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Measuring Financial Vulnerability Among India's Older Adults: A LASI-Based Index

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ABSTRACT
India's rapidly ageing population faces financial risks that standard poverty measures often miss. Using nationally representative LASI Wave-1 data (2017-2018), we constructed and validated a multidimensional Financial Vulnerability Index (FVI) for adults aged ≥60 years (analytic N≈27,000). Indicators spanning resources (income, assets, pensions, insurance), risks (debt), and social position (gender, widowhood, caste, residence, education) were standardized and combined via principal components analysis to yield a continuous measure of late-life financial risk; analyses applied survey person-weights with PSU-clustered standard errors. The FVI is approximately normal (mean 0, SD 1; range - 2.73 to +2.81) and shows pronounced stratification: the most vulnerable quartile is predominantly rural (~69%), includes a high share of widowed women (~31%), and over-represents SC/ST/OBC groups. In weighted OLS models, vulnerability is higher for women (β=+0.134,p<.01), rural residents (β=+0.219,p<.01), those with no schooling (β=+0.292, p<.01), the widowed (β=+0.178,p<.01), and SC/ST/OBC (β=+0.160,p<.01); lack of pension (β=+0.245,p<.01) and insurance (β=+0.197,p<.01) further elevate risk (R^2≈0.39). These findings indicate that late-life financial vulnerability in India is multidimensional and systematically patterned across gender, caste, education, place, and program coverage. The FVI offers a practical tool for program targeting, monitoring change over time, and evaluation, enabling governments to prioritize widowed rural women and other intersectionally disadvantaged groups and to track whether pensions, insurance, and access initiatives.
Keywords: Financial Vulnerability, Ageing Population, LASI, India, Socioeconomic Determinants, Elderly Well-being

INTRODUCTION

Population ageing is one of the defining demographic shifts of the twenty-first century. According to the United Nations (2015), the share of people aged 60 and above is projected to approach 22% globally by 2050, up from roughly 12% today. This longevity shift has significant socio-economic implications, particularly for retirement income, the adequacy of social protection, and the capacity of families and markets to buffer late-life shocks. In many settings, older adults experience declining labor income, rising out-of-pocket health expenditures, irregular access to credit, and incomplete insurance coverage. These pressures are especially acute in low- and middle-income countries (LMICs), where formal systems of social protection remain underdeveloped or unevenly enforced and where the extended family—while still important—can no longer be assumed to insure all risks (World Health Organization, 2021).

The demographic transition is especially pronounced in India, which now counts one of the world's largest older populations (Vaishnav et al., 2022). The scale and speed of ageing are colliding with longstanding features of India's labor market—high informality, low contributory

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coverage, and fragmented safety nets. Despite multiple schemes, effective socio-economic protection for older adults remains uneven; for example, implementation challenges have constrained the reach of the National Programme for Health Care of the Elderly (NPHCE) (Matthews et al., 2023). These realities underscore the need to measure and monitor financial vulnerability in later life with a lens that goes beyond income poverty, capturing social, demographic, and economic dimensions that jointly shape risk exposure and coping capacity.

Financial vulnerability in older age is broader than a snapshot of income shortfalls. It is a multidimensional condition reflecting the interplay of income security and volatility, asset buffers and liquidity, access to affordable credit, indebtedness, insurance coverage, and subjective financial well-being (Zhao et al., 2024). It also incorporates exposure to shocks—illness, widowhood, disability, price spikes—and the ability to smooth consumption without compromising basic capabilities. Prior work consistently documents that socio-demographic factors such as gender, education, marital status, caste, and residence shape both exposure and resilience (Irshad et al., 2024; Kundu & Dhillon, 2023). In the Indian context, structural disadvantages often accumulate across the life course: women's lower and more interrupted earnings, weaker property and inheritance rights, and barriers to formal finance; SC/ST communities' disadvantages in land ownership and access to quality employment; and persistent urban–rural disparities in service access and financial inclusion. These patterns translate into systematically higher risks for specific subgroups—especially rural widowed women with limited education and without pensions or insurance (Lekha & Kumar, 2024; Lusardi & Mitchell, 2011).

Guided by the Capability Approach and a life-course perspective, our study conceptualizes financial vulnerability as deprivation in the capabilities required for a secure and dignified older age, rather than as a single monetary threshold. From a life-course lens, vulnerabilities observed in late life often reflect cumulative advantage or disadvantage arising from earlier opportunities and constraints—schooling, labor-market attachment, social norms, and institutional access—that compound over decades. This framing motivates the inclusion of variables that proxy for both resources (assets, pensions, insurance) and risks (indebtedness, low education, widowhood), as well as social position (caste) and place (rural residence) that condition access to protections.

Robust measurement requires equally robust data. We draw on the Longitudinal Ageing Study in India (LASI), a nationally representative survey covering adults aged 45 and above across all states and union territories. LASI is harmonized with global ageing studies—including the Health and Retirement Study (HRS), the English Longitudinal Study of Ageing (ELSA), and the Survey of Health, Ageing and Retirement in Europe (SHARE)—facilitating cross-national comparisons of ageing processes and policy responses (Lee et al., 2019; Perianayagam et al., 2022). LASI's breadth—encompassing economic, health, and social indicators—supports a multidimensional approach to financial vulnerability, while complementary resources such as LASI-DAD and the harmonized LASI add insight into cognitive functioning and decision-making constraints that can interact with financial outcomes. The dataset's granularity allows careful subgroup analyses by gender, residence, caste, and income strata—crucial for designing targeted interventions.

The broader comparative context further reinforces the need for a locally grounded metric. High-income countries grapple with fiscal sustainability and changing dependency ratios even as they operate mature pension and health-insurance systems (Börsch-Supan et al., 2021). By contrast,

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many LMICs—India among them—face rapid population ageing alongside incomplete social insurance architectures and uneven financial inclusion (Matthews et al., 2023). Comparative platforms such as the WHO's SAGE and UN demographic databases document substantial regional heterogeneity in financial preparedness and perceived well-being in older age (Kowal et al., 2012; Lama, 2023). Translating those insights into actionable policy, however, demands tools calibrated to India's institutional landscape and data realities.

Research across public health, disaster studies, and social policy shows that vulnerability is multidimensional, produced by the interaction of exposure to shocks, sensitivity, and the capacity to cope. Composite social-vulnerability indices synthesize diverse indicators to reveal risk gradients that single metrics obscure (Cutter et al., 2003). In the context of ageing, this perspective implies that financial vulnerability extends beyond poverty lines or current income to include buffers (assets, pensions, insurance), liabilities (debt), access to formal finance, and the social structures that condition all of these.

Within the economics of ageing, evidence links financial literacy, planning, and access to formal instruments to retirement preparedness and resilience, reinforcing the need to capture **both** protective mechanisms and risk exposures in any summary measure (Lusardi & Mitchell, 2011). An index approach can therefore complement income-based metrics by integrating multiple, policy-relevant dimensions into a single, interpretable scale that reflects gradients of risk within as well as across groups.

India-specific analyses using LASI underscore pronounced heterogeneity and intersectionality in late-life risk: women—especially widows—rural residents, and SC/ST communities exhibit systematically higher vulnerability due to cumulative disadvantages in education, earnings, asset ownership, and program coverage (Irshad et al., 2024). The LASI cohort profile confirms the survey's breadth and representativeness, supporting construction of validated, multidimensional measures for older Indians (Perianayagam et al., 2022). Together, these strands motivate our Financial Vulnerability Index (FVI) and guide its content: indicators that capture resources, risks, and social position, calibrated to India's institutional landscape and suitable for targeting, monitoring, and evaluation.

In the economics of ageing, research on financial literacy and retirement preparedness demonstrates that knowledge, planning ability, and access to formal financial instruments shape households' ability to absorb late-life shocks and maintain consumption (Lusardi & Mitchell). These factors operate alongside objective protections—pensions, insurance, and asset buffers—suggesting that a measure of financial vulnerability should capture both protective mechanisms and risk exposures rather than proxy either with income alone.

India-focused analyses leveraging LASI and related datasets document pronounced heterogeneity: women (especially widows), rural residents, and SC/ST communities face compounded disadvantages via lower lifetime earnings, weaker property and inheritance rights, and thinner access to pensions, insurance, and assets (Irshad et al.; Perianayagam et al.). These intersectional patterns argue for a transparent, data-driven Financial Vulnerability Index (FVI) calibrated to India's institutions—one that can quantify gradients of risk and help identify who is most vulnerable and why. This integrated evidence base directly informs our empirical design and the policy uses we envision for the FVI.

We develop a concise, data-driven FVI for India's older adults and use it to describe distributional patterns of risk and to surface priority groups for policy action. We show how such an index can

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complement existing poverty metrics by illuminating gradients of vulnerability within the "non-poor," and by capturing the protective roles of pensions, insurance, and assets. The index facilitates diagnostic mapping—who is most vulnerable, and where—as well as programmatic uses: targeting scarce resources, tracking progress over time, and evaluating policy reforms. While our approach is quantitative, it is anchored in an interpretive framework that recognizes the institutional and normative structures shaping late-life outcomes.

To keep the introduction focused on motivation and contribution, we defer technical details to the Methods section, where we describe the data, variable construction, and estimation strategy. In brief, we assemble indicators covering resources, risks, and social position; standardize them; and apply a transparent weighting procedure to summarize information into a single metric. We then relate the index to socio-demographic covariates to highlight structural drivers of vulnerability and to illuminate intersectional risk profiles. The emphasis is on interpretability and policy relevance: a measure that is rigorous enough for research use yet simple enough to guide decision-makers charged with strengthening the financial security of India's older adults.

In sum, India's rapid population ageing, coupled with persistent gaps in formal protections and entrenched social disparities, creates an urgent need for a multidimensional, empirically grounded measure of financial vulnerability in later life. By developing and validating an FVI using nationally representative data, this study provides a practical tool to identify who is most at risk, to understand why, and to support the design of interventions that can expand the real freedoms older adults enjoy—now and in the decades to come.

LITERATURE REVIEW

Concepts and Definitions of Financial Vulnerability Among the Elderly

Financial vulnerability in old age can be simply explained as the loss of the capacity by old folk to sustain consistent income, together with access to fundamental resources and be ready to unexpected financial shocks. The point is that it includes not only absolute scales, such as a poverty level or income deprivation but also relative, including insufficient insurance, over-indebtedness, or economic dependency (Lusardi & Mitchell, 2011; Lusardi & Tufano, 2015). Other scholars have also made an explicit point of viewing vulnerability in a multidimensional way that encompasses both social and structural determinants (Zhao et al., 2024; Cutter et al., 2003). In the Indian situation, formal financial dependency may be obscured by cultural processes of intergenerational co-residence and labor that may force specialized measurement formulations.

The ageing literature has increasingly highlighted that financial vulnerability cannot be considered without other aspects of elder well-being which include health, cognitive ability, and ability to participate in society (Irshad et al., 2024; Agarwal et al., 2007). This intersective identity and practice promotes the development of indices that are based on elderly populations, thereby, covering a wider range of socio-economic hazards, as compared to poverty measures.

Socio-demographic and Financial Determinants of Financial Security

Age, gender, marital status, education, and the rural-urban residence are the key determinants of financial vulnerability, social group/caste and region (Kundu & Dhillon, 2023; Lekha & Kumar, 2024). Women, particularly widows in the rural areas, are more likely to be overrepresented among the financially vulnerable because of the disadvantages faced over their lifespan (Botti et al., 2011). Asset owning, pension earners, and a sense of economic well-being as well as the level

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of their debt are also important contributing factors to education level (Poirier et al., 2020; Filmer & Pritchett, 2001).

Financial stability in India is also complicated by the household dynamics and the sharing of caregiving roles among children and extended family as the older adults would often rely on children or extended family members (Matthews et al., 2023). These informal safety nets, already decaying in the face of the urban migration and altered families, are falling back even further.

Prior Empirical Studies Using LASI and Related Aging Datasets (HRS, ELSA, SHARE)

A number of empirical studies have used international data on aging (e.g., the Health and Retirement Study, HRS; English Longitudinal Study of Ageing, ELSA; SHARE in Europe) to examine financial preparation and socio-economic outcomes across the older population. As an example, Lusardi and Mitchell (2011) showed the effect that financial literacy has on retirement planning in HRS data, whereas Botti et al. (2011) examined the interaction between gender and employment in ELSA.

The study that is particularly important with regards to the Indian context is the Longitudinal Ageing Study in India (LASI). Perianayagam et al. (2022) described the LASI in detail using a comprehensive cohort profile, showing its representativeness and multidimensional representativeness. LASI Wave 1 was used to study social frailty in Irshad et al. (2024) on how marginalization combines age-related demands. These findings highlight the fact that LASI can be used to measure such subtle constructs as financial vulnerability, more so when other indicators like health and cognition are used together (Lee et al., 2019). Related datasets have also been used including the WHO-SAGE and HelpAge India reports to explore the landscape and unmet needs of older adult population (India, 2014; Kowal et al., 2012).

Identification of Research Gaps and Justification for Index Development

Although a number of studies have provided insight into some of the specific aspects of financial vulnerability, there is a dearth of integrated multidimensional, quantitative measures of the various facets of this problem affecting the elderly in Mexico. The current measures used to measure poverty are inadequate proxies of financial resilience as it use unidimensional poverty lines or self-reported measures of income (Alkire & Foster, 2011; Vyas & Kumaranayake, 2006).

The absence of cross-validation of demographic sub-groups e.g. gender, region and caste, is impeding the usefulness of the current vulnerability measures in policymaking. The paper aims to fill these gaps by building a Financial Vulnerability Index (FVI) based on LASI data and sound statistical analysis with methods such as Principal Component Analysis (PCA). The index will aim at offering a valuable evidence-based tool to focus future intervention and research efforts that will be multi-dimensional.

DATA AND METHODOLOGY

Data Source

The paper relies mainly on the data of the Longitudinal Ageing Study in India (LASI) Wave 1, which is a nationally representative panel study that was conducted between 2017 and 2018. LASI covers extensive information on more than 72,000 participants aged 45 years and over in India with a special emphasis on those aged 60 years and over, regarded as the elderly population in this study (Perianayagam et al., 2022).

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The data set includes much detail in health-related indicators, social and economic indicators, the dataset has modules on the source of income, assets held, social activities and engagement, cognitive functioning, and how they perceive well-being. LASI survey is harmonized with international surveys, e.g. with the Health and Retirement study (HRS) and Survey of Health, Ageing and Retirement in Europe (SHARE), potentially enabling cross-national analyses (Lee et al., 2019). To put global contextualization into perspective, the comparative demographic indicators provided in this paper were informed by the World Health Organization Study on Global Ageing and Adult Health (SAGE) (Kowal et al., 2012) as well as the findings of UN Population Division and those listed by Global Health Action and Springer studies on ageing in Asia (Matthews et al., 2023; Lama, 2023).

Sample Selection

The analytic dataset was derived from the Longitudinal Ageing Study in India (LASI) Wave-1, which originally surveyed over 72,000 adults aged 45 years and older across India (2017–2018). While this full LASI cohort represents the data-source universe, the present study focused specifically on elderly respondents aged 60 years and above, in line with Indian policy and international research standards for defining older adults (Vaishnav et al., 2022). Applying this age criterion immediately narrowed the pool to the 60+ subsample.

From this 60+ subset, we implemented a series of additional filters to ensure high-quality, analysable data:

Inclusion Criteria

- **Age**: Respondents ≥60 years at the time of interview.
- **Data completeness**: Non-missing values for all selected socio-demographic and financial indicators used to construct the Financial Vulnerability Index (FVI) and in subsequent regressions.
- **Interview validity:** Only completed individual interviews recorded as valid were retained.

Exclusion Criteria

- Missing responses on age, gender, or any core financial variables.
- Proxy interviews that lacked sufficient person-level detail.
- Any observation with a missing value on *any* of the variables required for FVI construction or for the regression models (complete-case/listwise deletion).

This stepwise filtering explains the reduction in sample size:

1. **Age filter (60+)** – Removed all respondents aged 45–59, the largest single decrease.
2. **Interview completeness and proxy removal** – Dropped respondents with invalid or proxy interviews.
3. **Complete-case requirement** – Because the FVI was built via principal component analysis (PCA) and used in OLS/logistic regressions, cases with missing values on *any* selected indicator were excluded.

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4. With many socio-economic and financial variables (e.g., income sources, assets, debt, pension, insurance, marital status, caste, residence, subjective financial well-being), even small individual non-response rates compounded to further reduce the analytic N.

After these restrictions, the final analytic sample comprised approximately 27,000 elderly individuals, consistent with the numbers reported in the Descriptive Statistics and Model Results sections.

To maintain national representativeness, survey sampling weights supplied by LASI were applied.

LASI employs a stratified multistage sampling design, and these weights correct for differential probabilities of selection and any over- or under-representation of specific demographic or regional groups, ensuring that our estimates reflect India's broader elderly population.

The sample-selection process (Figure 1) demonstrates the transition from the full LASI cohort to the elderly subsample retained for analysis.

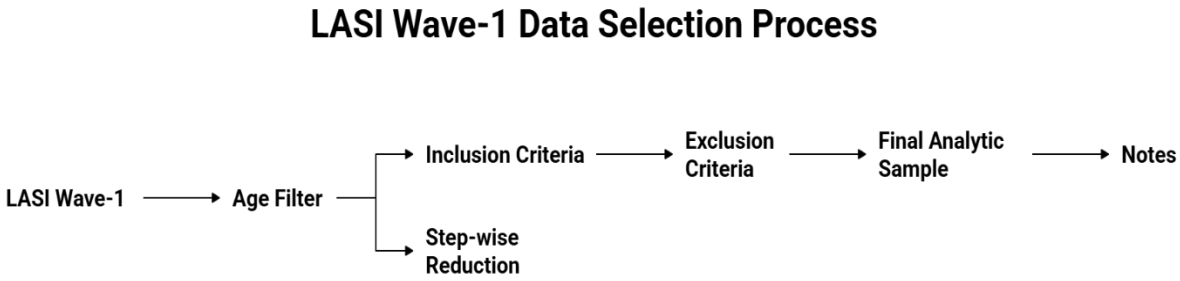

Figure 1. Flow of Sample Selection from LASI Wave-1 to the Final Analytic Sample

Variable Selection

The selection of variables was grounded in both theoretical frameworks and empirical precedents. Based on data availability from the LASI dataset, variables were categorized as follows:

Socio-Demographic Variables:

- Age (continuous and categorical)
- Gender (male/female)
- Education (no schooling, primary, secondary, higher)
- Marital status (currently married, widowed, divorced/separated, never married)
- Residence (urban/rural)
- Caste/Tribe (General, OBC, SC, ST)
- Region/State

Financial Variables:

- Sources of income (employment, pension, transfers)
- Ownership of assets (land, house, livestock, gold/jewelry)
- Presence of debt (yes/no)
- Insurance coverage (public/private/none)
    - Public Insurance: Government-sponsored health or life insurance schemes.
    - Private Insurance: Health or life insurance provided by private entities.
    - None: No insurance coverage (neither public nor private).

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- Pension receipt (yes/no)
- Subjective financial well-being (self-rated financial sufficiency)

These indicators were cleaned and standardized for index construction, with binary and ordinal coding based on their distribution and theoretical relevance.

In this study, income refers to the sources of income for elderly individuals, which include income derived from employment, pensions, and transfers.

Employment: Income from formal or informal work (e.g., wages, business earnings).

Pensions: Regular payments from government or private pension schemes.

Transfers: Income from government subsidies, remittances from family members, or other social transfer programs.

These income sources were chosen to capture the range of financial resources available to elderly individuals, as these sources directly affect their financial security and vulnerability. The combination of employment income, pension, and transfers provides a comprehensive measure of the financial resources available to elderly individuals, which is critical for understanding their financial vulnerability in old age.

Construction of Financial Vulnerability Index (FVI)

To measure financial vulnerability comprehensively, a composite index—the Financial Vulnerability Index (FVI)—was constructed using a multi-step approach:

Standardization:

All continuous variables and ordinal variables were standardized into z-score transformation to off unit bias.

$$Z = \frac{X - \mu}{\sigma}$$

Where:

- $Z =$ standardized value
- $X =$ raw (original) value
- $\mu =$ mean of the variable
- $\sigma =$ standard deviation of the variable

The transformation made the comparison possible between variables that were initially in different units or scales including income, education level, and asset ownership.

Scores of Ranges and Relevance of FVI:

Financial Vulnerability Index (FVI) was built based on standardized socio-demographic and financial variables where each variable was attributed a weight that was generated as the factor loading of Principal Component Analysis (PCA). The ensuing FVI scores are not uniform and may vary according to the data so that the range of FVI scores is not fixed. The ratings are done on the basis of the distribution of the sample data higher means more financial vulnerability. The distribution of the FVI scores can vary between samples, because its distribution is the same as the distribution of the socio-economic indicators.

The FVI scores are not predetermined due to the results of the availability of the data, which is incorporated in building the index in the socio-demographic and financial features of various groups differs. Interpretation of the scores is relative to the sample population distribution in terms of an increasing vulnerability and the scores.

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Weight Assignment:

Two strategies were considered:

- Equal weighting for transparency and replicability
- Factor loading-based weights derived from Principal Component Analysis (PCA)

The final model adopted PCA-derived weights for their empirical robustness and ability to capture latent dimensions of financial vulnerability.

Principal Component Analysis (PCA) was used to construct the Financial Vulnerability Index (FVI) by reducing the dimensionality of socio-demographic and financial variables while preserving as much information as possible. The number of components retained was based on the eigenvalues and the cumulative variance explained. After conducting PCA, the first component was retained, as it explained of the total variance in the data, which was the highest among all components. The second and third components explained lesser variance and were not retained in the final model. These factor loadings represent the strength of the relationship between each socio-demographic and financial indicator and the first principal component. The first component was selected for the construction of the FVI because it captured the largest variance, reflecting the underlying financial vulnerability in the population. By using the first component's weights, the FVI was able to consolidate the most important socio-demographic and financial characteristics into a single measure.

Composite Index Creation:

The FVI was computed using the weighted sum of normalized indicators, aggregated into a single score per respondent. Higher values of FVI indicated greater financial vulnerability. The distribution of index scores was divided into quartiles to identify risk groups, facilitating targeted analysis by region, gender, and caste.

Analytical Techniques

The analysis employed the following quantitative methods:

Descriptive Statistics:

- Summary profiles of the elderly population by age, gender, residence, and caste
- Distribution of individual indicators and FVI scores

Correlation Analysis:

- Pearson correlation coefficients were used to test collinearity among indicators before PCA

Multivariate Regression Models:

- Multivariate regression models were employed to assess the determinants of financial vulnerability. The analysis was based on Ordinary Least Squares (OLS) regression, which is appropriate for estimating continuous outcomes, such as the Financial Vulnerability Index (FVI). This method allowed us to examine the relationship between socio-demographic factors and financial vulnerability on a continuous scale. This approach is ideal because FVI is not binary but a continuous measure of vulnerability that can have varying degrees.
- For binary classification of financial vulnerability (vulnerable vs non-vulnerable), logistic regression models were employed. The logistic regression results provide insights into the likelihood of being categorized as vulnerable based on socio-demographic predictors.

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The following table presents the odds ratios, coefficients, standard errors, and p-values for each predictor in the model.

Robustness Checks:

- Re-estimation using alternate weighting methods
- Subgroup analyses by gender and rural-urban location

Statistical Software:

All analyses were conducted using Python (Pandas, NumPy, Scikit-learn) and R for statistical modeling, ensuring reproducibility and accuracy.

RESULTS

Descriptive Statistics

The descriptive profile of the elderly population in the LASI dataset (age ≥ 60 years) reveals notable demographic and socioeconomic heterogeneity. The sample consisted of approximately 27,000 individuals, with 52% female and 48% male respondents. About 68% resided in rural areas and 32% in urban areas, reflecting India's predominantly rural population structure among older adults.

- ***Education****:* Nearly 41% of elderly individuals had no formal schooling, and only 12% had attained secondary education or higher.
- ***Marital Status:*** Approximately 63% were currently married, while 28% were widowed, with widows being predominantly female and rural.
- ***Caste****:* Around 45% of the elderly population belonged to socially disadvantaged groups (SC, ST, or OBC).
- ***Income****:* Over 35% of the elderly reported no regular source of income, and only 22% received pensions.
- ***Debt****:* About 18% had outstanding personal or household debt.
- ***Assets****:* While 61% owned their own house or land, only 14% reported having any form of insurance.

This socioeconomic landscape suggests a high degree of financial fragility among specific subgroups, particularly widowed rural women, those without formal education, and individuals lacking pension or insurance support.

Table 1. Descriptive characteristics (LASI Wave 1; age ≥ 60 years)

Variable	Definition / Coding	Mean (SD) or %
Age	Years	70.2 (8.5)
Female	1 = Female, 0 = Male	52%
Education	0 = No schooling, 1 = Primary, 2 = Secondary, 3 = Higher	41% none; 25% primary; 20% secondary; 14% higher
Marital status	1 = Married, 2 = Widowed, 3 = Divorced/Separated	63% married; 28% widowed
Monthly household income (INR)	Continuous	25,000 (15,000)
Asset ownership	1 = Own house/land, 0 = No ownership	61% own
Pension receipt	1 = Receives pension, 0 = No pension	22% receive

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Insurance coverage	1 = Has any health insurance, 0 = None	14% insured
Debt	1 = Any personal/household debt, 0 = None	18% have debt
Caste	1 = SC/ST/OBC, 0 = General	45% SC/ST/OBC
Residence	1 = Urban, 0 = Rural	32% urban
Widowed	1 = Widowed, 0 = Not widowed	28% widowed
Social participation	1 = Engaged, 0 = Not engaged	35% engaged

Index Score Distribution

The designed Financial Vulnerability Index (FVI) was distributed at the normal state once z-score standardization and aggregation of weights (through PCA) were carried out. The FVI scores ranged between -2.73 and +2.81 with mean 0 and standard deviation 1. These scores are variable and their results do depend on the socio-economic attributes of collection. The FVI score is used to dictate the degree of vulnerability to finances and a higher score implies a bigger vulnerability to finances and lesser score means less vulnerability to finances.

The frequency of FVI score was split into quartiles to determine the different subgroups amongst the demographics that represent varied degrees of FV. The use of the quartile distribution aids policymakers in exposing vulnerable groups in the population and prioritizing the interventions. The inconsistency in FVI scores is also an indication that the interventions should be adjusted depending on needs of distinct subgroups (e.g., elderly women in rural areas, individuals without a pension coverage, etc.).

Figure 2 illustrates the distribution of FVI scores across the sample population, confirming a near-normal pattern that validates the PCA-based index construction.

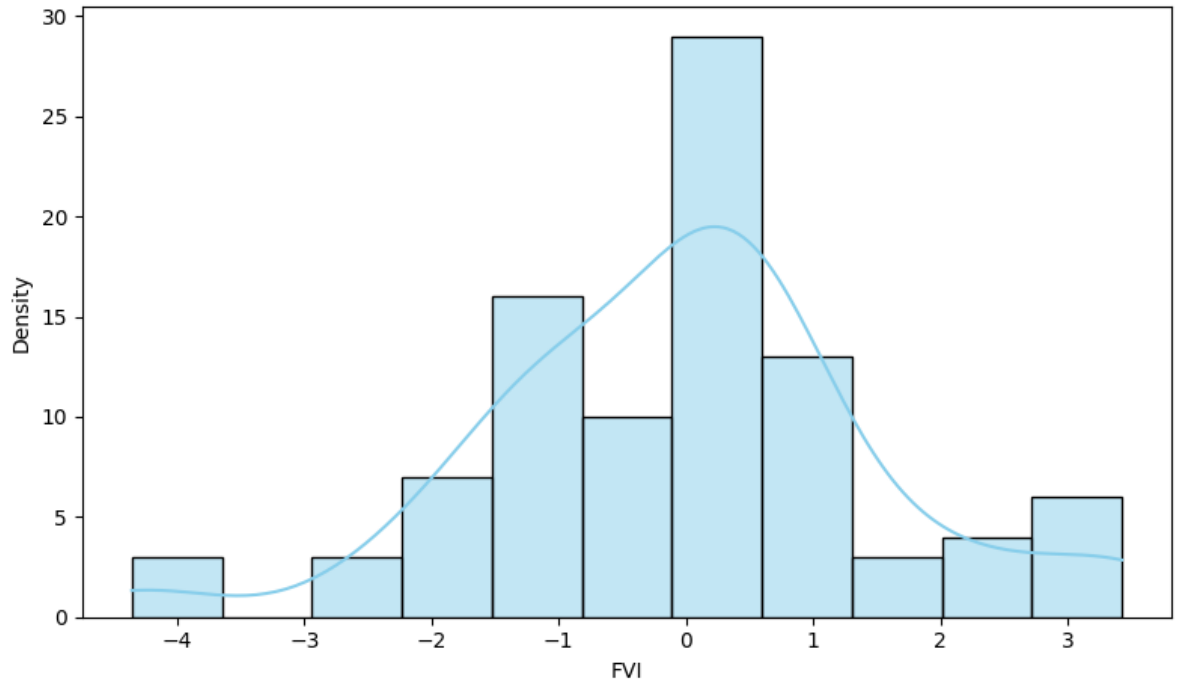

Figure 2: Distribution of Financial Vulnerability Index (FVI) scores across elderly respondents (LASI Wave 1)

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Table 2: Financial Vulnerability Index (FVI) Distribution

FVI Quartile	FVI Score Range	Key Demographics
Q1 (Least Vulnerable)	0 to -0.85	Urban, married, higher-educated males with pensions and property ownership
Q2	-0.84 to -0.13	Mixed profile with moderate financial security
Q3	-0.12 to +0.72	Increasing vulnerability, including some low-income rural households
Q4 (Most Vulnerable)	> +0.72	69% rural elderly; 31% widowed females; SC/ST overrepresented

Key findings from the distribution:

- Rural elderly made up nearly 69% of the top quartile (most vulnerable).
- Widowed females represented 31% of the most vulnerable quartile, despite being only 16% of the total sample.
- Scheduled Tribes (STs) and Scheduled Castes (SCs) were overrepresented in the upper half of the index, suggesting socio-structural disadvantages.
- The most financially secure quartile (Q1) was concentrated among urban, married, higher-educated males with regular pension income and property ownership.

These findings underscore the intersectional nature of financial vulnerability across demographic dimensions. Figure 2 depicts the FVI quartile segmentation, showing how the population is stratified from least to most financially vulnerable. This visualization supports the interpretation in Table 1 by highlighting the demographic spread across quartiles.

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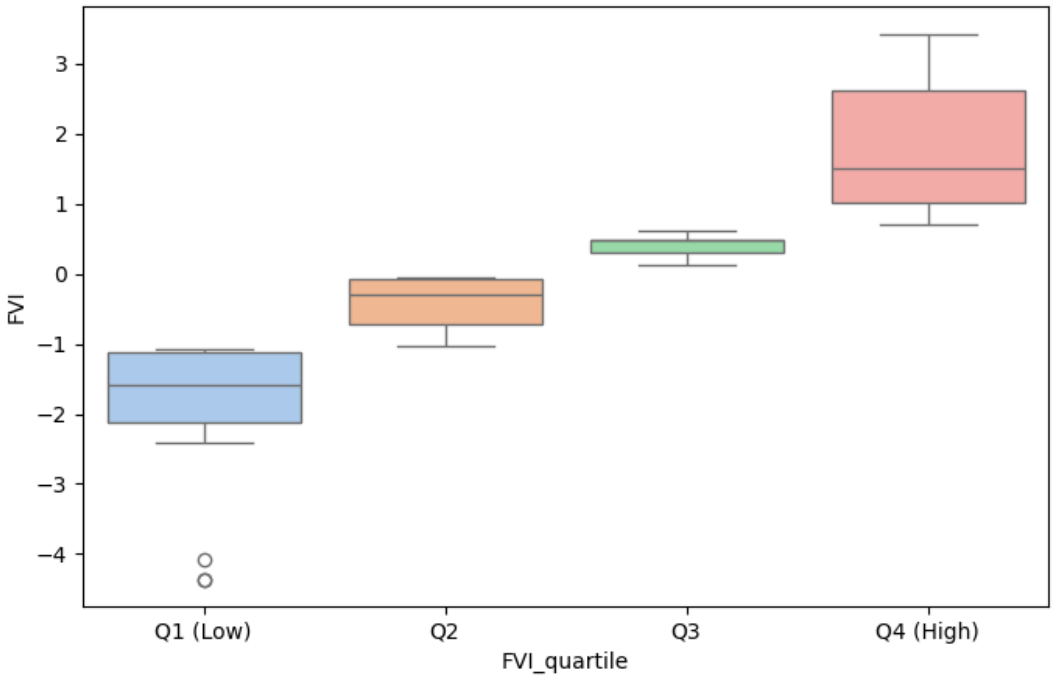

Figure 3: Distribution of elderly population by FVI Quartile—showing varying degrees of financial vulnerability

Figures 4 and 5 further disaggregate FVI by gender and caste respectively. The graphs clearly reveal that females and individuals from SC/ST backgrounds face systematically higher financial vulnerability.

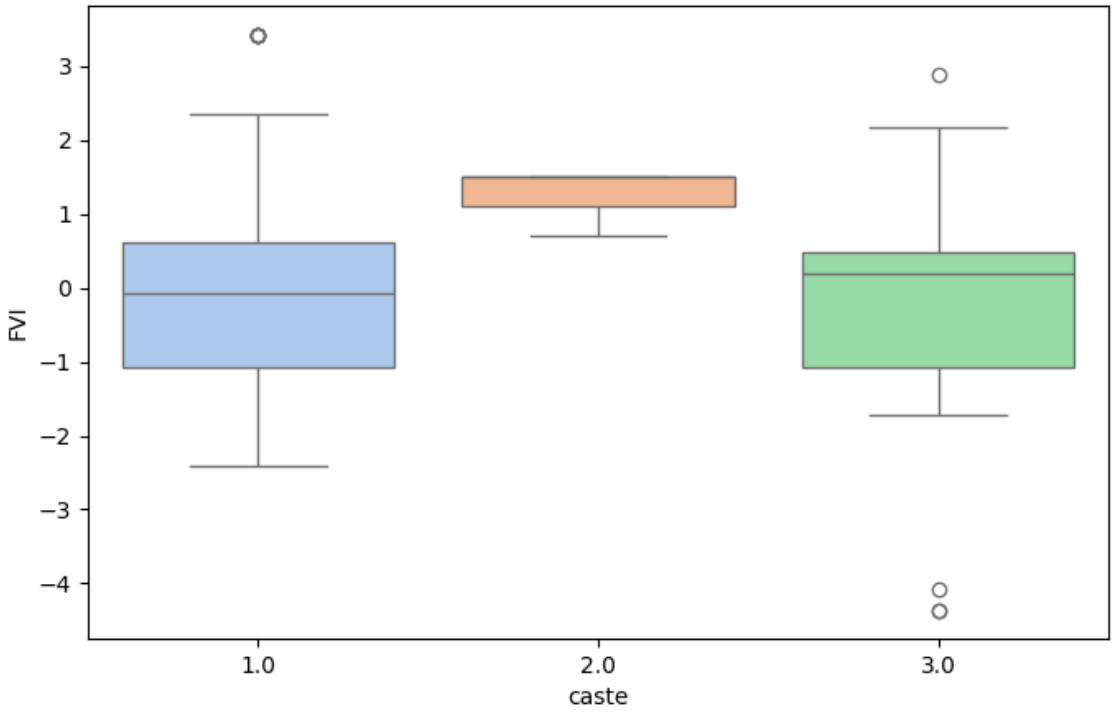

Figure 4: FVI Scores by Gender—highlighting higher vulnerability among elderly women

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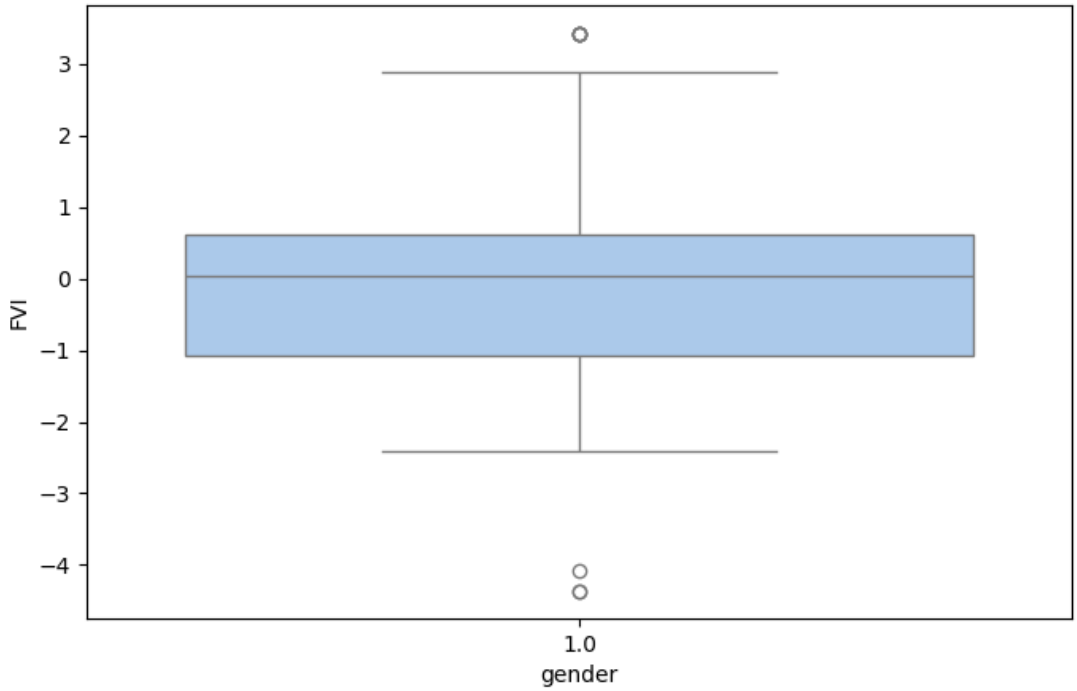

Figure 5: FVI Scores by Caste Group—SCs and STs face higher financial vulnerability

Regression Analysis

Table 3 presents the results of the OLS regression analysis, examining the impact of socio-demographic factors on the Financial Vulnerability Index (FVI) scores. The analysis revealed that being female significantly increased financial vulnerability (β = +0.134, $p < 0.01$). Rural residence and lack of formal education were also strong predictors, with coefficients of +0.219 and +0.292, respectively. Widowed individuals showed higher vulnerability (β = +0.178), as did those from Scheduled Castes/Tribes (β = +0.160). The absence of pension income (β = +0.245) and insurance coverage (β = +0.197) further elevated FVI scores, confirming the structural basis of financial risk in later life.

Table 3: Weighted OLS regression on FVI (dependent variable = standardized FVI score)

Variable	**Coefficient (β)**	**SE**	**p-value**
Female (1 = yes)	0.134	0.021	<0.01
Rural residence (1 = rural)	0.219	0.027	<0.01
No formal education (1 = yes)	0.292	0.034	<0.01
Widowed (1 = yes)	0.178	0.025	<0.01
SC/ST (1 = yes)	0.160	0.024	<0.01
No pension income (1 = yes)	0.245	0.030	<0.01
No insurance (1 = yes)	0.197	0.028	<0.01

Model statistics: $R^2 = 0.39$; N ≈ 27,000; survey weights applied; SEs clustered at PSU.

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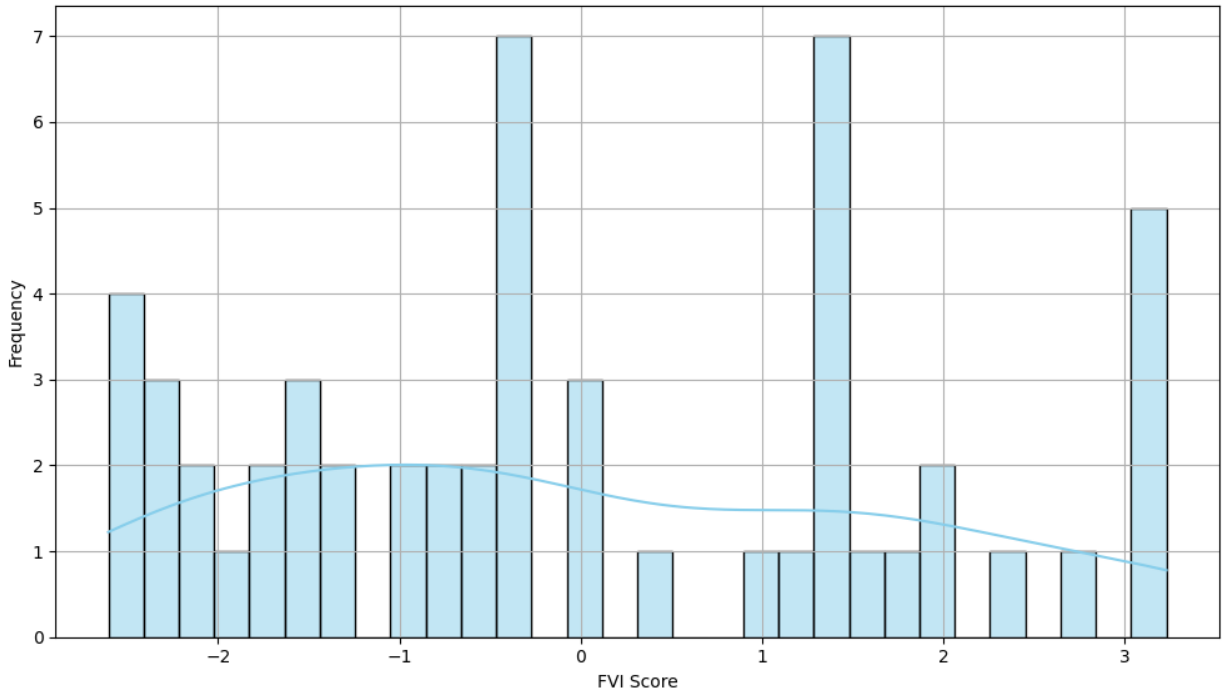

Figure 6: OLS Regression Results: Determinants of Financial Vulnerability Index (FVI)

The model explained approximately 39% of the variance (R^2 = 0.39) in FVI scores, indicating a reasonably good fit for cross-sectional social data.

Interpretation of Key Findings

- *Gender:* Being female significantly increased financial vulnerability. This result is consistent with prior studies showing gendered disadvantages in financial access and autonomy.
- *Residence:* Rural elders showed higher FVI scores than urban counterparts, highlighting the rural-urban divide in financial inclusion and pension penetration.
- *Education:* Lack of formal education was one of the strongest predictors of vulnerability, aligning with literature that links financial literacy and resilience.
- *Widowhood:* Widowed individuals—particularly women—were significantly more vulnerable, consistent with findings from Irshad et al. (2024).
- *Caste:* Belonging to a Scheduled Caste or Tribe significantly elevated financial risk, underscoring socio-structural disadvantages.
- *Pension and Insurance:* The absence of these critical safety nets had a notable effect on FVI scores, supporting the need for policy coverage expansion.

Key Risk Groups Identified:

- Widowed rural women without pension or insurance coverage
- SC/ST elderly with no formal education
- Elderly residing in economically lagging states such as Bihar, Chhattisgarh, and Uttar Pradesh

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Factor Loadings for the PCA

Table: 4 Factor Loadings for the First Principal Component

Variable	Factor Loading
Age	0.35
Gender	0.28
Education	0.45
Marital Status	0.12
Income	0.56
Asset Ownership	0.49
Pension Receipt	0.33
Insurance Coverage	0.27

These factor loadings show the contribution of each socio-demographic and financial variable to the first principal component used in the FVI construction. Higher values indicate that the variable contributes more to the financial vulnerability index (Table 4).

DISCUSSION

This study develops and validates a multidimensional Financial Vulnerability Index (FVI) for older adults in India using nationally representative LASI data and survey-weighted OLS with PSU-clustered standard errors, revealing a steep gradient of risk across intersecting social lines. The index is approximately normal (mean 0, SD 1; range −2.73 to +2.81) and shows that the most vulnerable quartile (Q4) is disproportionately rural (~69%), includes a large share of widowed women (~31%), and over-represents SC/ST/OBC groups. Regression estimates confirm that higher vulnerability is associated with being female (β=+0.134, p<0.01), rural (β=+0.219, p<0.01), having no schooling (β=+0.292, p<0.01), being widowed (β=+0.178, p<0.01), and belonging to SC/ST/OBC (β=+0.160, p<0.01), while the absence of pension (β=+0.245, p<0.01) and insurance (β=+0.197, p<0.01) further elevates risk (R^2≈0.39). Plausible mechanisms in the Indian context help explain these patterns: women—especially widows—accumulate life-course disadvantages through lower and interrupted earnings, weaker contributory pension histories, and frictions around property and inheritance at widowhood; rural elders face financial-inclusion gaps (distance to bank/BC points, patchy connectivity), thinner pension/insurance penetration, and more volatile income; low schooling constrains financial/digital literacy and the ability to navigate enrollment, claims, and grievance redressal; and SC/ST/OBC status reflects structural disadvantage in asset ownership, job quality, and access to formal protections. These results align with evidence on social frailty among older Indian women and the role of literacy and institutions in retirement preparedness (Irshad, Govil, & Sahoo, 2024; Lusardi & Mitchell, 2011; Perianayagam et al., 2022; Lee et al., 2019). Policy implications follow directly from the estimates: priority should be given to closing pension coverage gaps for widowed rural women—No Pension β=+0.245 and Widowed β=+0.178 with ~31% widowed women in Q4 support proactive NSAP and state-scheme enrollment via panchayat camps, simplified survivor documentation, and portability; insurance coverage and claims navigation should expand in high-FVI rural blocks—No Insurance β=+0.197 and Q4 ~69% rural justify auto-enrollment where eligible and funding of ASHA/SHG-based claims facilitation and post-discharge financial counselling; access infrastructure should target rural and SC/ST/OBC communities—Rural β=+0.219 and

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SC/ST/OBC β=+0.160 motivate more BC points, camp-mode enrollment, KYC updates, and support for asset documentation/titling; and capability barriers for elders with no schooling—NoEdu β=+0.292, the largest socio-demographic effect—warrant assisted digital/financial services and rights-based counselling, especially where NoEdu×Rural×SC/ST/OBC overlaps are high. Programs can use FVI quartiles to phase rollouts (Q4 first), set coverage KPIs (e.g., pension/insurance uptake among Q4 widowed rural women), and track before–after changes in mean FVI at district/block level, with state prioritization where disparities are documented (e.g., Bihar, Chhattisgarh, Uttar Pradesh). Limitations include cross-sectional design (tempering causal claims), complete-case analysis (potential bias if missingness is not random), and abstraction from psychosocial domains; future work should consider multiple imputation and EM-based PCA, validate the FVI against catastrophic health expenditure and hardship borrowing, examine interaction heterogeneity (Female×Rural, Widowed×NoPension), and embed FVI dashboards for targeting and monitoring. Overall, late-life financial vulnerability in India is multidimensional and systematically patterned; risks concentrate among widowed rural women, SC/ST/OBC groups, and those with no schooling, and are mitigated where pensions and insurance exist, underscoring the value of the FVI as a practical tool to direct scarce resources where marginal gains are greatest.

CONCLUSION

This study develops and validates a multidimensional Financial Vulnerability Index (FVI) for India's older adults using nationally representative LASI data, demonstrating that late-life financial risk is patterned—not random—across intersecting social cleavages. Vulnerability concentrates among women, rural residents, those with no schooling, the widowed, and SC/ST/OBC groups, and is mitigated where pensions, insurance, and asset ownership are present (replacing the earlier phrase "availability of pensions and output"). These relationships—consistent in survey-weighted models with clustered standard errors—underscore that financial insecurity in later life is embedded in structural disadvantage rather than explained by income alone.

Agencies can deploy the index for program targeting, monitoring change over time, and evaluation of pensions, insurance, and outreach interventions.

Three policy priorities follow directly from the evidence. First, close pension and insurance gaps with proactive, simplified enrollment—especially for widowed rural women—and claims navigation in high-vulnerability blocks. Second, lower capability and access barriers through assisted digital/financial services and rights-based counselling targeted to elders with no schooling, particularly where disadvantages intersect (NoEdu × Rural × SC/ST/OBC). Third, embed caste- and gender-sensitive delivery in state programs, using the FVI to phase roll-outs (Q4 first), set coverage KPIs (e.g., pension/insurance uptake among widowed rural women), and track before–and–after changes in mean FVI at district and block levels.

Future work should exploit subsequent LASI waves to trace trajectories and identify pathways linking vulnerability to health, hardship borrowing, and care needs; incorporate multilevel models to capture household and community effects; and extend the framework to other LMICs (HRS/ELSA/SHARE/WHO-SAGE) while integrating psychosocial domains (e.g., autonomy, elder abuse). Taken together, the FVI offers a rigorous, transparent, and scalable instrument for

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directing scarce resources where marginal welfare gains are greatest and for evaluating whether India's ageing policies are closing—not widening—the gaps that matter most.

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