When public financing or insurance coverage is limited, even common illness can place pressure on household budgets. Earlier HIES-based evidence has associated out-of-pocket health expenditure with catastrophic expenditure and

impoverishment in Bangladesh [1]. Internationally, out-of-pocket payments are treated as an important indicator of weak financial protection in health systems [2], [3].

This problem is connected with both population ageing and shifting disease patterns. Older people often need regular consultations, medicines, tests, and follow-up care. Studies from low- and middle-income countries show that older adults face barriers in affordability, availability, and continuity of care [4], while regional evidence from India shows that older households can face high healthcare spending and catastrophic expenditure [5]. Chronic disease adds another layer because treatment is usually continuous rather than one-time. Evidence from low- and middle-income countries shows that families often respond to chronic illness costs by borrowing, using savings, selling assets, or cutting other expenditures [6]. Studies from China and end-of-life care settings also show that chronic illness and repeated treatment can increase household financial burden [7], [8].

Problem statement

Bangladesh has improved in several health and socioeconomic indicators, but financial protection in healthcare remains weak. Households still pay directly for many services, medicines, diagnostics, and treatment-related costs. Previous Bangladesh studies have shown that illness-related costs can lead households to borrow, delay treatment, or reduce other consumption [9]. The broader health-financing literature also identifies out-of-pocket payments as a barrier to universal health coverage [10], [11].

Bangladesh evidence is particularly clear for chronic disease. Rahman et al. reported that households with chronic illness face higher financial catastrophe and inequality [12]. Later HIES-based work also found continuing concern around financial risk protection in healthcare [13]. Sultana et al. showed that chronic illness and disability create a measurable out-of-pocket burden in Bangladesh [14]. Recent evidence using HIES 2016 and 2022 shows higher out-of-

pocket spending among households facing chronic and acute illness, with medicines playing an important role [15]. These findings suggest that household health expenditure is shaped by both health need and economic capacity.

Study gap

An important gap remains. Many Bangladesh studies focus on catastrophic health expenditure, impoverishment, or specific out-of-pocket payments. Less attention has been given to the combined role of household-level ageing and chronic disease burden in explaining total household health expenditure using the most recent HIES 2022 data. Ageing and chronic illness are also often studied separately, although in real households they may overlap.

This study addresses that gap by using the Household Income and Expenditure Survey 2022 [16] to examine how elderly population share and chronic disease burden share are associated with monthly household health expenditure.

The study also contributes by keeping two health-expenditure concepts separate. The main outcome follows the standard COICOP-based household consumption-expenditure schedule, while illness/treatment-based expenditure is used only for robustness. This separation is important because a standard expenditure measure and an illness-episode-based measure do not capture exactly the same concept.

The selection of controls is guided by prior Bangladesh and regional evidence. Rural-urban location, income, and household characteristics are known to influence health spending and the risk of financial burden [17], [18], [19]. Age and sex composition also affect healthcare expenditure in Bangladesh [20], and chronic disease risk is relevant for the country's continuing non-communicable disease burden [21]. International and regional studies from China, Iran, Tajikistan, India, Bangalore, Nepal, and urban Bangladesh further support the

inclusion of ageing, chronic illness, income, residence, and regional controls in the analysis [22], [23], [24], [25], [26], [27], [28], [29].

Objectives

The general objective of this study is to examine how ageing and chronic disease burden are associated with household health expenditure in Bangladesh using HIES 2022 data.

The specific objectives are to:

1. estimate the adjusted associations of elderly population share and chronic disease burden share with household health expenditure;
2. assess how household income, household size, residence, household-head education and division relate to household health expenditure;
3. compare household health expenditure across residence, income class, division and chronic-elderly household composition groups; and
4. assess whether the main findings remain stable under alternative health-expenditure measures, variable definitions and model specifications.

Methods

Data source and sample

This study used data from HIES 2022, conducted by the Bangladesh Bureau of Statistics. HIES 2022 is a nationally representative household survey that collected information on household composition, education, health, income, and expenditure. The survey was conducted from 1 January to 31 December 2022. The official target sample was 14,400 households selected from 720 primary sampling units, with 20 households selected from each primary sampling unit. The survey followed a two-stage stratified cluster design. In this study, the final household-level analytical sample contained 14,395 households.

Study design and unit of analysis

The study follows a quantitative cross-sectional design. The unit of analysis is the household. This is appropriate because the dependent variable is household-level health expenditure and the key explanatory variables are household-level ageing and chronic disease burden. Individual-level information from the roster, education, and health modules was combined to household level before the concluding analysis.

Data processing and variable construction

The household base file was used as the starting file because it contains one record per household and includes location, residence, household size, and weights. Other modules were cleaned, collapsed where necessary, and merged to the household base file. The common household identifiers used for merging were TERM, PSU, and HHID. For person-level modules, the member identification variable was standardized and then aggregated to household level before merging. This preserved the household-level design and avoided inappropriate many-to-many merges.

The household roster was used to construct household size and ageing variables. The education module was used to identify the education level of the household head. Illness and chronic-profile information was used to construct chronic disease burden and annual illness/treatment-based expenditure. The standard COICOP-based household consumption-expenditure schedule was used to construct the main monthly health expenditure variable. Income-related records were used to construct household income.

Study variables and operational definitions

The main outcome variable was monthly household health expenditure from the standard COICOP-based household consumption-expenditure schedule. Monthly health-related items were added directly, and annual health-related items were divided by 12 and added as a monthly

equivalent. The alternative outcome was annual illness/treatment-based health expenditure, constructed by annualizing 30-day outpatient and routine health spending and adding 12-month inpatient spending. This second measure was used for robustness only.

Elderly population share was calculated as the number of household members aged 60 years or above divided by total household size. Chronic disease burden share was calculated as the number of household members reporting chronic illness or disability divided by household size. The control variables were log monthly household income, household size, residence, household-head education, and division (Table 1).

Table 1. Operational definitions

Variable	Role	Operational definition
Monthly household health expenditure	Main dependent variable	Monthly COICOP-based health items plus annual COICOP-based health items divided by 12
Annual illness/treatment-based expenditure	Robustness dependent variable	12 x outpatient and routine 30-day spending plus 12-month inpatient expenditure
Elderly population share	Key independent variable	Members aged 60+ divided by total household members
Chronic disease burden share	Key independent variable	Members reporting chronic illness or disability divided by total household members
Monthly household income	Control	Reconstructed annual household income divided by 12; log form used in regression
Household size	Control	Number of household members
Residence	Control	Rural or urban
Household-head education	Control	Categorical education level of the household head
Division	Control	Eight administrative divisions

Note: The main outcome and the illness/treatment-based outcome were kept conceptually separate.

Statistical analysis and model specification

Descriptive statistics were calculated using household weights. Group differences were examined by residence, income class, division, and chronic-elderly household composition. Because health expenditure is highly right-skewed, the main regression used the natural logarithm of one plus monthly household health expenditure. Non-parametric tests and survey-weighted Wald tests were used as additional group-comparison checks.

The main regression model was specified as:

- $\ln(1+HHE_i) = \beta_0 + \beta_1 ElderlyShare_i + \beta_2 ChronicShare_i + \beta_3 \ln(1+Income_i) + \beta_4 HHsize_i + \beta_5 Urban_i + \Sigma\theta_\eta HeadEducation_{\eta i} + \Sigma\gamma_d Division_{di} + \varepsilon_i$

Here, HHE_i denotes monthly household health expenditure for household i. $ElderlyShare_i$ is the proportion of members aged 60 years or above, and $ChronicShare_i$ is the proportion of members with chronic illness or disability. Division fixed effects are included. The coefficients are interpreted as adjusted associations, not causal effects.

Robustness analysis used the annual illness/treatment-based expenditure outcome, alternative binary ageing and chronic-disease indicators, a positive-spender log-linear model, a two-part model for any positive spending, and a Gamma generalized linear model with log link among positive spenders. Model diagnostics involved checks for zero expenditure, multicollinearity, and functional form.

Software

Stata was used for all data cleaning, merging, variable creation, descriptive analysis, regression modelling, survey-weighted estimation, and diagnostic checks. Microsoft Excel was used only for making and formatting graphs from the analytical outputs.

Ethical considerations

This study used secondary, de-identified HIES 2022 survey data. No primary data were collected, and no direct contact was made with participants. The analysis used household-level records without identifying individual participants.

Results

Validation of the analysis dataset

The constructed household-level dataset closely matched the official HIES 2022 benchmarks. The weighted mean household size was 4.26 nationally, 4.30 in rural areas, and 4.18 in urban areas, the same as the official estimates after rounding. The weighted mean monthly household health expenditure was Tk. 2,101.34 nationally, Tk. 1,896.25 in rural areas, and Tk. 2,537.21 in urban areas, very close to the official COICOP health expenditure values of Tk. 2,115, Tk. 1,906, and Tk. 2,560, respectively. This supports the reliability of the constructed main outcome (Table 2).

Table 2. Benchmark validation

Indicator	Area	Study estimate	Official HIES 2022 value
Average household size	National	4.26	4.26
Average household size	Rural	4.30	4.30
Average household size	Urban	4.18	4.18
Monthly household income (Tk.)	National	32,112.38	32,422
Monthly household income (Tk.)	Rural	26,215.57	26,163
Monthly household income (Tk.)	Urban	44,644.21	45,757
Monthly household health expenditure (Tk.)	National	2,101.34	2,115
Monthly household health expenditure (Tk.)	Rural	1,896.25	1,906
Monthly household health expenditure (Tk.)	Urban	2,537.21	2,560

Note: Study estimates are survey-weighted. Official values are from the HIES 2022 final report.

Descriptive statistics of main variables

Table 3 presents the main descriptive statistics. The weighted mean monthly household health expenditure was Tk. 2,101.34. The weighted mean elderly population share was 0.1125, meaning that about 11.25% of household members were aged 60 years or above on average. The weighted mean chronic disease burden share was 0.3138. Around 8.01% of households had zero monthly health expenditure under the standard expenditure measure, and 8.14% had zero illness/treatment-based expenditure.

Table 3. Descriptive statistics

Variable	Obs.	Unweighted mean	Std. dev.	Min.	Max.	Survey-weighted mean
Monthly household health expenditure (Tk.)	14,395	2,050.28	4,027.33	0	125,165	2,101.34
Annual illness/treatment-based expenditure (Tk.)	14,395	38,867.99	78,385.04	0	1,909,200	39,800.91
Elderly population share (60+)	14,395	0.1117	0.2028	0	1	0.1125
Chronic disease burden share	14,395	0.3199	0.2832	0	1	0.3138
Monthly household income (Tk.)	14,395	30,400.23	67,964.07	-54,541.67	3,846,300	32,112.38
Household size	14,395	4.3353	1.7572	1	18	4.2586

Note: The negative minimum income reflects reconstructed income from contributing modules and is handled through the non-negative log-income version in regression.

Figure 1. Distribution of monthly household health expenditure

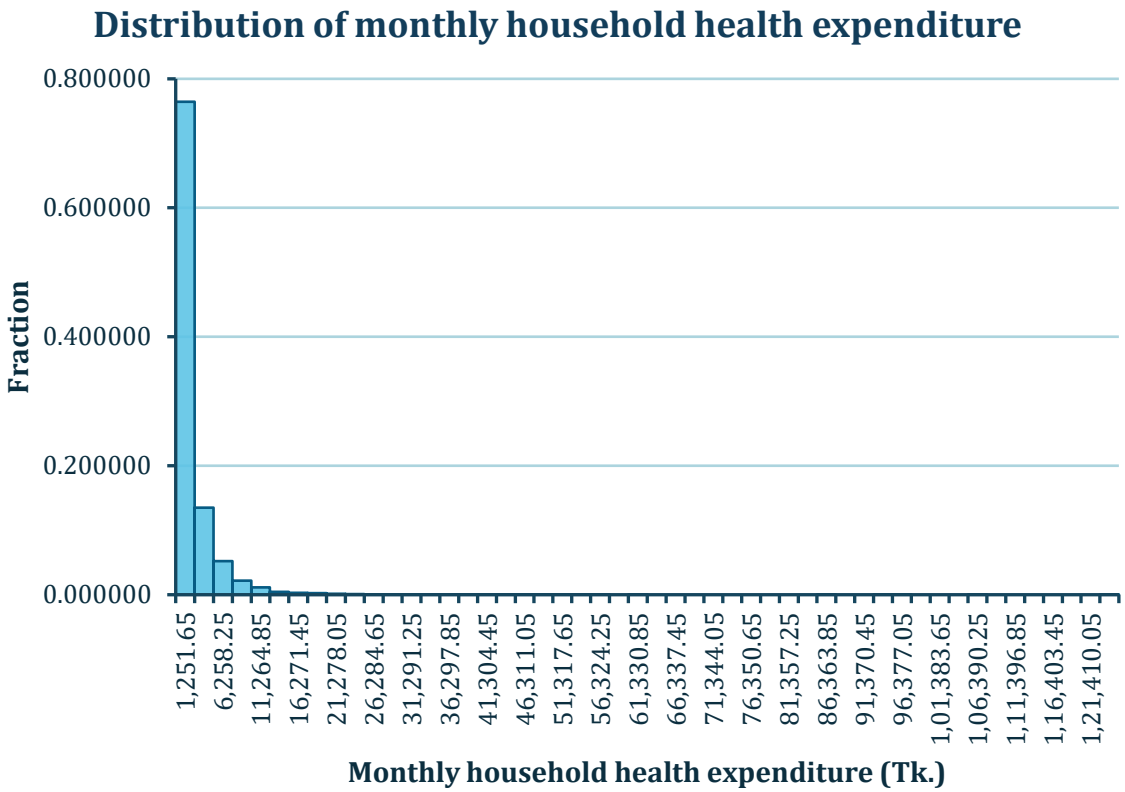


Figure 1. It shows that monthly household health expenditure is concentrated at lower values with a long right tail. This pattern is typical of health expenditure data, where many households spend a relatively small amount while a smaller number of households face very high expenses.

Figure 2. Distribution of log monthly household health expenditure

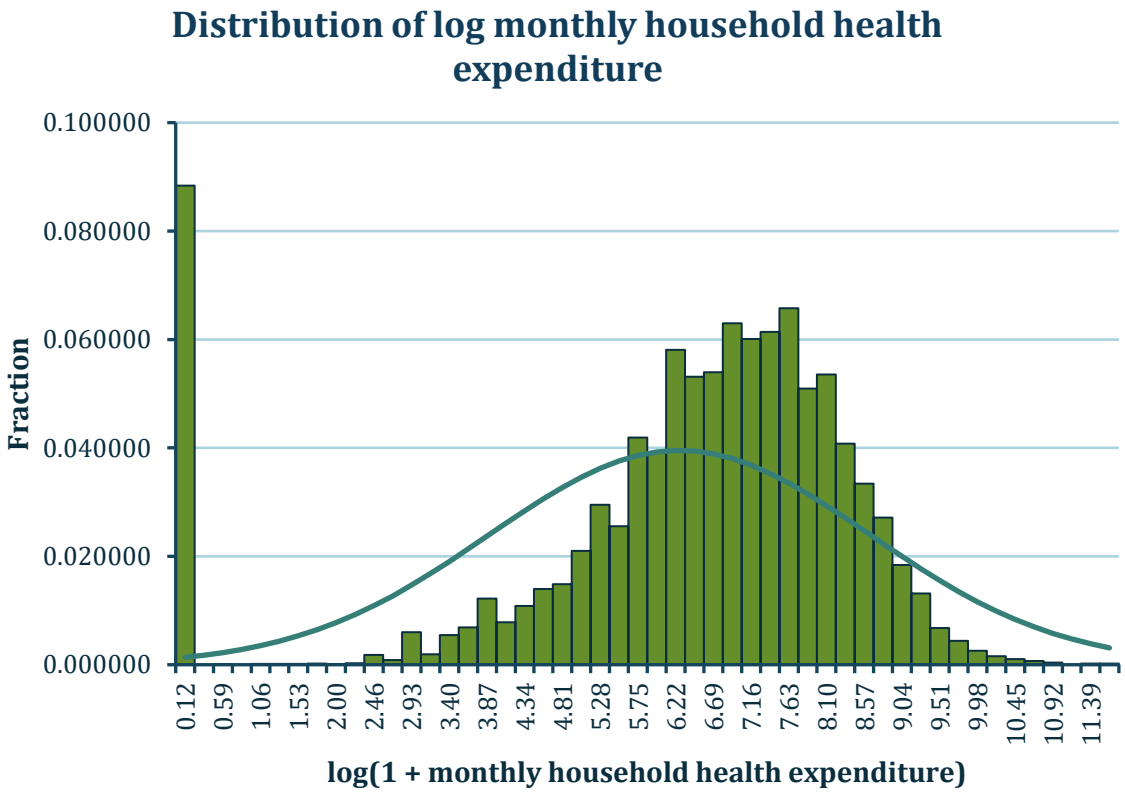
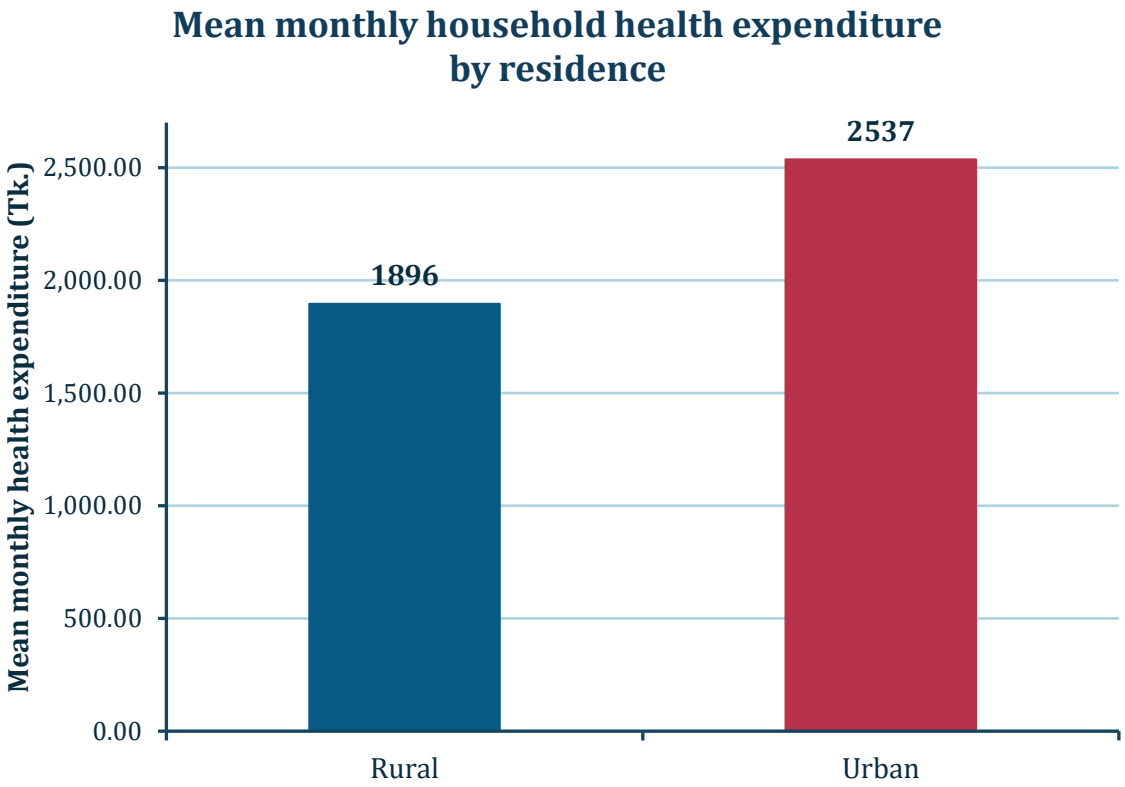


Figure 2. It shows that the log transformation makes the expenditure distribution more compact by reducing the influence of very high expenditure values, while retaining zero-spending households through ln(1 + expenditure).

Household health expenditure by residence, income class, and division

Mean monthly health expenditure was higher in urban households than in rural households. It also increased across income classes, especially in the highest income class. The income-residence pattern suggests that observed health spending reflects both need and ability to pay. Urban households may spend more because of greater access to private providers, diagnostics, and higher-cost services, while poorer households may spend less because they cannot always obtain care.

232 **Figure 3. Mean monthly household health expenditure by residence**



233

234 **Figure 3.** It shows that urban households had higher mean monthly household health

235 expenditure than rural households.

Figure 4. Mean monthly household health expenditure by income quartile and residence

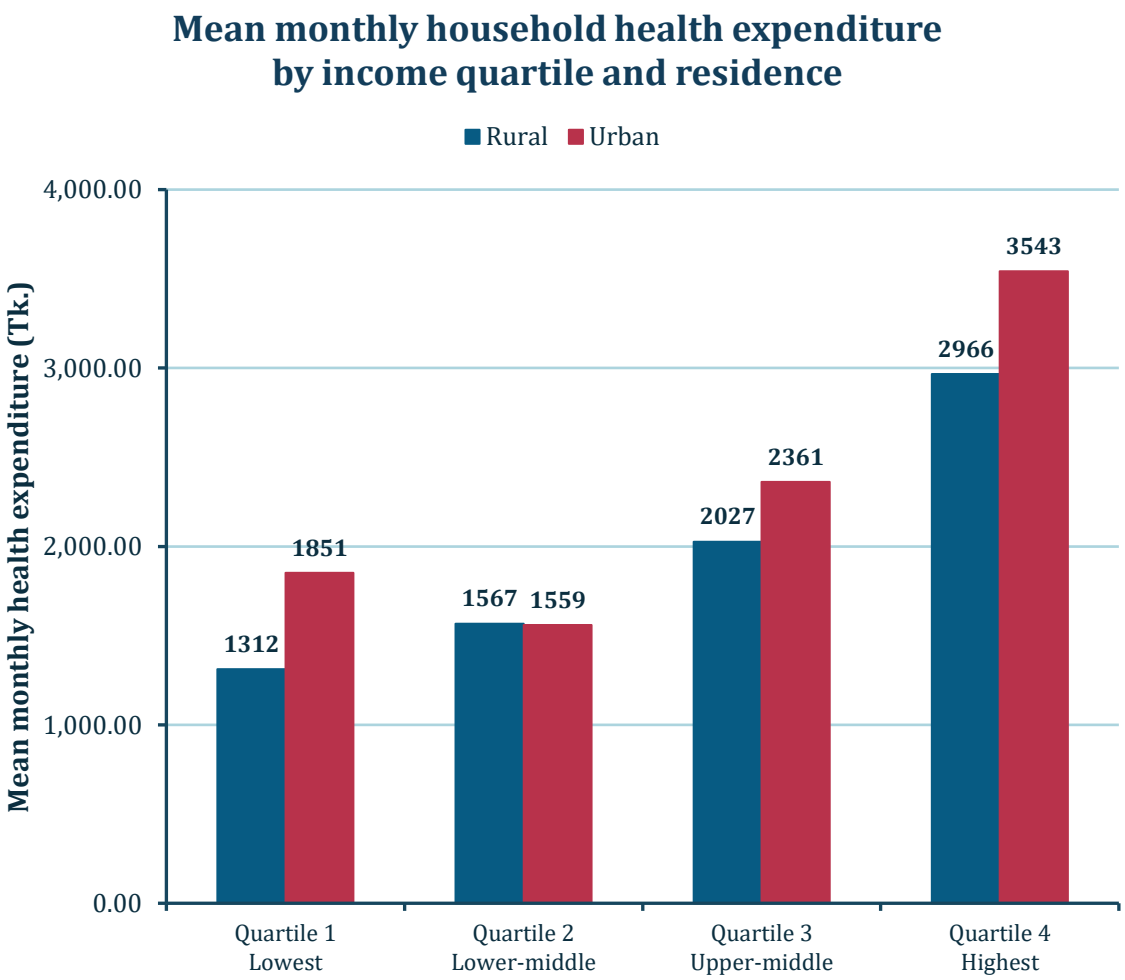


Figure 4. It shows that mean monthly household health expenditure generally rises across income quartiles in both rural and urban areas, with the highest spending in the highest income quartile.

There was also clear divisional variation. Dhaka and Chattogram had the highest mean monthly household health expenditure, while Rangpur had the lowest. These regional differences support the inclusion of division fixed effects in the regression model.

Figure 5. Mean monthly household health expenditure by division

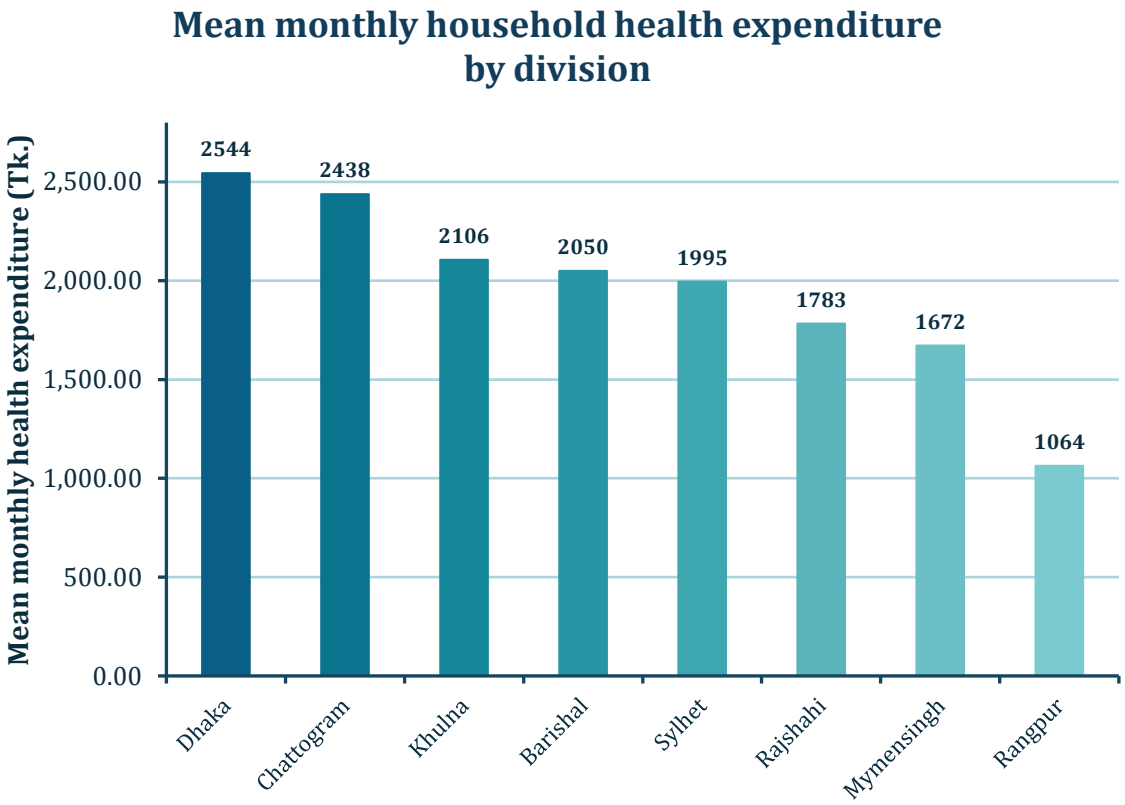


Figure 5. It shows divisional variation in mean monthly household health expenditure. Dhaka and Chattogram had the highest mean spending, while Rangpur had the lowest.

Chronic and elderly household composition

Households were also compared across three composition groups: chronic-only, elderly-only, and both chronic and elderly households. Chronic-only households had mean monthly spending of Tk. 2,232. Elderly-only households spent much less, at Tk. 966. Households with both chronic illness and elderly members had the highest mean monthly spending, Tk. 3,240. The overall test showed a clear difference across the three groups ($F(2, 703) = 74.08$; $p < 0.001$). All pairwise differences were statistically significant at $p < 0.001$ (Table 4).

Table 4. Household group comparison

Household group	Households in sample	Sample share	Estimated monthly spending	Comparison result
Chronic only	6,135	42.62%	Tk. 2,232	Reference group
Elderly only	689	4.79%	Tk. 966	Tk. 1,266 lower than chronic-only; $p < 0.001$
Both chronic + elderly	4,283	29.75%	Tk. 3,240	Tk. 1,008 higher than chronic-only; $p < 0.001$

Note: Both chronic + elderly households also spent Tk. 2,274 more than elderly-only households; $p < 0.001$.

Figure 6. Mean monthly household health expenditure by household group

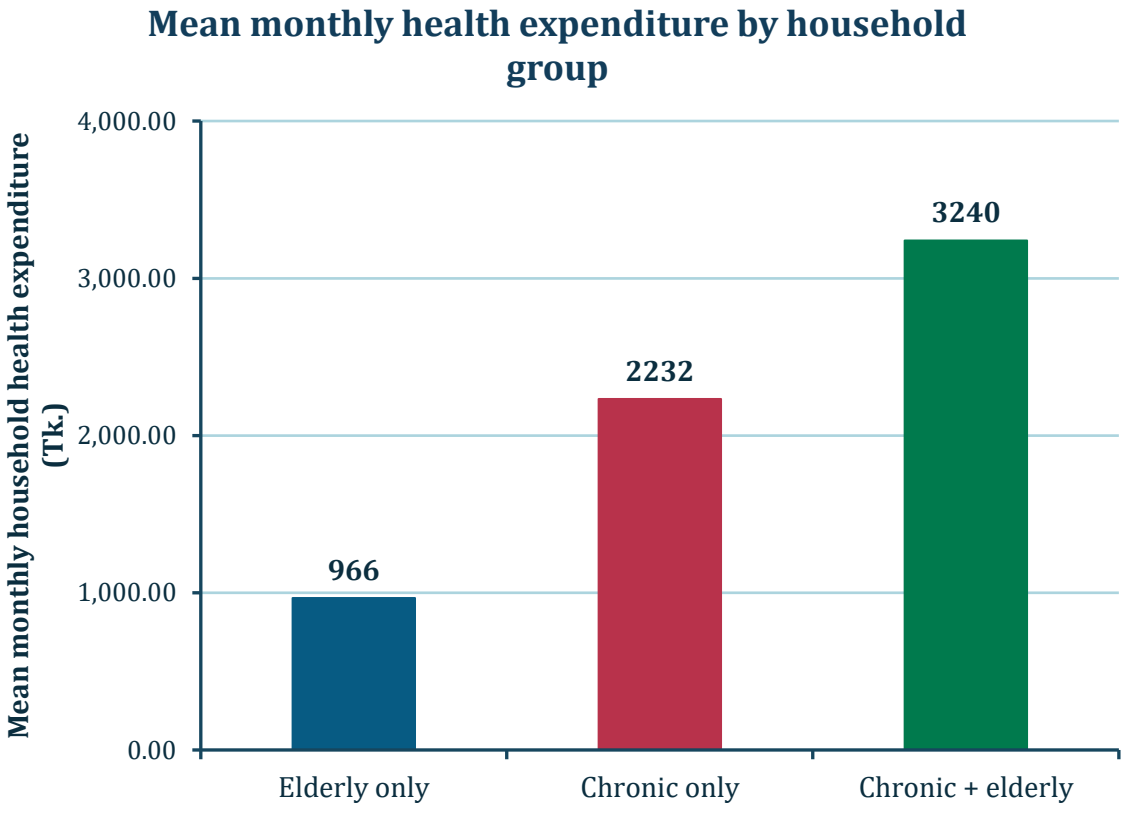


Figure 6. It shows that households with both chronic and elderly members had the highest mean monthly health expenditure, followed by chronic-only households, while elderly-only households had the lowest mean spending among the three comparison groups.

The bivariate relationship between chronic disease burden share and log monthly household health expenditure was positive. The fitted line in Figure 7 is not a substitute for the adjusted regression model, but it helps show why chronic disease burden is central to the analysis.

Figure 7. Chronic disease burden share and log monthly household health expenditure

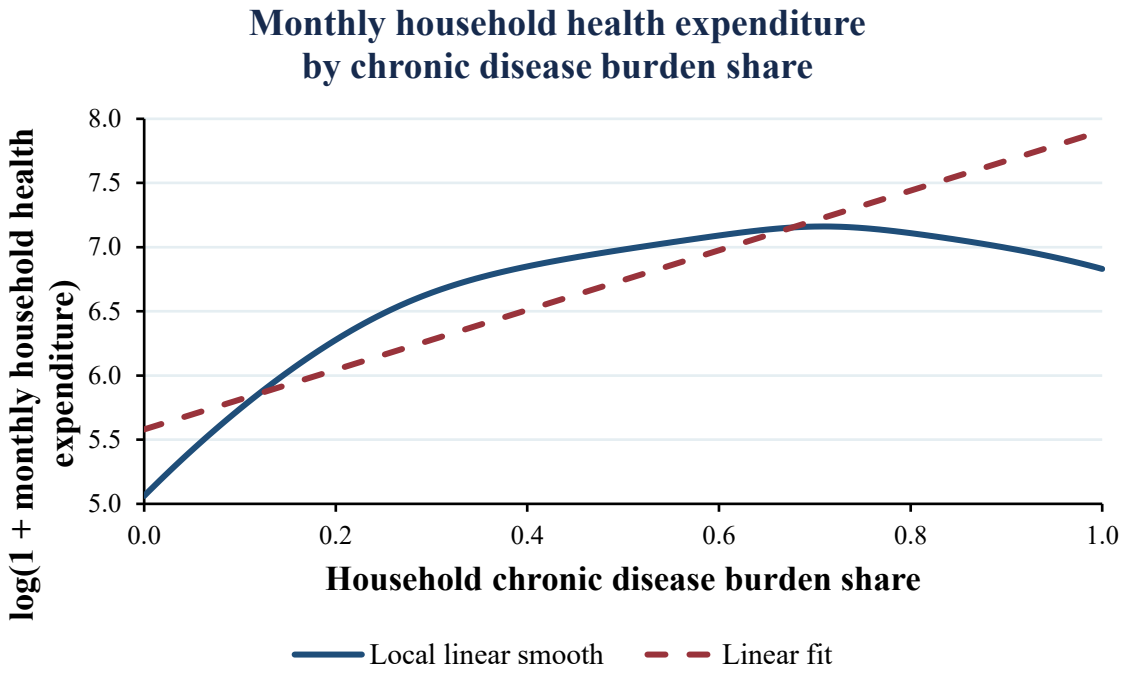


Figure 7. It shows a positive association between chronic disease burden share and log monthly household health expenditure. The solid line presents the weighted local linear smooth, and the dashed line presents the weighted linear fit.

Figure 8. Elderly population share and log monthly household health expenditure

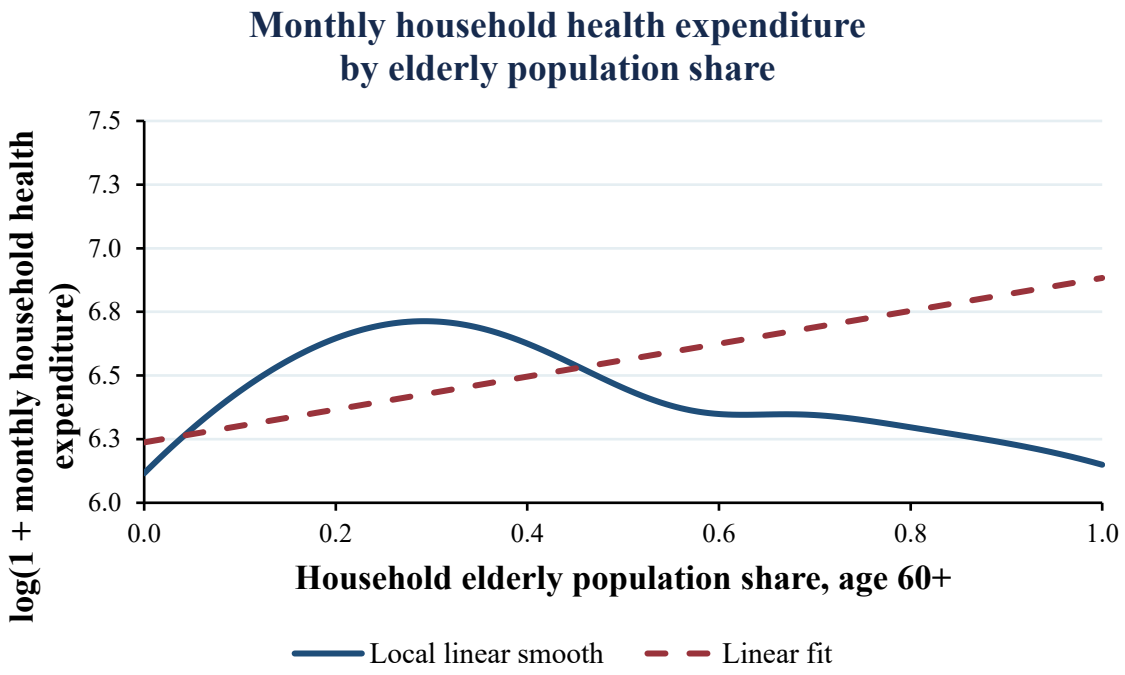


Figure 8. It shows the relationship between elderly population share and log monthly household health expenditure. The solid line presents the weighted local linear smooth, and the dashed line presents the overall weighted linear fit.

Main regression results

Table 5 reports the main survey-weighted log-linear regression model. The dependent variable is ln(1 + monthly household health expenditure). The main finding is that chronic disease burden share is strongly associated with higher household health expenditure. The coefficient of 2.725 means that a 0.10 increase in chronic disease burden share is associated with about 0.272 higher log-points in monthly household health expenditure, holding other variables constant.

Elderly population share was positive but not statistically significant in the main model. This indicates that, after chronic disease burden, income, household size, residence, education, and division are involved, the elderly share alone does not show a steady independent association

with the standard monthly spending outcome. Household income and household size were both positive and statistically significant. Urban residence was positive and marginally significant. Several household-head education categories and division indicators were also associated with expenditure.

Table 5. Main regression model

Variable	Coef.	SE	t	p-value	95% CI
Elderly population share (60+)	0.099	0.110	0.90	0.370	-0.117 to 0.315
Chronic disease burden share	2.725	0.116	23.59	<0.001	2.498 to 2.952
Log monthly household income	0.176	0.029	6.11	<0.001	0.120 to 0.233
Household size	0.273	0.014	19.32	<0.001	0.245 to 0.301
Urban residence	0.153	0.080	1.92	0.055	-0.003 to 0.309
Head education: Primary or below	0.205	0.064	3.23	0.001	0.080 to 0.330
Head education: Secondary	0.260	0.071	3.68	<0.001	0.121 to 0.398
Head education: Higher secondary	0.416	0.098	4.24	<0.001	0.223 to 0.608
Head education: Tertiary and above	0.529	0.102	5.20	<0.001	0.329 to 0.729
Head education: Other/unknown	-0.189	0.486	-0.39	0.698	-1.142 to 0.765
Division: Chattogram	0.494	0.164	3.02	0.003	0.172 to 0.815
Division: Dhaka	0.443	0.155	2.86	0.004	0.138 to 0.748
Division: Khulna	0.267	0.170	1.57	0.117	-0.067 to 0.600
Division: Mymensingh	-0.076	0.193	-0.39	0.694	-0.455 to 0.303
Division: Rajshahi	0.342	0.158	2.16	0.031	0.031 to 0.653
Division: Rangpur	-0.643	0.189	-3.40	0.001	-1.014 to -0.272
Division: Sylhet	0.121	0.194	0.63	0.532	-0.259 to 0.502
Constant	2.105	0.301	7.00	<0.001	1.514 to 2.695

Note: Reference categories: rural residence, no schooling for household-head education, and Barisal division. Design: survey-weighted regression with PSU, strata, and household weights.

Robustness and supplementary checks

The robustness checks support the central result. Chronic disease burden remained positive and statistically significant when the annual illness/treatment-based expenditure outcome was used, when chronic disease was measured as any chronic household, when only positive spenders were analyzed, and when a Gamma generalized linear model was estimated among positive-spending households. The ageing result was less stable: elderly share was not significant in the main model, but became significant in some positive-spender and alternative-indicator specifications (Table 6).

Table 6. Robustness checks

Model	Outcome/specification	Age variable/result	Chronic variable/result	Interpretation
Main model	Standard monthly health expenditure, log form	Elderly share: coef. 0.099; p = 0.370	Chronic share: coef. 2.725; p < 0.001	Preferred full-sample model
Robustness-1	Annual illness/treatment-based expenditure, log form	Elderly share: coef. -0.761; p < 0.001	Chronic share: coef. 5.431; p < 0.001	Confirms strong chronic-burden result under alternate expenditure concept
Robustness-2	Standard monthly outcome, log form	Elderly share: coef. 0.573; p < 0.001	Any chronic household: coef. 1.679; p < 0.001	Alternative chronic indicator
Robustness-3	Standard monthly outcome, log form	Any elderly household: coef. 0.162; p = 0.001	Chronic share: coef. 2.673; p < 0.001	Alternative ageing indicator
Positive-spender log model	Only households with positive standard monthly health spending	Elderly share: coef. 0.159; p = 0.027	Chronic share: coef. 1.843; p < 0.001	Conditional on positive spending
Gamma GLM	Positive standard monthly spending, log link	Elderly share: exp(b) 1.225; p = 0.025	Chronic share: exp(b) 5.001; p < 0.001	Supports conditional positive-expenditure result

Model	Outcome/specification	Age variable/result	Chronic variable/result	Interpretation
Two-part first stage	Probability of any positive standard monthly health spending	Elderly share: OR 0.888; p = 0.585	Chronic share: OR 12.021; p < 0.001	Chronic burden strongly predicts positive spending

Note: These models test sensitivity to expenditure concept, variable definition, and zero expenditure. They are supplementary, not replacements for the main model.

Diagnostic checks also supported cautious interpretation. The mean VIF was 1.45, indicating no serious multicollinearity. The link test suggested some functional-form concern, and the modified Park-type slope was 1.774 ($p < 0.001$), which supports reporting a Gamma-type positive-expenditure model as a supplementary specification. These checks do not change the main conclusion that chronic disease burden is the most consistent associate of health expenditure.

Discussion

The results show that household health expenditure in Bangladesh is most consistently associated with chronic disease burden. Ageing remains relevant, but the baseline model suggests that its independent association is weaker after chronic disease burden, income, household size, residence, education, and division are included. For this reason, the discussion identifies chronic disease burden as the main health-related predictor, while interpreting ageing as a relevant but more conditional household vulnerability.

The discussion is built on the results reported in the results section. It does not mention the associations as causal because the study uses cross-sectional household survey data. Instead, the findings are taken as controlled relationships between household characteristics and observed monthly household health expenditure.

Health expenditure measure and distribution

The benchmark validation supports the reliability of the main outcome. The constructed weighted mean monthly household health spending was very close to the official HIES 2022 values at national, rural, and urban levels. This is important because the main outcome is designed to represent the standard COICOP-based household expenditure concept, not only illness-episode expenses [16].

The distribution of monthly household health expenditure is concentrated at lower values with a long right tail. In addition, 8.01% of households reported zero monthly health expenditure under the standard measure. The use of ln(1 + monthly health expenditure) is therefore suitable for the main model because it keeps zero-spending households in the analysis and reduces the influence of very high expenditure values. The illness/treatment-based expenditure measure is kept as a robustness outcome because it captures a related but different spending concept.

Chronic disease burden as the main driver of health expenditure

The robust finding is the positive association between chronic disease burden share and monthly household health expenditure. In the main survey-weighted log-linear model, chronic disease burden share had a coefficient of 2.725 ($p < 0.001$). This means that a 0.10 increase in the household chronic disease burden share is associated with about 0.272 higher log-points in monthly COICOP-based household health expenditure, holding other variables constant.

This result is consistent with the nature of chronic disease. Long-term illness often requires regular medicines, diagnostic tests, routine consultation, monitoring, and follow-up care. These expenses are repetitive over time and can place steady pressure on household budgets. Earlier Bangladesh evidence associates chronic illness with financial catastrophe and inequality [12], and HIES-based evidence also documents the household burden of chronic illness and disability [14]. Recent HIES evidence additionally shows higher out-of-pocket costs among

households facing chronic and acute illness [15]. The present analysis adds to this evidence by using HIES 2022 and a COICOP-based total monthly household spending outcome.

Ageing and household health expenditure

The ageing result requires careful interpretation. Elderly population share was positive in the baseline model, but it was not statistically significant (coefficient = 0.099; p = 0.370). This does not mean that ageing is not important. Rather, it indicates that the independent association of elderly share became weaker when chronic disease burden and socioeconomic controls were included in the same model.

The accompanying models show that ageing is sensitive to measurement and model choice. The any-elderly household indicator is significant in one specification, and elderly share becomes significant among positive-spending households and in the Gamma model. This suggests that the expenditure association of ageing may be more evident among households that already report positive health spending, or when ageing is measured as the presence of an elderly member rather than as a household share.

This pattern is reasonable in the Bangladesh context. Older members may need more recurrent care, but some elderly households may also delay treatment or use fewer formal services because of inadequate resources. Part of the expenditure association of ageing may also operate through chronic disease, disability, and care-seeking. This interpretation is consistent with evidence that older people often face barriers in affordability, availability, and continuity of care [4], and that healthcare spending among older persons is closely connected with chronic illness and repetitive treatment needs [5], [7], [20].

Income, household size, residence, education, and division

Household income was positively associated with health expenditure in the main model. This should be understood as an association with observed spending, not as proof that wealthier

households are more vulnerable. Higher-income households may be more able to seek formal care, buy medicines, use diagnostics, and pay for private facilities. Lower observed spending among poorer households may partly reflect unmet need, delayed care, or constrained access.

Household size was also positive and statistically significant. Larger households contain more members who may need medicines, consultation, tests, or treatment. Therefore, total household health expenditure is likely to increase with household size.

Residence and division display that place of residence still matters. Urban households had higher descriptive mean spending, and urban residence was positive and marginally significant in the baseline model. This may reflect better service availability, more use of private services, and higher facility fees. At the same time, lower rural spending should not be understood as lower health need, because it may also reflect access barriers and lower ability to pay. Rural-urban differences in health-related financial risk have also been reported in Bangladesh [17].

Household-head education and division remained relevant in the adjusted model. Higher education categories generally showed higher expenditure, which may reflect better awareness and treatment-seeking. Divisional differences suggest that regional context, service availability, and local socioeconomic conditions continue to shape observed household health spending. This is consistent with earlier evidence that household characteristics and location influence out-of-pocket healthcare expenditure in Bangladesh [18].

Chronic-only, elderly-only, and combined chronic-elderly households

The comparison among chronic-only, elderly-only, and both chronic-and-elderly households adds an important descriptive layer to the regression results. Households with both chronic illness and elderly members had the highest mean monthly health expenditure (Tk. 3,240). Chronic-only households spent Tk. 2,232 on average, while elderly-only households spent Tk.

966. The overall difference across the three groups was statistically significant ($F(2, 703) = 74.08$; $p < 0.001$), and all pairwise differences were significant.

This pattern supports the main interpretation. Chronic disease burden is the stronger direct indicator of spending burden, but ageing becomes more important when it overlaps with chronic illness. The result also cautions against interpreting elderly-only spending as a complete measure of elderly need. Lower observed spending may reflect lower need in some households, but it may also reflect constrained access or forgone care.

Robustness and diagnostic interpretation

The robustness checks support the central finding. Chronic disease burden remained positive and statistically significant when the annual illness/treatment-based expenditure outcome was used, when chronic disease was measured as any chronic household, when only positive spenders were analyzed, and when the Gamma model was estimated among positive-spending households. In the two-part model, chronic disease burden was also strongly associated with the probability of reporting any positive health expenditure.

The ageing result was less stable. Elderly share was not significant in the full-sample baseline model, but it became significant in some positive-spender and alternative-indicator models. This difference is important because it shows that ageing is not irrelevant, but its expenditure association depends more on model specification than the chronic disease result does.

The diagnostic checks support cautious reporting. The mean VIF was 1.45, suggesting no serious multicollinearity. The link test indicated some functional-form concern, and the modified Park-type result supported reporting a Gamma-type positive-expenditure model as a supplementary specification. These diagnostics do not nullify the baseline result; rather, they justify presenting robustness checks together with the preferred COICOP-based model.

Comparison with previous evidence

The results are consistent with previous Bangladesh studies. Ahmed et al. identified older household members, chronic illness, private facility use, and geographical location as determinants of catastrophic expenditure and impoverishment [1]. Rahman et al. showed that chronic illness is associated with health-related financial catastrophe and inequality [12]. Khan et al. reported higher HIES 2022 out-of-pocket spending among households affected by chronic and acute illness [15]. The present study supports these findings, while using COICOP-based total monthly household health expenditure as the main continuous outcome.

The results also fit regional and international evidence. Studies from India, Nepal, China, Iran, and other settings show that ageing, chronic disease, and weak financial protection can increase household healthcare costs [5], [7], [22], [23], [24], [28]. The specific contribution of this HIES 2022 analysis is that chronic disease burden remains a more stable predictor than elderly population share when both are included with socioeconomic controls.

Policy implications

The results suggest that financial protection should give priority to households with chronic disease burden, especially where chronic illness overlaps with ageing. The main reason is that chronic disease is associated with repeated spending rather than a single episode of care. Support for long-term medicines, diagnostics, routine consultation, monitoring, and follow-up care may therefore be important for reducing steady household expenditure pressure.

The findings also suggest that age-based support alone may not be enough. Some households without elderly members may still face high chronic disease burden, while elderly-only households may show lower observed spending. A more focused approach would consider chronic disease burden, ageing, income, residence, and access conditions together.

Finally, the positive association between income and spending should be understood carefully. Higher spending among wealthy and urban households may reflect greater access and ability to pay. On the other hand, lower spending among poorer or rural households may partly reflect unmet need. Policies should therefore focus not only on reducing direct costs but also on improving access to affordable care.

Strengths and limitations

This study has several strengths. It uses the most recent HIES 2022 household data, keeps the unit of analysis at household level, validates the main expenditure variable against official benchmarks, separates the COICOP-based expenditure outcome from the illness/treatment-based outcome, and estimates ageing and chronic disease burden in the same model. These choices make the interpretation consistent with the research question.

The study also has limitations. The cross-sectional design does not allow causal interpretation. Chronic illness and disability are based on reported information and may be affected by recall bias. Observed health expenditure does not fully capture forgone care; a household may spend little because it has little need, but it may also spend little because it cannot afford care. The analysis does not include detailed disease severity, provider type, medicine composition, insurance coverage, coping strategy, or disease-specific expenditure. These limitations should be considered when understanding the size of the coefficients.

Overall, the discussion supports one central conclusion from the results: chronic disease burden is the most consistent health-related predictor of household health expenditure in Bangladesh. Ageing remains relevant, but its expenditure association is more conditional and partly connected with chronic illness, healthcare use, and household capacity to pay.

Conclusions

This study examined ageing, chronic disease burden, and household health expenditure in Bangladesh using HIES 2022 data. The analysis produced three main findings. First, the constructed household-level dataset closely matched official HIES 2022 benchmarks for household size, income, and monthly health expenditure, which supports the reliability of the main outcome measure. Second, chronic disease burden was the most consistent predictor of household health expenditure. In the main survey-weighted log-linear model, chronic disease burden share had a large positive association with monthly household health expenditure after adjustment for ageing, income, household size, residence, household-head education, and division. This result also remained strong in the illness/treatment-based expenditure model, the positive-spender model, the Gamma model, and the two-part spending model.

Third, ageing was important but more restricted. Elderly population share was positive but not statistically significant in the baseline model. However, descriptive and supplementary results show that ageing should not be ignored. Households with both elderly and chronically ill members had the highest mean monthly health expenditure, and alternative ageing measures became significant in some models. The most reasonable interpretation is that ageing affects household expenditure partly through chronic illness, disability, care-seeking, and the need for continuing treatment. Therefore, ageing and chronic disease burden should be understood together rather than as completely separate household risks.

The results also show that income, household size, education, residence, and division shape household health expenditure. Higher spending among better-off and urban households may indicate greater access and ability to pay, while lower observed spending among poorer or elderly-only households should not automatically be interpreted as lower need. It may also reflect unmet need or forgone care. For this reason, the study should be read as evidence on observed expenditure, not as a full measure of health need.

Overall, the evidence points to chronic disease burden as the clearest household-level signal for financial pressure from health spending in Bangladesh. Financial protection should therefore give more attention to recurring chronic-care costs, particularly medicines, diagnostics, routine consultations, and follow-up care. Households where chronic illness overlaps with ageing deserve special attention because they show the highest descriptive spending. Future research should examine disease-specific expenditure, medicine costs, coping strategies, and forgone care to better understand the full welfare effect of chronic illness and ageing in Bangladesh.

List of abbreviations

BBS: Bangladesh Bureau of Statistics; CI: confidence interval; COICOP: Classification of Individual Consumption According to Purpose; HHE: household health expenditure; HIES: Household Income and Expenditure Survey; LMIC: low- and middle-income country; NCD: non-communicable disease; OOP: out-of-pocket; PSU: primary sampling unit; UHC: universal health coverage; VIF: variance inflation factor.

Declarations

Ethics approval and consent to participate

This study used secondary, de-identified HIES 2022 data produced by the Bangladesh Bureau of Statistics. No primary data collection or direct participant contact was conducted for this manuscript. As the analysis was based on anonymized secondary data, separate informed consent from participants was not required for this study. The original survey data collection was conducted by the Bangladesh Bureau of Statistics.

Consent for publication

Not applicable.

Availability of data and materials

The datasets analysed during the current study were produced by the Bangladesh Bureau of Statistics and are available subject to its official data access procedures.

Competing interests

The authors declare that they have no competing interests.

Funding

No specific funding was received for this study.

Authors' contributions

FAM developed the study concept under the supervision of MJU. MJU obtained access to the HIES 2022 dataset from the Bangladesh Bureau of Statistics through its official data access procedures and provided overall academic and methodological guidance. FAM prepared the dataset for analysis, conducted the statistical analysis, interpreted the findings, and drafted the initial manuscript. MJU guided the study design, analytical approach, interpretation of results, and manuscript development, and critically revised the manuscript for important intellectual content. Both authors read and approved the final manuscript.

Acknowledgements

The authors acknowledge the Bangladesh Bureau of Statistics for conducting the Household Income and Expenditure Survey 2022 and for making the survey data available through official data access procedures. The authors alone are responsible for the analysis, interpretation, and conclusions presented in this manuscript.

References

1. Ahmed S, Ahmed MW, Hasan MZ, Mehdi GG, Islam Z, Rehnberg C, et al. Assessing the incidence of catastrophic health expenditure and impoverishment from out-of-

pocket payments and their determinants in Bangladesh: evidence from the nationwide Household Income and Expenditure Survey 2016. Int Health. 2022;14(1):84-96. doi:10.1093/inthealth/ihab015.

2. World Health Organization. Out-of-pocket expenditure as percentage of current health expenditure (CHE) (%). Global Health Observatory. https://www.who.int/data/gho/data/indicators/indicator-details/GHO/out-of-pocket-expenditure-as-percentage-of-current-health-expenditure-%28che%29-%28-%29. Accessed 26 Mar 2026.
3. Wagstaff A, van Doorslaer E. Catastrophe and impoverishment in paying for health care: with applications to Vietnam 1993-1998. Health Econ. 2003;12(11):921-34. doi:10.1002/hec.776.
4. Dableh S, Frazer K, Stokes D, Kroll T. Access of older people to primary health care in low and middle-income countries: a systematic scoping review. PLoS One. 2024;19(4):e0298973. doi:10.1371/journal.pone.0298973.
5. Ahmad F, Mohanty PC. Incidence and intensity of catastrophic health expenditure and impoverishment among the elderly: an empirical evidence from India. Sci Rep. 2024;14:15908. doi:10.1038/s41598-024-55142-1.
6. Murphy A, McGowan C, McKee M, Suhrcke M, Hanson K. Coping with healthcare costs for chronic illness in low-income and middle-income countries: a systematic literature review. BMJ Glob Health. 2019;4(4):e001475. doi:10.1136/bmjgh-2019-001475.
7. Xu X, Huang X, Zhang X, Chen L. Family economic burden of elderly chronic diseases: evidence from China. Healthcare. 2019;7(3):99. doi:10.3390/healthcare7030099.

8. Reid E, Ghoshal A, Khalil A, Jiang J, Normand C, Brackett A, et al. Out-of-pocket costs near end of life in low- and middle-income countries: a systematic review. PLoS Glob Public Health. 2022;2(1):e0000005. doi:10.1371/journal.pgph.0000005.
9. Rahman MM, Gilmour S, Saito E, Sultana P, Shibuya K. Self-reported illness and household strategies for coping with health-care payments in Bangladesh. Bull World Health Organ. 2013;91(6):449-58. doi:10.2471/BLT.12.115428.
10. World Health Organization, World Bank. Tracking universal health coverage: 2023 global monitoring report. Geneva: World Health Organization; 2023. https://www.who.int/publications/i/item/9789240080379.
11. Molla AA, Chi C. Who pays for healthcare in Bangladesh? An analysis of progressivity in health systems financing. Int J Equity Health. 2017;16:167. doi:10.1186/s12939-017-0654-3.
12. Rahman MM, Gilmour S, Saito E, Sultana P, Shibuya K. Health-related financial catastrophe, inequality and chronic illness in Bangladesh. PLoS One. 2013;8(2):e56873. doi:10.1371/journal.pone.0056873.
13. Rahman T, Gasbarro D, Alam K. Financial risk protection in health care in Bangladesh in the era of Universal Health Coverage. PLoS One. 2022;17(6):e0269113. doi:10.1371/journal.pone.0269113.
14. Sultana M, Mahumud RA, Sarker AR. Burden of chronic illness and associated disabilities in Bangladesh: evidence from the Household Income and Expenditure Survey. Chronic Dis Transl Med. 2017;3(2):112-22. doi:10.1016/j.cdtm.2017.02.001.
15. Khan JJ, Sehrin F, Quayyum Z, Sarker AR, Rahman MS. Factors affecting out-of-pocket expenditures for chronic and acute illnesses in Bangladesh. PLoS One. 2025;20(4):e0320429. doi:10.1371/journal.pone.0320429.

16. Bangladesh Bureau of Statistics. Household Income and Expenditure Survey (HIES) 2022: final report. Dhaka: Statistics and Informatics Division, Ministry of Planning, Government of Bangladesh; 2023.
17. Rahman T, Gasbarro D, Alam K. Rural-urban disparities in household catastrophic health expenditure in Bangladesh: a multivariate decomposition analysis. Int J Equity Health. 2024;23:43. doi:10.1186/s12939-024-02125-3.
18. Molla AA, Chi C, Nunez Mondaca AL. Predictors of high out-of-pocket healthcare expenditure: an analysis using Bangladesh Household Income and Expenditure Survey, 2010. BMC Health Serv Res. 2017;17:94. doi:10.1186/s12913-017-2047-0.
19. Rahman MM, Islam MR, Rahman MS, Hossain F, Alam A, Rahman MO, et al. Forgone healthcare and financial burden due to out-of-pocket payments in Bangladesh: a multilevel analysis. Health Econ Rev. 2022;12:5. doi:10.1186/s13561-021-00348-6.
20. Sarker AR, Mahumud RA, Sultana M, Ahmed S, Ahmed W, Khan JAM. The impact of age and sex on healthcare expenditure of households in Bangladesh. SpringerPlus. 2014;3:435. doi:10.1186/2193-1801-3-435.
21. World Health Organization. 2018 National STEPS Survey for Non-communicable Diseases Risk Factors in Bangladesh. Dhaka: WHO Bangladesh; 2022. https://www.who.int/bangladesh/about-us/publications/m/item/2018-national-steps-survey-for-non-communicable-diseases-risk-factors-in-bangladesh.
22. Du J, Yang X, Chen M, Wang Z. Socioeconomic determinants of out-of-pocket pharmaceutical expenditure among middle-aged and elderly adults based on the China Health and Retirement Longitudinal Survey. BMJ Open. 2019;9(7):e024936. doi:10.1136/bmjopen-2018-024936.

604 23. Zhai X, Zhang Q, Li X, Zhao X. Association between multimorbidity patterns and
605 catastrophic health expenditure among Chinese older adults living alone. Arch
606 Gerontol Geriatr. 2023;106:104892. doi:10.1016/j.archger.2022.104892.
607 24. Meshkat SAM, Kassaeian SS, Danaei N, Gharibi F. Households catastrophic health
608 expenditure among older people with noncommunicable diseases: a cross-sectional
609 study from Iran. Health Sci Rep. 2024;7(3):e1992. doi:10.1002/hsr2.1992.
610 25. Fischer FB, Mengliboeva Z, Karimova G, Abdujabarov N, Prytherch H, Wyss K. Out
611 of pocket expenditures of patients with a chronic condition consulting a primary care
612 provider in Tajikistan: a cross-sectional household survey. BMC Health Serv Res.
613 2020;20:546. doi:10.1186/s12913-020-05392-2.
614 26. Pandey A, Ploubidis GB, Clarke L, Dandona L. Trends in catastrophic health
615 expenditure in India: 1993 to 2014. Bull World Health Organ. 2018;96(1):18-28.
616 doi:10.2471/BLT.17.191759.
617 27. Swetha NB, Shobha S, Sriram S. Prevalence of catastrophic health expenditure and its
618 associated factors, due to out-of-pocket health care expenses among households with
619 and without chronic illness in Bangalore, India: a longitudinal study. J Prev Med Hyg.
620 2020;61(1):E92-E97. doi:10.15167/2421-4248/jpmh2020.61.1.1191.
621 28. Rai S, Gautam S, Yadav GK, Niraula SR, Singh SB, Rai R, et al. Catastrophic health
622 expenditure on chronic non-communicable diseases among elder population: a cross-
623 sectional study from a sub-metropolitan city of Eastern Nepal. PLoS One.
624 2022;17(12):e0279212. doi:10.1371/journal.pone.0279212.
625 29. Rahman MM, Zhang C, Swe KT, Rahman MS, Islam MR, Kamrujjaman M, et al.
626 Disease-specific out-of-pocket healthcare expenditure in urban Bangladesh: a
627 Bayesian analysis. PLoS One. 2020;15(1):e0227565.
628 doi:10.1371/journal.pone.0227565.