

Article

Intra-provincial household income inequality: Demographic vulnerability, health burden, and locational disadvantage in Binh Dinh Province, Vietnam

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Abstract: This study examines how household demographic vulnerability, health burden, human capital, and locational disadvantage are associated with monthly per capita household income in Binh Dinh Province, Central Vietnam. Using cross-sectional survey data collected in 2025 from 320 households nested within 12 communes/wards across six district-level units, the study estimates linear mixed-effects models with a random intercept at the commune/ward level to account for within-locality clustering. The results show that household income differences are associated with both household-level characteristics and local context. Household size exhibits a concave association with per capita income, while higher elderly and female shares, severe or chronic illness burden, and ethnic-minority status are negatively associated with income. By contrast, the household head's age and educational attainment are positively associated with income. Urban residence and residence in the western midland–mountain area are not statistically significant after accounting for commune/ward-level clustering, whereas greater distance from Quy Nhon is negatively associated with income. Sensitivity analyses using total household income, categorical education levels, and female household headship support the robustness of the household-size pattern, education association, and female-share result while underscoring the need for cautious interpretation of locational associations. The findings suggest that household income disadvantage is linked not only to demographic dependency and health burden but also to unequal human-capital resources and accessibility. These patterns have implications for place-sensitive human-resource development, skills support, and livelihood policies in territorially differentiated regions.

Keywords: household income inequality; household income; demographic vulnerability; health burden; ethnic minority; locational disadvantage; Binh Dinh Province; Central Vietnam

1. Introduction

Household income is a core indicator of living standards, livelihood capacity, and access to essential resources (Ravallion, 2016). In economies undergoing structural transformation, income disparities are shaped not only by household demographic characteristics and resource endowments, but also by inequalities that are produced and reproduced across space (Almeida et al., 2024; Ferreira & Gignoux, 2011; Kanbur & Venables, 2005; OECD, 2023). In Vietnam, industrialization, urbanization, and economic restructuring over recent decades have generated substantial economic growth, while simultaneously accentuating disparities across regions, between urban and rural areas, and among population groups with unequal access to markets, infrastructure, and public services (Benjamin, Brandt, & McCaig, 2017; Ha, Le, & Trung-Kien, 2019; OECD, 2025; World Bank, 2022). In this context, the analysis of per capita household income needs to be situated within the combined

influence of household-level characteristics and the territorial settings in which households are embedded.

From a household-economics perspective, household size and composition may affect income through multiple mechanisms. On the one hand, larger households may benefit from shared fixed costs, greater internal labor mobilization, and more diversified income sources. On the other hand, when dependency burdens increase, particularly through a higher share of children or older adults, per capita income may decline because of resource dilution and caregiving pressures (Xu, Wang, & Li, 2022). In addition, gender composition, educational attainment, the age of the household head, ethnic status, and health shocks all shape the household's income-generating capacity, resilience, and ability to adapt. Chronic illness and severe health shocks may further weaken household welfare by reducing labor supply, increasing care demands, and raising out-of-pocket expenditure burdens (Han, Nan, Yang, Zang, & Xue, 2024; Okediji et al., 2017). These relationships, however, are not universal; rather, they are strongly conditioned by spatial context, livelihood opportunities, and the degree of territorial connectivity in particular localities (Almeida et al., 2024; Iammarino, Rodriguez-Pose, & Storper, 2019; OECD, 2023).

This context dependence is especially important in provinces characterized by pronounced territorial differentiation. Binh Dinh provides an informative case in the South-Central Coast of Vietnam, where contrasts coexist between urban and rural areas, between the eastern coastal plain and the western midland–mountain zone, and among livelihood spaces linked to industry and services, agriculture, and forestry. These differences reflect not only natural and geographical conditions, but also the uneven distribution of infrastructure, labor-market opportunities, public services, accessibility to provincial growth centers, and the concentration of ethnic-minority populations. Earlier work on Vietnam has long shown that poverty and inequality are spatially structured and closely associated with topography, remoteness, and market accessibility (Minot & Baulch, 2005; Minot, Baulch, & Epprecht, 2006). More recent studies in and around Central Vietnam further suggest that territorial disadvantage is mediated by land tenure security, settlement stability, migration opportunities, and unequal access to infrastructure and services (Hien, Hai, Thanh, & Ngu, 2026; Nhat, Phuong, & Ngu, 2025). Research on ethnic minority communities in Central Vietnam likewise indicates that income poverty and multidimensional deprivation are closely tied to livelihood constraints, exposure to shocks, and limited access to markets and roads (D. T. Nguyen et al., 2023).

Although a substantial body of research has examined the determinants of household income, much of the existing literature either focuses on the national scale or considers demographic, health, and spatial factors separately. For Vietnam in general, and Binh Dinh in particular, rigorous quantitative evidence on the relationship between household demographic composition, health burden, and intra-provincial spatial disadvantage remains limited. Existing studies have shown that income inequality in Vietnam varies by ethnic status, urban–rural location, and access to wage labor opportunities (C. V. Nguyen & Tarp, 2024), while spatial poverty mapping has underscored the importance of geographic targeting and place-specific constraints (Benjamin et al., 2017; Minot & Baulch, 2005; Minot et al., 2006; World Bank, 2022). Yet there remains a lack of studies that ask not only which households are more vulnerable in income terms, but also how such forms of disadvantage are shaped across different territorial subregions within the same province. The key geographical gap is therefore not simply the lack of household-income studies, but

the limited understanding of how household-level vulnerabilities are territorially embedded within differentiated provincial opportunity structures (Almeida et al., 2024; OECD, 2023; Rodríguez-Pose, 2018).

Against this background, this study examines the associations between household demographic structure, human capital, health burden, and locational context and monthly per capita household income in Binh Dinh Province in 2025. The analysis is based on a cross-sectional survey of 320 households sampled from administrative units representing the province's major territorial spaces. Recognizing that households are nested within 12 sampled communes/wards, the study employs a linear mixed-effects model with a commune/ward-level random intercept to account for within-locality clustering. The study tests for the possible nonlinear association of household size while also examining the roles of the elderly share, child share, female share, household-head characteristics, ethnic-minority status, severe or chronic illness burden, and indicators of locational disadvantage, including mountain residence, urban residence, and distance to the provincial center. These household characteristics are also relevant to regional human-resource conditions because demographic dependency, educational attainment, health limitations, and accessibility may influence households' capacity to participate in labor markets, develop skills, and sustain income-generating activities. However, because employment participation, training access, and organizational human-resource practices are not directly measured, these workforce-related implications are treated as contextual interpretations rather than directly estimated relationships.

This study makes three contributions at the intersection of household welfare, spatial inequality, and regional human-resource development. First, it shifts the analysis of household income from a general urban–rural framing to an intra-provincial locational perspective, examining whether income differences remain associated with ethnicity, accessibility, and broader territorial location after commune/ward-level clustering is taken into account. Second, it integrates demographic structure, human capital, health burden, and social and locational context within a unified empirical framework, allowing household-level vulnerabilities to be interpreted as territorially embedded rather than purely individual or demographic characteristics. From a human-resource perspective, this integration is particularly relevant because education represents a key household human-capital resource, while aging, illness, and demographic composition may constrain the availability and productive capacity of household labor. Third, it provides updated micro-level evidence from a territorially differentiated province in Central Vietnam, where the contrast between the eastern coastal/plain zone and the western midland–mountain zone offers a useful setting for examining how social and health-related vulnerability intersects with locational disadvantage. The findings therefore provide an evidence base for considering place-sensitive approaches to skills development, employability support, health-related labor constraints, and regional human-resource development, while avoiding assumptions about workforce mechanisms that are not directly observed in the survey.

2. Literature review

2.1. Theoretical framework

Household income can be understood as the outcome of an interaction between household capabilities (Browning, Chiappori, & Weiss, 2014) and the territorial conditions within which livelihoods are pursued. In this study, the analysis is guided

by four complementary perspectives: the human capital perspective, the dependency-burden and resource-dilution perspective, the health-shock vulnerability perspective, and the spatial inequality perspective. Together, these perspectives explain how household resources and vulnerabilities interact with unequal access to employment, services, and infrastructure across places (Almeida et al., 2024; OECD, 2023).

First, the human capital perspective originates in the classical view that education and skills are productive investments that raise earnings and economic performance (Becker, 1994). At the household level, the education of the household head may capture productive knowledge, access to information, and the capacity to mobilize labor and other resources, while age may reflect accumulated experience and social networks. These attributes are also relevant to skills, employability, and households' capacity to participate in income-generating activities (Siri & Combary, 2025). Accordingly, the household head's education and age are treated as indicators of embodied human capital expected to be positively associated with per capita household income (Becker, 1994; Siri & Combary, 2025).

Second, the dependency-burden and resource-dilution perspective begins from the long-standing idea that household welfare depends not only on total resources, but also on how those resources are shared across members (Becker, 1991; Lanjouw & Ravallion, 1995). Household size may have nonlinear economic implications: larger households can benefit from pooled labor, risk sharing, and economies of scale (Deaton & Paxson, 1998), but these advantages may weaken as dependency burdens increase and place greater pressure on working members (Xu et al., 2022). Household size, elderly share, and child share are therefore used to capture demographic pressures that may affect per capita income through the balance between productive labor and dependency demands (Becker, 1991; Xu et al., 2022).

Third, the health-shock vulnerability perspective is rooted in the classical view that health is a productive asset that affects the amount of healthy time available for work and daily functioning (Grossman, 1972). Severe or chronic illness can reduce labor supply and earnings capacity while increasing caregiving and medical expenditure burdens (Mitra, Palmer, Mont, & Groce, 2016; Wagstaff, 2007). The number of household members with severe or chronic illness is therefore treated as an indicator of livelihood and labor-related vulnerability expected to be negatively associated with per capita household income (Grossman, 1972; Han et al., 2024).

Fourth, the spatial inequality perspective starts from the established understanding that economic outcomes are shaped by geography as well as by household attributes (Minot et al., 2006). Unequal access to jobs, services, education, infrastructure, and growth centers may generate locational differences in household opportunities (Almeida et al., 2024; OECD, 2023). In Binh Dinh, urban residence, midland–mountain location, and distance to the provincial center are therefore treated as indicators of locational context rather than as direct measures of spatial effects. Place-based studies from Central Vietnam similarly show that land tenure, settlement stability, and migration opportunities are embedded in territorial conditions that shape household livelihood options (Hien et al., 2026; Nhat et al., 2025).

Taken together, the four perspectives suggest that household income reflects the combined influence of human capital, demographic dependency, health vulnerability, and locational context. They also provide a basis for considering how these factors may affect household labor capacity and access to economic opportunities without assuming workforce mechanisms that are not directly measured (Almeida et al., 2024; OECD, 2023).

2.2. Research status on household demographic structure, health burden, and per capita household income

Recent empirical research indicates that per capita household income is shaped by the combined effects of demographic structure, human capital, health-related vulnerability, and spatial context rather than by any single factor in isolation (Tran, Tsuji, & Fujimura, 2024). Household size may generate both additional labor capacity and additional dependency demands, which helps explain why its association with welfare is not necessarily linear. Recent research therefore increasingly emphasizes household dependency structure, particularly old-age dependency, alongside household size (Du & Mohd, 2024; Xu et al., 2022). Evidence from China further shows that dependency burdens are associated with expenditure pressure and vary across territorial contexts (Xu et al., 2022), while population aging may alter household saving behavior and economic flexibility differently across urban and rural settings (Du & Mohd, 2024).

Human capital remains one of the most consistently identified positive correlates of household income. Household-level evidence indicates that education strengthens productive capacity and the ability to convert available resources into income (Siri & Combary, 2025). This is particularly relevant from a human-resource perspective because education and skills influence access to occupations, earnings opportunities, and labor-market mobility. Evidence from Vietnam similarly links labor-market outcomes to occupational positioning and earnings opportunities (Chowdhury, Johnson, Mannava, & Perova, 2019).

Health-related vulnerability constitutes another important mechanism. Chronic illness and health shocks can reduce labor time and earnings while increasing caregiving and out-of-pocket medical expenditures (Thuong, 2021). Evidence further shows that chronic disease can constrain household consumption (Han et al., 2024), while catastrophic health expenditure remains a major source of financial stress among vulnerable households (Atake, 2018; Eze, Lawani, Agu, & Acharya, 2022). These findings indicate that health burden may affect household welfare partly through reduced productive capacity and greater resource pressure.

The literature also highlights gender and ethnicity. In Vietnam, women earn less than men on average, with part of the gap associated with occupational sorting and unequal labor-market participation (Chowdhury et al., 2019). Comparative evidence also shows that gender composition interacts with household structure and economies of scale in shaping welfare outcomes (Brown & Van de Walle, 2021). However, household gender composition does not by itself identify the mechanisms underlying income differences, which may also reflect employment, migration, headship, caregiving, or age structure.

Ethnic inequality remains another major axis of household economic differentiation (Imai, Gaiha, & Kang, 2011; T. Pham, 2022). The 2022 Vietnam Poverty and Equity Assessment shows that poverty and vulnerability are increasingly concentrated among ethnic minorities and geographically disadvantaged populations, especially in remote and mountainous areas where access to productive employment, quality services, and economic mobility remains constrained (World Bank, 2022). Evidence from mountainous ethnic-minority communities in Central Vietnam likewise links deprivation to restricted livelihood opportunities, infrastructure deficits, and territorial disadvantage (D. T. Nguyen et al., 2023).

Finally, spatial research shows that income and well-being remain territorially differentiated because access to jobs, services, education, and infrastructure is uneven

(Almeida et al., 2024; OECD, 2023). Earlier work on Vietnam identified higher poverty in remote highland areas and lower poverty in major urban and better-connected areas (Minot & Baulch, 2005). More recent Central Vietnamese studies similarly show that livelihood opportunities are embedded in place-specific conditions related to migration, land tenure, and settlement stability (Hien et al., 2026; Nhat et al., 2025). These findings support examining household demographic and health characteristics together with locational indicators, while distinguishing household-level associations from broader contextual spatial effects.

Overall, the literature points to an integrated relationship among demographic composition, human capital, health burden, gender and ethnic inequality, and territorial context. Yet these dimensions are often examined separately or at broader geographical scales, leaving limited evidence on how they jointly relate to household income within territorially diverse provinces.

2.3. Research gaps and study contribution

Despite the growing literature on household income, three gaps remain relevant to the present study. First, much of the existing evidence either predates the post-pandemic period or pays limited attention to the changing demographic and livelihood conditions associated with recent economic restructuring, labor-market uncertainty, internal migration, and population aging. Second, studies in Vietnam often examine household size, dependency burden, education, health shocks, ethnicity, and spatial inequality separately rather than within a unified analytical framework, making it difficult to assess their relative importance in shaping household income. Third, the spatial dimension remains underdeveloped at the intra-provincial scale, despite the fact that household income is embedded in differentiated territorial contexts and may vary substantially across distinct livelihood spaces within the same province.

This study addresses these gaps using a 2025 household survey from Binh Dinh Province, a territorially diverse setting in Central Vietnam. It examines how household size, demographic composition, human capital, health burden, ethnic status, and locational disadvantage are jointly associated with monthly per capita household income. By integrating these dimensions within an intra-provincial framework, the study provides updated evidence on how household vulnerabilities intersect with accessibility and local context. From a human-resource perspective, the analysis also highlights how education, demographic dependency, and health constraints may be relevant to household labor capacity and access to economic opportunities, while recognizing that employment participation and organizational HR practices are not directly measured.

2.4. Research hypotheses

Guided by the human capital, dependency-burden, health-vulnerability, and spatial inequality perspectives, this study develops four hypotheses concerning associations with monthly per capita household income (**Figure 1**).

H1. Demographic pressure hypothesis.

Household demographic structure is expected to be nonlinearly associated with per capita household income, with income disadvantages becoming more pronounced when household size and dependency burden increase (Becker, 1991; Xu et al., 2022).

H2. Human capital hypothesis.

Higher levels of household head human capital, reflected in education and accumulated experience, are expected to be positively associated with per capita household income (Becker, 1994; Siri & Combarry, 2025).

H3. Health vulnerability hypothesis.

A greater household health burden is expected to be negatively associated with per capita household income (Eze et al., 2022; Grossman, 1972; Han et al., 2024).

H4. Spatial and social disadvantage hypothesis.

Households experiencing social or locational disadvantage, particularly ethnic-minority households and those with poorer accessibility or residence in less advantaged territorial settings, are expected to have lower per capita household income (Almeida et al., 2024; OECD, 2023; World Bank, 2022).

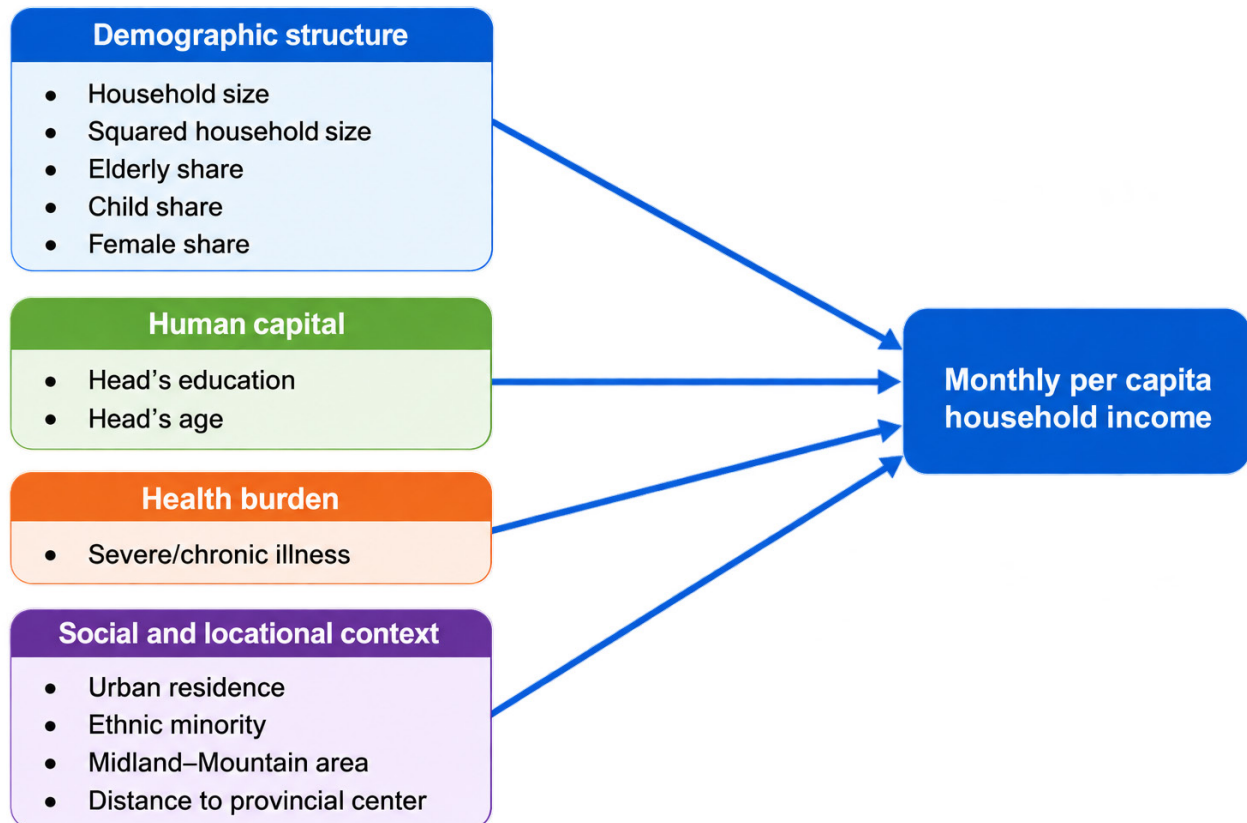


Figure 1. Analytical framework linking household vulnerability and spatial-social disadvantage to per capita household income.

Note: The figure summarizes the hypothesized relationships between demographic structure, human capital, health burden, social and locational context, and monthly per capita household income.

3. Materials and Methods

3.1. Study setting and data collection

This study is based on a household survey conducted in Binh Dinh Province between January and April 2025, prior to the provincial administrative reorganization implemented in July 2025. For consistency, the study area is referred to throughout the paper as Binh Dinh Province. The province was selected because it exhibits marked intra-provincial spatial differentiation, particularly between the more urbanized and economically dynamic eastern coastal plain and the less-connected western midland–mountain zone. These territorial contrasts provide an appropriate setting for examining how household demographic characteristics, health burden, and locational disadvantage are associated with monthly per capita household income.

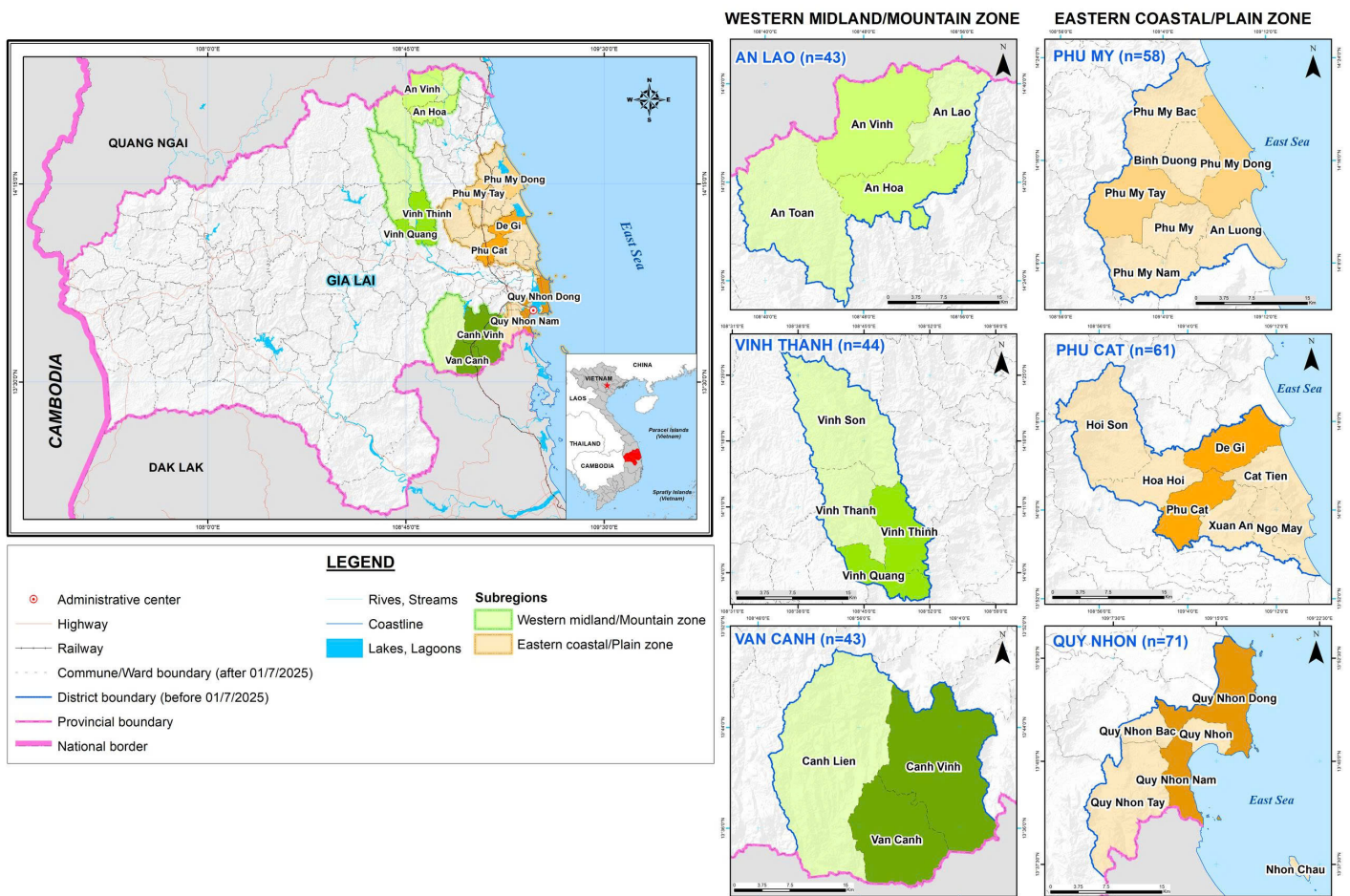


Figure 2. Location of the study area and sampled district-level administrative units in the former Binh Dinh Province, currently under Gia Lai Province, Vietnam, following the July 2025 provincial consolidation (National Assembly of Vietnam, 2025).

Note: The map distinguishes the eastern coastal/plain zone and the western midland–mountain zone used in the empirical analysis. *n* denotes the number of surveyed households in each sampled district-level unit.

To capture this internal heterogeneity, the survey covered six district-level administrative units representing the province's two major territorial subregions. Quy Nhon City, Phu Cat District, and Phu My District represent the eastern coastal/plain zone, while An Lao District, Van Canh District, and Vinh Thanh District represent the western midland–mountain zone. These units were selected to reflect differences in urbanization, livelihood structure, accessibility to the provincial center, infrastructure conditions, and the distribution of ethnic-minority populations. **Figure 2** shows the location of the study area and the sampled district-level units across these two subregions.

The target sample size was determined using Cochran's formula for proportions at the 95% confidence level ($Z = 1.96$), assuming maximum variability ($p = 0.5$) and an allowable error of ($e = 0.055$) (Cochran, 1977). After applying the finite population correction to the study population of 211,599 households across the six selected administrative units, the minimum required sample size was approximately 317 households. For fieldwork purposes, the target was rounded to 320 households. The Cochran calculation was used to establish the household-level fieldwork target and did not incorporate a cluster design effect; commune/ward-level clustering was explicitly accounted for in the subsequent mixed-effects analysis.

The study used a multi-stage sampling design combining purposive selection of study sites with random household selection within the selected localities. In the first stage, six district-level administrative units were purposively selected to represent the province's two major territorial subregions. The total sample was then allocated across these units using a combined rule. Each unit received a minimum of 40 interviews to ensure adequate subregional coverage, and the remaining observations were distributed proportionally to the number of households in each unit. This resulted in the following allocation: Quy Nhon City (71 households), Phu Cat District (61), Phu My District (58), An Lao District (43), Van Canh District (43), and Vinh Thanh District (44).

In the second stage, two communes or wards were selected within each district-level unit. The 12 communes/wards were purposively selected to reflect medium and lower living-standard conditions within each district-level area and to capture within-area variation in urban–rural setting, coastal/plain or mountain location, accessibility to the district or provincial center, infrastructure conditions, and dominant livelihood activities. This selection strategy ensured that the survey captured not only broad east–west subregional contrasts, but also local variation within each sampled district-level unit.

In the third stage, eligible households were listed with support from local administrative authorities. Within each selected commune or ward, households were then randomly selected from the local household lists to meet the assigned quota. Face-to-face interviews were conducted using a semi-structured questionnaire administered to household heads or, when the household head was unavailable, to an adult household representative knowledgeable about the household's socioeconomic conditions. Completed questionnaires were checked for internal consistency, coded, cleaned, and prepared for statistical analysis.

The sample should therefore be interpreted as an analytically stratified household sample designed to compare major territorial subregions, rather than as a fully representative probability sample of the entire province. For this reason, the analysis is reported without sampling weights. The purposive selection and limited number of sampled communes/wards also constrain population-wide and locality-specific generalization; accordingly, the analysis focuses on associations observed across the sampled territorial settings.

All statistical analyses were conducted using IBM SPSS Statistics 27. Descriptive statistics were first used to characterize the sample, followed by mixed-effects regression analyses that explicitly accounted for the nesting of households within the 12 sampled communes/wards.

3.2. Measures and variables

Monthly household income was measured as the sum of the main income sources reported by respondents at the time of the survey, including wages and salaries, income from agriculture, forestry and fisheries, non-farm self-employment and services, remittances, and other regular transfers. Income was recorded in million Vietnamese dong (VND) per month. Monthly per capita household income was calculated by dividing total monthly household income by household size and is therefore expressed in million VND per person per month. The dependent variable, *ln_inc*, is the natural logarithm of monthly per capita household income. Because the survey was conducted within a single period, income was recorded in nominal terms and was not adjusted for inflation. All households reported positive income; therefore, the logarithmic transformation was applied directly.

Consistent with the conceptual framework presented in **Figure 1**, the explanatory variables were organized into four analytical dimensions: demographic structure, human capital, health burden, and spatial-social disadvantage. Demographic structure includes household size in mean-centered form (*hhsizc*) and its squared term (*hhsizc2*), together with the share of household members aged 65 years or above (*share65*), the share aged under 15 (*share_u15*), and the share of female members (*share_female*). Mean-centering household size reduces collinearity between the linear and quadratic terms and facilitates interpretation of the nonlinear household-size association.

Human capital is represented by the age of the household head (*age_head*) and the household head's education level (*edu_head*). The education variable is coded on a seven-category ordinal scale ranging from no schooling to postgraduate education. Health burden is measured by the number of household members reported to have a physician-diagnosed severe or chronic illness (*illness*). Reported conditions include cancer, cardiovascular disease, diabetes, chronic kidney failure, severe mental disorders, and serious neurological or spinal conditions. Because diagnoses were not independently verified through medical records, this measure is self-reported and may therefore be subject to measurement error.

Spatial-social disadvantage is captured by urban residence (*urban*), ethnic-minority status (*minority*), residence in the western midland–mountain zone (*mountain*), and road distance to Quy Nhon (*dist_QN*), the provincial economic and administrative center. Urban residence is coded 1 for urban households and 0 for rural households. Ethnic-minority status is coded 1 for ethnic-minority households and 0 for Kinh households. Mountain residence is coded 1 for households located in the western midland–mountain zone and 0 for those in the eastern coastal plain. Distance to Quy Nhon is measured in kilometers as road distance. These variables are interpreted as indicators of locational and social context rather than as direct measures of spatial dependence or causal spatial effects. **Table 1** summarizes the operational definitions, scales, and expected directions of all variables used in the main model.

Table 1. Operationalization of variables used in the analysis.

Dimension	Variable	Code	Operational definition	Scale	Expected sign
Dependent variable	Monthly per capita household income (log)	<i>ln_inc</i>	Natural logarithm of monthly household income divided by household size	Continuous (log)	-
Demographic structure	Household size (mean-centered)	<i>hhsizc</i>	Household size minus sample mean (3.92)	Continuous	± / nonlinear
	Squared household size	<i>hhsizc2</i>	Squared term of mean-centered household size	Continuous	-
	Elderly share	<i>share65</i>	Share of household members aged 65 years or above	Percentage points	-
	Child share	<i>share_u15</i>	Share of household members aged under 15	Percentage points	-
	Female share	<i>share_female</i>	Share of female household members	Percentage points	-
Human capital	Head's age	<i>age_head</i>	Age of household head in years	Continuous	+

Continuation Table:

Dimension	Variable	Code	Operational definition	Scale	Expected sign
	Head's education	<i>edu_head</i>	Seven-category education scale from no schooling to postgraduate education	Ordinal (1–7)	+
Health burden	Severe/chronic illness burden	<i>illness</i>	Number of household members reported by the respondent as having a physician-diagnosed severe or chronic illness.	Count	-
Spatial-social disadvantage	Urban residence	<i>urban</i>	1 = urban; 0 = rural	Binary	+
	Ethnic-minority household	<i>minority</i>	1 = ethnic-minority household; 0 = Kinh household	Binary	-
	Midland–mountain residence	<i>mountain</i>	1 = western midland-mountain zone; 0 = eastern coastal plain	Binary	-
	Distance to provincial center	<i>dist_QN</i>	Road distance from household location to Quy Nhon City	Continuous (km)	-

Notes: Shared variables are interpreted in percentage points. *hhsizes_c* is mean-centered to reduce collinearity with *hhsizes_c2* and to facilitate interpretation of the nonlinear household-size association. The *illness* variable is self-reported and may therefore be subject to measurement error.

3.3. Linear mixed-effects model

To examine the associations between household characteristics and monthly per capita household income while accounting for the clustered sampling structure, the study estimates a linear mixed-effects model with households nested within the 12 sampled communes/wards. A random intercept at the commune/ward level allows households from the same locality to share an unobserved contextual component rather than treating all 320 observations as statistically independent.

An unconditional random-intercept model was first estimated to assess the degree of within-locality clustering through the intraclass correlation coefficient (ICC). The full model then included the four analytical dimensions identified in the conceptual framework: demographic structure, human capital, health burden, and social and locational context. The model is specified as

$$\ln_inc_{ij} = \beta_0 + \sum_{k=1}^{12} \beta_k X_{kij} + u_j + \varepsilon_{ij}, \quad (1)$$

where i indexes households and j indexes communes/wards; X_{kij} represents the 12 household and locational predictors; u_j is the random intercept for commune/ward j ; and ε_{ij} is the household-level residual. The random intercept and residual are assumed to be normally distributed with variances σ_u^2 and σ_e^2 , respectively. Models were estimated using restricted maximum likelihood (REML) with a variance-components covariance structure.

The ICC was calculated as

$$ICC = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_e^2}, \quad (2)$$

providing an estimate of the proportion of residual variation attributable to differences between sampled communes/wards.

This specification directly operationalizes the conceptual framework shown in **Figure 1**. The demographic structure dimension is represented by household size, its squared term, and the shares of elderly, child, and female members. Human capital is captured by the household head's age and education. Health burden is represented by the number of household members with severe or chronic illness. Spatial-social disadvantage is captured by urban residence, ethnic-minority status, midland–mountain residence, and distance to the provincial center.

Because the dependent variable is specified in logarithmic form, coefficients on continuous variables can be interpreted approximately as semi-elasticities. For binary variables, the estimated percentage difference relative to the reference category is computed as $100 \times (e^B - 1)$. The inclusion of both `hhsizes_c` and `hhsizes_c2` allows the model to capture a possible nonlinear relationship between household size and per capita household income. Where relevant, the turning point of the quadratic household-size specification was calculated from the linear and squared coefficients and interpreted as model-specific rather than as an optimal household size.

3.4. Diagnostic checks and sensitivity analysis

Multicollinearity among predictors was assessed using Variance Inflation Factors (VIFs) from the corresponding OLS specification, with values below 5 taken to indicate no serious concern. The unconditional mixed model was used to assess the magnitude of commune/ward-level clustering before estimating the fully adjusted random-intercept model. Substantive inference is based on the mixed-effects estimates rather than on conventional household-level OLS standard errors or individual-level bootstrap resampling.

Three sensitivity analyses were conducted in response to potential specification concerns. First, because monthly per capita income is constructed by dividing total household income by household size while household size is also included as a predictor, the model was re-estimated using the natural logarithm of total monthly household income as the dependent variable. This analysis assessed whether the estimated nonlinear household-size pattern persisted when household size was removed from the construction of the outcome.

Second, the seven-category education variable was re-estimated as a categorical factor rather than as a single ordinal score. This specification removed the assumption of equal increments between successive educational levels and allowed the overall association between education and income to be evaluated without imposing linear spacing across categories.

Third, female household headship was added as an additional covariate to assess whether the association between the female share of household members and income was materially altered after accounting for household headship. Because the survey did not directly measure sex-specific employment participation, migration, caregiving arrangements, or other potential mechanisms, the female-share coefficient is interpreted as a compositional association rather than as evidence of a direct gender or labor-market effect.

All sensitivity analyses retained the commune/ward random-intercept structure so that comparisons were made under an inferential framework consistent with the clustered sampling design.

4. Results

This section presents the empirical results in three steps. First, we summarize

the characteristics of the 320 surveyed households using descriptive statistics (Section 4.1). Second, we assess commune/ward-level clustering and report the main linear mixed-effects model for log monthly per capita household income, with a random intercept at the commune/ward level (Section 4.2). Third, we present targeted sensitivity analyses addressing the construction of the income outcome, the specification of household-head education, and the interpretation of household gender composition (Section 4.3).

4.1. Descriptive statistics

Table 2 presents descriptive statistics for the 320 households surveyed in Binh Dinh Province in 2025. The dependent variable, log monthly per capita household income ($\ln_inc$), has a mean of 1.218 and ranges from -0.288 to 2.110 , indicating substantial variation in household income across the sample.

Table 2. Descriptive statistics of study variables.

Variable	N	Minimum	Maximum	Mean
Monthly per capita household income (log)	320	-0.288	2.110	1.218
Household size (mean-centered)	320	-2.916	4.084	.000
Squared household size	320	.007	16.682	1.421
Elderly share	320	.000	66.670	3.724
Child share	320	.000	66.670	9.202
Female share	320	.000	100.000	55.298
Head's age	320	23	88	55.144
Head's education	320	1	7	3.156
Severe/chronic illness burden	320	0	2	.191
Distance to provincial center	320	5	75	43.594
Binary sample characteristics, n (%): Urban residence, 70 (21.9%); ethnic-minority household, 86 (26.9%); western midland–mountain residence, 130 (40.6%).				

Source: Authors' calculations from household survey data.

The sample displays substantial variation across the four analytical dimensions. Household size varies sufficiently to examine a possible nonlinear association with income, while the elderly, child, and female shares also show considerable between-household variation. The elderly share averages 3.724%, the child share 9.202%, and the female share 55.298%.

Human-capital characteristics also vary across households. The household head is 55.144 years old on average, with ages ranging from 23 to 88 years. The mean education score is 3.156 on the seven-category scale, although the distribution across education categories is examined separately in the sensitivity analysis because the ordinal scale does not necessarily imply equal differences between successive levels.

The severe/chronic illness variable averages 0.191 affected household members, with a maximum of two, indicating that health burden is concentrated in a relatively small subset of households.

The sample also captures substantial territorial and social heterogeneity. Ethnic-minority households account for 26.9% of the sample, 21.9% of households are

located in urban areas, and 40.6% reside in the western midland–mountain zone. Road distance to Quy Nhon averages 43.594 km and ranges from 5 to 75 km, providing variation in accessibility to the province’s principal economic center.

Overall, the descriptive statistics indicate sufficient variation in demographic composition, human capital, health burden, and locational context to support the multivariable mixed-effects analysis that follows.

4.2. Commune/ward clustering and mixed-effects results

The unconditional random-intercept model indicated substantial clustering of household income within the 12 sampled communes/wards. The estimated between-commune/ward variance was 0.319, compared with a household-level residual variance of 0.295, yielding an intraclass correlation coefficient (ICC) of approximately 0.519. Thus, a substantial share of the variation in log monthly per capita household income was located between sampled communes/wards, supporting the use of a multilevel specification rather than treating all 320 households as statistically independent.

Table 3 presents the fully adjusted linear mixed-effects model with a random intercept at the commune/ward level. After accounting for within-locality clustering, the demographic, human-capital, health, and social and locational variables exhibited differentiated associations with monthly per capita household income.

Table 3. Linear mixed-effects model for log monthly per capita household income (N = 320 households; 12 communes/wards)

Variable	B	SE	df	p-value	95% CI
Demographic structure					
Household size (mean-centered)	0.0135	0.0275	300.049	0.624	[−0.0407, 0.0677]
Squared household size	−0.0288	0.0118	298.990	0.016	[−0.0521, −0.0055]
Elderly share	−0.0197	0.0028	302.291	< 0.001	[−0.0252, −0.0142]
Child share	−0.0002	0.0019	299.566	0.932	[−0.0039, 0.0036]
Female share	−0.0064	0.0017	299.299	< 0.001	[−0.0097, −0.0032]
Human capital					
Head’s age	0.0106	0.0036	298.993	0.004	[0.0034, 0.0177]
Head’s education	0.1056	0.0225	302.606	< 0.001	[0.0613, 0.1498]
Health burden					
Severe/chronic illness burden	−0.1552	0.0627	301.112	0.014	[−0.2787, −0.0317]
Social and locational context					
Urban residence	−0.1211	0.3551	9.816	0.740	[−0.9143, 0.6721]
Ethnic-minority household	−0.3599	0.1387	292.970	0.010	[−0.6329, −0.0869]
Midland–mountain residence	−0.3342	0.2728	10.934	0.246	[−0.9351, 0.2667]
Distance to Quy Nhon	−0.0062	0.0024	263.007	0.011	[−0.0110, −0.0015]
Random-effects information					
Between-commune/ward variance	0.1446				

Continuation Table:

Variable	B	SE	df	p-value	95% CI
Household-level residual variance	0.2328				
Conditional ICC	0.383				

Notes: The model was estimated using restricted maximum likelihood (REML) with a random intercept for commune/ward. Fixed-effect estimates are reported as unstandardized coefficients (B). Continuous-variable coefficients are interpreted approximately as semi-elasticities. Exact percentage differences for binary variables are calculated as $100[\exp(B)-1]$. Share variables are measured in percentage points.

Source: Authors' calculations from household survey data.

Within the demographic dimension, the squared household-size term remained negative and statistically significant ($B = -0.0288$, $p = 0.016$), whereas the linear term was not significant. This supports a concave association between household size and per capita income. The implied turning point in the per-capita income specification is approximately 4.1 household members; however, this value is treated as a model-specific turning point rather than an optimal household size. Higher elderly and female shares were both negatively associated with income, whereas the child share was not statistically significant.

Human capital and health burden also remained important. The household head's age ($B = 0.0106$, $p = 0.004$) and education ($B = 0.1056$, $p < 0.001$) were positively associated with income, while severe/chronic illness burden was negatively associated with income ($B = -0.1552$, $p = 0.014$). Because education is measured on a seven-category ordinal scale, the interpretation of its coefficient as an equal increment across successive education levels is examined further in Section 4.3.

The social and locational results changed more noticeably after commune/ward-level clustering was taken into account. Ethnic-minority status remained negatively associated with per capita household income ($B = -0.3599$, $p = 0.010$), corresponding to an estimated income difference of approximately 30.2% relative to Kinh households. In contrast, neither urban residence nor the broad western midland–mountain indicator remained statistically significant. Greater road distance from Quy Nhon was negatively associated with income ($B = -0.0062$, $p = 0.011$), corresponding to approximately 0.62% lower income per additional kilometer, other factors held constant. In the adjusted specification, distance to Quy Nhon retained a significant association with income, whereas the broad mountain/non-mountain indicator did not.

After adjustment for the observed covariates, the estimated between-commune/ward variance declined from 0.319 in the unconditional model to 0.145, while the residual variance was 0.233. The resulting conditional ICC was approximately 0.383, indicating that substantial residual clustering remained even after household characteristics and measured locational factors were taken into account.

4.3. Sensitivity analyses

Three targeted sensitivity analyses were conducted to address concerns regarding the construction and interpretation of key variables while retaining the commune/ward random-intercept structure used in the main model. The analyses focused on the household-size specification, the treatment of education, and the interpretation of the female-share coefficient (Table 4).

Table 4. Targeted sensitivity analyses

Sensitivity check	Key estimate/test	p-value	Conclusion
Alternative outcome: log total household income	Household size: $B = 0.2822$	< 0.001	Positive linear component remains
	Household size ² : $B = -0.0741$	< 0.001	Concave household-size pattern persists
Education treated as a seven-category factor	Overall Type III test: $F = 4.134$	< 0.001	Education remains jointly associated with income
Female household headship added	Female headship: $B = -0.0455$	0.631	Female headship is not independently associated with income
	Female share: $B = -0.0063$	< 0.001	Female-share association remains stable

Notes: All sensitivity analyses retained a random intercept at the commune/ward level. The alternative-income model used the natural logarithm of total monthly household income as the dependent variable. Education was entered as a seven-category factor rather than as a single ordinal score. The female-headship analysis additionally controlled for whether the household head was female.

Source: Authors' calculations from household survey data.

4.3.1. Alternative income specification

Because monthly per capita household income is constructed by dividing total household income by household size, the nonlinear association between household size and the primary outcome could partly reflect this mechanical relationship. To assess this possibility, the mixed-effects model was re-estimated using the natural logarithm of total monthly household income as the dependent variable. The linear household-size coefficient became positive and statistically significant ($B = 0.2822$, $p < 0.001$), while the squared term remained negative and statistically significant ($B = -0.0741$, $p < 0.001$). The persistence of the concave pattern when household size was removed from the construction of the dependent variable indicates that the nonlinear association is not solely a mechanical consequence of the per-capita income specification. However, the location of the turning point differed across the two outcome specifications and should therefore not be interpreted as a fixed or optimal household size.

4.3.2. Alternative specification of education

The main model treats the seven-category education variable as an ordinal score, which imposes an equal-spacing assumption across successive education levels. As a sensitivity check, education was therefore entered as a categorical factor. The overall education effect remained statistically significant ($F = 4.134$, $df = 6$, $p < 0.001$). Adjusted marginal means generally increased across higher education categories, although the pattern was not strictly monotonic. These results support the substantive conclusion that higher educational attainment is associated with higher household income, while indicating that the relationship should not be interpreted as implying equal income increments between every pair of successive education levels.

4.3.3. Female share and household headship

To examine whether the negative association between the female share of household members and income was materially related to household headship, female household headship was added to the mixed-effects model. Female household headship was not statistically significant ($B = -0.0455$, $p = 0.631$), whereas the female-share coefficient remained negative and virtually unchanged ($B = -0.0063$, $p < 0.001$). Thus, controlling for female household headship did not materially account

for the observed female-share association.

This result nevertheless does not identify the mechanism underlying the female-share coefficient. Employment participation, migration of working-age household members, caregiving responsibilities, and age composition were not directly measured and therefore cannot be distinguished empirically in the present study. Accordingly, the female-share coefficient is interpreted as an association with household gender composition rather than as evidence of a direct gender or labor-market effect.

5. Discussion

5.1. Main findings in relation to the conceptual framework

The findings support an integrated interpretation of household income in which demographic structure, human capital, health vulnerability, and locational context operate jointly rather than independently. This is consistent with evidence that household welfare reflects the interaction of dependency structure, human capital formation, health shocks, and unequal access to economic opportunities across places (OECD, 2023; Siri & Combary, 2025; World Bank, 2022; Xu et al., 2022). Accounting for commune/ward-level clustering is important for interpreting the locational variables and for distinguishing household-level associations from broader contextual differences.

Demographic composition remains important, but its association with income is not simply linear. The negative quadratic household-size term indicates a concave relationship, while the elderly share is consistently associated with lower per capita income. These findings are compatible with the view that household expansion may initially permit labor pooling and resource sharing, but that these benefits weaken when dependency demands increase (Becker, 1991; Deaton & Paxson, 1998; Xu et al., 2022). The sensitivity analysis using total household income also retains a positive linear and negative quadratic household-size pattern, indicating that the nonlinearity is not solely a mechanical consequence of dividing household income by household size.

Human capital and health burden operate in opposite directions. Household-head education and age are positively associated with income, whereas severe/chronic illness burden is negatively associated with income. These findings are consistent with evidence that education improves productive capacity and access to higher-return opportunities, while illness can reduce healthy labor time, increase caregiving demands, and impose additional financial pressure (Chowdhury et al., 2019; Eze et al., 2022; Han et al., 2024; Siri & Combary, 2025). From a human-resource perspective, these results point to the importance of skills, accumulated experience, and health in shaping households' capacity to sustain income-generating activities. However, employment participation and organizational HR practices were not directly measured and should therefore be treated as implications rather than demonstrated mechanisms.

The social and locational findings show a differentiated pattern. Ethnic-minority status remains negatively associated with income after commune/ward-level clustering is taken into account. By contrast, neither urban residence nor the broad midland–mountain indicator remains statistically significant, while greater road distance from Quy Nhon is negatively associated with income. This suggests that accessibility may capture a more relevant locational gradient than broad settlement or subregional categories in the adjusted model. Such a pattern remains consistent with broader evidence that inequalities in Vietnam are associated with ethnic disadvantage,

remoteness, infrastructure, and unequal access to services and economic opportunities (Minot & Baulch, 2005; OECD, 2023; World Bank, 2022).

5.2. Demographic pressure, human capital, and health vulnerability

The household-size result should be interpreted as a nonlinear association rather than as evidence of an optimal household size. In the per capita income model, the estimated turning point occurs at approximately 4.1 members, but the sensitivity model using total household income shifts the turning point upward. The persistence of a concave pattern across the two outcome specifications supports the existence of nonlinearity, while the changing turning point indicates that any numerical threshold is specification-dependent. This is consistent with research emphasizing that the economic consequences of household size depend on the balance between additional labor capacity and additional dependency demands (Becker, 1991; Du & Mohd, 2024; Xu et al., 2022).

Among dependency measures, the elderly share shows a clear negative association, whereas the child share does not remain statistically significant in the adjusted model. This difference suggests that dependency types need not have equivalent short-run income implications. Older household members may be associated with reduced labor availability, greater care needs, and recurrent health expenditures, while the economic costs associated with children may be partly absorbed through intra-household adjustment or family support. Evidence from other aging contexts similarly shows that old-age dependency can constrain household economic flexibility and participation in higher-return activities (Du & Mohd, 2024; Kotamäki & Lehtimäki, 2025; Lu, Gao, Li, Li, & Luo, 2024; Xu et al., 2022).

Education remains one of the clearest positive correlates of household income. However, the sensitivity analysis treating the seven education levels as separate categories shows that the relationship is not strictly linear across all levels. The overall education effect remains statistically significant, but equal income increments between successive educational levels should not be assumed. The substantive conclusion is therefore that higher educational attainment is generally associated with better household income outcomes, consistent with evidence linking human capital to productive capacity, occupational opportunity, and household economic advancement (T. T. Pham, Lang, Ho, & Vo, 2024; Siri & Combary, 2025).

The negative association of severe/chronic illness burden reinforces the importance of health as an economic resource. Illness can weaken household income through reduced labor capacity, care demands, and health expenditures, while simultaneously limiting the ability to invest in education, mobility, or productive activities (Eze et al., 2022; Han et al., 2024; Zhao, Wang, Ren, & Zhang, 2025). These results indicate that human capital and health vulnerability should not be treated as separate domains: the returns to education and experience may be constrained when households face persistent health-related burdens.

5.3. Gender composition, ethnicity, and locational disadvantage

The negative association between the female share of household members and income requires cautious interpretation. The coefficient remains negative and statistically significant after female household headship is added to the model, while female headship itself is not significant. Thus, household headship does not materially account for the observed female-share association. Nevertheless, the available data do not identify the underlying mechanism. Differences in labor-force participation, migration of working-age members, caregiving responsibilities, occupational

composition, or age structure could potentially contribute to the pattern, but these factors were not directly measured. The coefficient should therefore be interpreted as an association with household gender composition rather than as evidence that women themselves reduce household income or as a demonstrated gender labor-market effect (Chowdhury et al., 2019).

Ethnic-minority status remains an important negative correlate of household income after accounting for demographic, human-capital, health, and commune/ward-level factors. This result is consistent with evidence that ethnic-minority households in Vietnam continue to face unequal access to productive employment, services, infrastructure, and economic mobility (D. T. Nguyen et al., 2023; World Bank, 2022). The coefficient should not be interpreted as an effect of ethnicity itself; rather, ethnic-minority status may capture cumulative differences in access to resources and opportunities that are only partly observed in the present model.

The locational results require cautious interpretation. The broad midland–mountain indicator is not statistically significant after commune/ward-level clustering is taken into account, whereas distance to Quy Nhon shows a significant negative association. This pattern suggests that household income differences may be more closely associated with accessibility to the provincial economic center than with a simple mountain/non-mountain distinction. Earlier research in Vietnam and recent OECD evidence similarly show that remoteness, connectivity, infrastructure, and access to jobs and services are important dimensions of territorial inequality (Almeida et al., 2024; Minot & Baulch, 2005; OECD, 2023). Recent studies from Central Vietnam further show that migration, settlement stability, and access to development resources are embedded in place-specific opportunity structures (Hien et al., 2026; Nhat et al., 2025).

These findings therefore do not provide evidence of formal “spatial effects,” because spatial dependence was not explicitly modeled. Rather, they demonstrate associations between household income and selected indicators of social and locational context. This distinction is important because the sampled communes/wards were limited in number and purposively selected, and because ethnic status, accessibility, and territorial location overlap substantially in the study area.

5.4. Policy and human-resource implications

The findings suggest that responses to household income disadvantage should combine human-capital development, health protection, support for aging-related dependency, and improved accessibility to economic opportunities. These implications should remain proportionate to the evidence: the study identifies household-income associations but does not directly measure employment participation, training access, caregiving arrangements, or organizational HR practices.

First, the positive association between education and income supports continued investment in accessible skills development and vocational training, particularly in disadvantaged localities and among groups with weaker access to higher education. Provincial authorities and vocational institutions could prioritize locally accessible training, job-matching services, and partnerships between training providers and employers. Such measures are consistent with evidence that human-capital development can strengthen household earning capacity and economic mobility (Siri & Combary, 2025; World Bank, 2022).

Second, the negative associations of severe/chronic illness and elderly dependency indicate a need to reduce the tension between work, health, and caregiving. Healthcare providers and local authorities can improve access to chronic-

disease management and community-based care, while employers may consider flexible work arrangements or reskilling support for workers facing illness-related or eldercare responsibilities. These measures are consistent with evidence that aging and health shocks can constrain household labor capacity and financial resilience (Eze et al., 2022; Han et al., 2024; International Monetary Fund, 2025).

Third, the persistence of ethnic-minority disadvantage and the negative association with distance to Quy Nhon suggest that human-resource development should be sensitive to accessibility and local opportunity structures. Rather than relying on a uniform urban–rural or mountain–plain classification, provincial authorities, employers, training institutions, and community organizations could focus on improving access to skills, employment information, mobility, and non-farm livelihood opportunities in less-connected communities (Almeida et al., 2024; OECD, 2023; Phung & Pham, 2022; World Bank, 2022).

Finally, vulnerable groups should not be treated as homogeneous. Older households, ethnic-minority households, households affected by illness, and geographically less-connected communities may differ substantially in their capacity to participate in formal employment or training. The appropriate response is therefore not a single intervention, but a differentiated combination of skills development, health and care support, employment access, and place-sensitive livelihood measures.

6. Conclusions, limitations, and directions for future research

This study examined how demographic structure, human capital, health burden, and spatial-social disadvantage are associated with monthly per capita household income in Binh Dinh Province, Vietnam, using a 2025 cross-sectional survey of 320 households. Using a linear mixed-effects model that accounts for the nesting of households within 12 communes/wards, the results show that lower household income is associated with higher elderly and female shares, severe/chronic illness burden, ethnic-minority status, and greater distance from Quy Nhon, while household-head age and educational attainment are positively associated with income. Urban residence and the broad midland–mountain indicator are not statistically significant after commune/ward-level clustering is taken into account. Household size exhibits a concave association with per capita income, and this nonlinear pattern persists when total household income is used as an alternative outcome. Taken together, the findings suggest that household income differences in Binh Dinh reflect the combined roles of demographic vulnerability, human capital, health burden, social disadvantage, and accessibility rather than a simple urban–rural or mountain–plain divide.

From a policy perspective, the results point to the need for integrated interventions that strengthen human capital, reduce vulnerability associated with aging and illness, and improve access to skills, employment, services, and livelihood opportunities in less-connected communities. Particular attention may be warranted for ethnic-minority households and households facing overlapping demographic, health, and accessibility constraints. From a human-resource perspective, the findings also highlight the potential relevance of locally accessible skills development, vocational training, health support, and measures that reduce work–care constraints. However, these are practical implications rather than directly estimated workforce effects because employment participation, training access, and organizational HR practices were not measured.

Several limitations should be acknowledged. First, the cross-sectional design

prevents causal interpretation; the estimated coefficients should therefore be interpreted as associations rather than causal effects. Second, although the sample was designed to capture major territorial contrasts within the study area, it should be interpreted as an analytically stratified household sample rather than as a fully representative probability sample of the entire province. Third, although the mixed-effects model accounts for household clustering within the 12 sampled communes/wards, the small number and purposive selection of these localities limit the precision and generalizability of locality-level inference. Moreover, the study does not estimate formal spatial dependence or spatial spillovers; the locational results should therefore be interpreted as associations with measured contextual indicators rather than as spatial effects in an econometric sense. Fourth, the study uses locational indicators such as urban residence, midland–mountain residence, ethnic-minority status, and distance to Quy Nhon, but it does not directly measure infrastructure quality, travel time, market access, public-service availability, or local labor-demand conditions. Finally, income and illness variables are self-reported and may be subject to recall error or measurement bias. The survey also lacks detailed information on employment status, occupation, working time, caregiving, migration, training participation, and household labor allocation, limiting identification of the mechanisms underlying several observed associations, particularly those involving gender composition, aging, and human capital.

Future research could extend this study in three directions. First, panel data or repeated cross-sections would help identify income dynamics over time and better distinguish structural from transitory shocks. Second, richer measurement of household conditions—including health expenditure, time use, labor participation, migration, occupation, skills and training participation, caregiving responsibilities, and asset ownership—would clarify the mechanisms linking demographic structure to income outcomes. Third, studies covering a larger and more representative set of communes/wards, combined with finer measures of accessibility, local labor demand, services, and formal spatial-dependence methods, could distinguish household-level associations from contextual and spatial processes more rigorously. Interaction analyses may also examine whether disadvantages accumulate across dimensions such as minority status and education, aging and health burden, or gender composition and migration. Such extensions would support more precise targeting and more rigorous evaluation of interventions aimed at inclusive income growth and place-sensitive human-resource development in Binh Dinh Province.

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