# Informal Long-Term Care, Labor-Market Risks, and Social Protection in Uzbekistan: A Measurement and Evaluation Framework

*Extended Abstract*

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**Abstract**

This extended abstract develops a measurement and evaluation framework for studying how informal long-term care affects employment, earnings, social-insurance continuity, and caregiver well-being in Uzbekistan. It does not claim completed causal estimates. Instead, it combines official demographic statistics, nationwide household survey evidence covering all regions of Uzbekistan, international labor-economics research, and the ILO decent-work framework to define testable hypotheses and a feasible empirical design. The permanent population aged 65 and older increased from 1.19 million in 2013 to 2.39 million in 2026, while a survey of 1,002 households caring for persons over age 70 reports high weekly care intensity and a marked gender gap. Age alone is not a measure of long-term-care need; the proposed data system therefore links caregiving questions to ADL and IADL limitations, cognitive impairment, service use, employment histories, earnings, pension contributions, and caregiver health. The paper specifies a formative Caregiver Decent Work Risk Index (CDWRI) with six dimensions, explicit coding thresholds, and a variable-level codebook. It then proposes a prospective common-start difference-in-differences evaluation in future expansion districts not yet exposed to the integrated support package. The primary sample comprises working-age unpaid caregivers of adults aged 70 and older with documented functional or cognitive needs; caregivers of working-age adults with severe disabilities form a separately analyzed secondary sample. The main outcomes are employment, paid working hours, earnings, contribution density, caregiver strain, and unmet care need; hospital use and residential placement are longer-term secondary outcomes. The framework is internationally relevant because Uzbekistan is a middle-income country at an early stage of population aging, with a family-centered care regime and an expanding digital social-protection infrastructure. Its contribution is a reproducible design for making unpaid caregiving visible without treating descriptive associations as causal results, and for testing whether home- and community-based services can protect both care quality and labor-market attachment.

**Keywords:** informal caregiving; long-term care; labor supply; decent work; social protection; linked administrative data; Uzbekistan

**JEL classification:** I13, I18, J14, J22, J26, J46, J48

## 1. Introduction

Long-term care is not only a health-service issue. When an older person loses functional capacity, family members often absorb the resulting demand for assistance with personal care, mobility, medication, transportation, supervision, and household tasks. This allocation can preserve continuity and dignity for the care recipient, but it also changes the caregiver's labor supply, earnings path, health, and social-insurance record. Because the work is commonly unpaid and performed inside households, national labor statistics and public budgets capture only part of its economic cost.

The economic mechanism begins with time allocation. Care raises the shadow price of market work and can produce adjustments at the extensive margin (employment exit, delayed entry, or early retirement) and at the intensive margin (shorter hours, absences, reduced responsibility, or job change) (Becker, 1965; Carmichael and Charles, 2003). Longitudinal studies show that intensive eldercare may reduce hours and wages and that severe family health shocks generate labor-supply responses across household members (Van Houtven, Coe, and Skira, 2013; Skira, 2015; Fadlon and Nielsen, 2021). Working conditions also matter because schedule and location flexibility can alter the feasible combination of paid work and adult care (Costa-Font and Wang, 2026).

Uzbekistan offers a policy-relevant setting in which to study these mechanisms. It remains younger than most high-income economies, but the absolute number and population share of older persons are rising rapidly. Formal long-term-care provision is developing, while family care remains central and women carry a disproportionate share of unpaid work (UNDP, 2024, 2026a). At the same time, the National Agency for Social Protection, local "Inson" centers, functional assessment procedures, and the Unified National Social Protection System create an emerging administrative infrastructure that could support linked-data research and policy evaluation (UNDP, 2026a).

The paper asks three questions. First, which observable channels connect informal long-term care to decent-work and social-protection risks? Second, how can those risks be measured reproducibly without confusing age, caregiving, and functional dependence? Third, how can a home- and community-based support package be evaluated using one pre-specified empirical

strategy? The contribution is therefore methodological and prospective: the paper defines an index, a minimum data architecture, testable hypotheses, and an evaluation design. It does not present individual-level causal estimates for Uzbekistan.

**Table 1. Comparative research value of the Uzbekistan case**

| Feature | Established high-income LTC literature | Uzbekistan/current context | Research implication |
|---|---|---|---|
| Demographic stage | Mature systems often reform after aging and institutional structures are already entrenched. | The 65+ population is growing quickly from a lower base, creating scope for preventive institutional design. | Tests whether caregiver protection can be built before a fiscal and service crisis emerges. |
| Care regime | Formal services and insurance are more developed, although family care remains important. | Family-based care substitutes for limited or uneven formal provision. | Makes the labor-market cost of service scarcity especially visible. |
| Labor market | Formal employment histories are more complete and benefit eligibility is easier to observe. | Formal and informal employment coexist, so caregiving may intensify unprotected work and contribution gaps. | Requires outcomes beyond employment status, including contribution density and job formality. |
| Institutional reform | Policy evaluation often concerns mature programs. | Social-support centers, functional assessment, and digital registries are being developed and piloted. | Creates an opportunity to embed evaluation in phased implementation. |
| International transferability | Evidence is concentrated in high-income countries. | Uzbekistan resembles other transition and middle-income systems reviewed by UNDP where families bridge service gaps. | Provides a design transferable to countries at an early stage of population aging with family-centered care regimes. |

Source: Authors' synthesis based on Addati et al. (2018), ILO (2024a, 2024b), Llena-Nozal (2022), WHO Regional Office for Europe (2024), and UNDP (2026b).

## 2. Conceptual Framework: Caregiving as a Decent-Work Risk

### 2.1. From time allocation to cumulative disadvantage

Caregiving is endogenous to household organization. A person with weaker labor-market attachment or lower expected earnings may be more likely to assume care, while the onset of care can itself weaken attachment. Cross-sectional differences between caregivers and non-caregivers therefore cannot be interpreted automatically as causal effects. A credible design must observe the timing and intensity of care, pre-care employment trajectories, household composition, the recipient's functional status, and local access to services.

The costs are cumulative. A temporary reduction in hours lowers current income, may slow wage progression, reduces contribution density, and can later weaken pension rights. Health strain and sleep loss can further reduce productivity and employment continuity. These mechanisms justify analyzing current labor supply, job quality, income security, social protection, and health as connected outcomes rather than as separate policy domains (Bauer and Sousa-Poza, 2015; Llena-Nozal, 2022).

### 2.2. Extending the decent-work framework

The ILO frames care policy through recognition, reduction, redistribution, reward, and representation. The framework links quality care to gender equality, work-life balance, social protection, and decent employment for paid care workers (Addati et al., 2018; ILO, 2024a, 2024b). This paper extends that logic to the employment consequences of unpaid long-term care. The extension does not redefine family care as conventional employment. It asks whether a socially valuable activity produces avoidable losses in employment opportunity, earnings, social-insurance coverage, health, and voice.

The primary unit of analysis is a working-age person who provides unpaid assistance to an adult aged 70 or older with documented ADL, IADL, cognitive, or supervision needs. The recipient may live in the same household or elsewhere. A secondary sample includes caregivers of working-age adults with severe disabilities; this group will be analyzed separately and will not be pooled with the primary eldercare sample. Paid domestic and care workers are also analyzed separately because their core issue is the formality and quality of paid employment.

## 3. Data and Descriptive Evidence

### 3.1. Sources, scope, and limits

The descriptive component uses four sources. First, the National Statistics Committee's SIAT series "Permanent population of 65 years of age or older" (indicator code 2.01.02.0019) and "Permanent population-Total" (indicator code 2.01.02.0001), accessed July 27, 2026. Second, the 2024 UNDP household study, which included a separate survey of 1,002 households caring for persons over age 70 and covered all regions of Uzbekistan; the paper describes this evidence as nationwide rather than nationally representative because published survey weights and a formal representativeness statement are not available in the cited report. Third, the 2026 gender-responsive review of Uzbekistan's care system and its companion multi-country analysis. Fourth, national legal and institutional documents governing social-support centers and services for persons requiring care.

These materials support demographic and institutional description, not causal inference. The count of persons aged 65 and older is a pressure indicator, not a measure of long-term-care need. Need should be measured through limitations in activities of daily living (ADLs), instrumental activities of daily living (IADLs), cognitive impairment, supervision requirements, and the

availability of an informal caregiver. The framework therefore treats age as a stratification variable and functional dependence as the eligibility and intensity variable.

**Table 2. Descriptive evidence and its measurement implication**

| Indicator | Available evidence | Source | Interpretation for research design |
|---|---|---|---|
| Population aged 65+ | 1,191,082 in 2013; 1,613,779 in 2020; 2,392,051 in 2026 | National Statistics Committee, SIAT | Demand pressure is rising, but age does not identify functional need. |
| Share of total population aged 65+ | 3.97% in 2013; 4.76% in 2020; 6.26% in 2026 | Authors' calculations from SIAT | The older share is increasing as well as the absolute count. |
| Eldercare survey coverage | 1,002 households with care focus on persons over age 70 | UNDP (2024) | Provides nationwide descriptive coverage but is not a longitudinal labor-market panel and is not labeled statistically nationally representative in the cited report. |
| Weekly eldercare intensity, caregivers aged 60–70 | 43.79 hours overall; 46.99 for women; 31.47 for men | UNDP (2024) | High intensity and gender difference justify measuring hours, nights, and unpredictability. |
| Preference and support needs | 843 responses favored personal/family care; 477 requested allowances linked to elder expenses; 377 requested higher caregiver pay | UNDP (2024) | Home-based preference should be supported by services rather than equated with unpaid availability. |
| Functional and disability context | UNDP reports disability among 13.5% of the population and 54% among older persons; 65+ population projected at 4.02 million by 2040 | UNDP (2026a) | Functional assessment and disability status are required to translate demographic aging into care need. |

Note: The survey response counts in the fifth row are reported as counts because the source does not present a common denominator for all response categories. The 1,002-household study is described as nationwide coverage, not as statistically nationally representative.

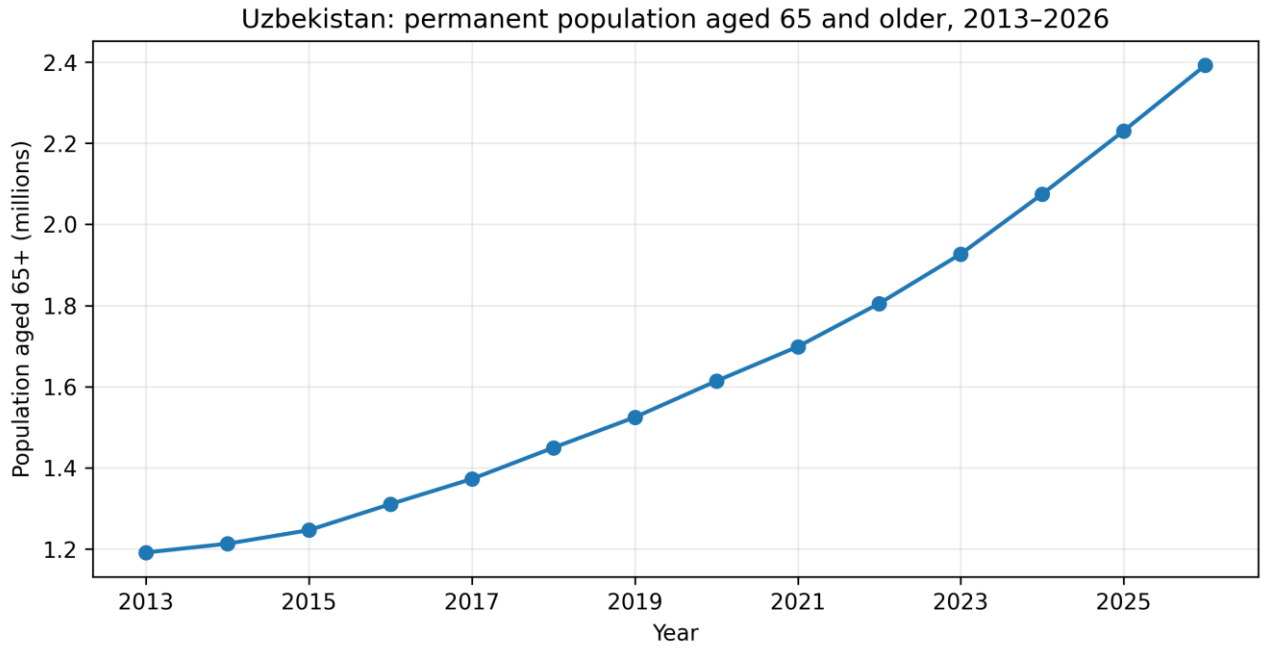



**Figure 1. Permanent population aged 65 and older in Uzbekistan, 2013–2026**

*Source: Authors' calculations based on National Statistics Committee SIAT indicator 2.01.02.0019 (accessed July 27, 2026).*

The annual series shows a 100.8% increase between 2013 and 2026 and a 48.2% increase since 2020. The trend establishes urgency, but it should not be interpreted as the number of persons requiring long-term care. The measurement gap is therefore central: population aging must be linked to functional status, care hours, service access, and labor-market outcomes.

The 2024 household evidence provides a stronger indication of burden. Among caregivers aged 60–70, reported weekly eldercare averaged 43.79 hours, with women reporting 46.99 hours and men 31.47 hours (UNDP, 2024). Respondents strongly preferred personal or family care over institutional options, while quality and cost concerns limited demand for institutional care. This preference is not itself a problem. The labor-market risk arises when home-based care is supplied without respite, visiting services, income protection, or flexible work arrangements.

## 4. Caregiver Decent Work Risk Index: Reproducible Specification

### 4.1. Index purpose and construction

The Caregiver Decent Work Risk Index (CDWRI) is a formative policy measure: its components jointly constitute risk rather than reflect a single latent trait. It is intended for distributional monitoring and evaluation, not as an automatic rule for

granting or denying a benefit. Equal normative weights are the primary specification because they are transparent; principal-component weights are reserved for sensitivity analysis and do not replace policy judgment. Appendix B provides the variable-level codebook, reference periods, thresholds, and exact 0-1 transformations.

Each item is coded on a 0-1 risk scale. Binary risks take values 0 or 1; ordinal items use pre-specified intermediate values; and continuous items are capped at stated lower and upper policy thresholds and linearly rescaled. Protective indicators are reverse-coded. The primary specification avoids item-level imputation and prevents the same condition from being counted in more than one dimension; for example, sleep duration is included only under caregiver health, while time poverty is measured through care intensity, night care, unpredictability, simultaneous childcare, and insufficient discretionary time.

$$z_{ij} = min\{1, max[0, \frac{x_{ij} - L_j}{U_j - L_j}]\} \quad (1)$$

Within each dimension, a score is calculated only when at least 60% of the listed items are observed. The overall index is calculated only when all six dimension scores are available and is the equally weighted sum of those dimension scores, with each weight equal to one-sixth. Multiple imputation, alternative thresholds, and alternative weights are reserved for sensitivity analysis and will be reported separately from the primary score.

$$CDWRI_i = \frac{D_{i1} + D_{i2} + D_{i3} + D_{i4} + D_{i5} + D_{i6}}{6}, \; w_1 = \cdots = w_6 = \frac{1}{6} \quad (2)$$

For descriptive reporting, provisional bands are low risk (0.00-0.32), moderate risk (0.33-0.66), and high risk (0.67-1.00). These bands are not eligibility cutoffs and must be validated against subsequent employment loss, contribution interruption, caregiver health, and unmet care need before any administrative use. Results will be reported by sex, age, region, rural or urban residence, household income, employment form, care intensity, and the recipient's functional, cognitive, and dementia status.

**Table 3. Operational specification of the CDWRI**

| Dimension | Core indicators | Coding rule | Potential data source |
|---|---|---|---|
| 1. Care intensity and time poverty | Weekly care hours; night care; short-notice care; simultaneous childcare; insufficient discretionary time | Hours: 0 below 10, linear to 1 at 40 or more; night care and unpredictability use 0/0.5/1; childcare is binary; discretionary time is 0 at 14 or more hours per week and 1 below 7 | Caregiver module; time-use diary |
| 2. Employment disruption | Care-related work exit; reduced paid hours; absence; job change; declined training or promotion; early retirement | Binary events; hours reduction is 0 below 10%, 0.5 at 10-19%, and 1 at 20% or more; absence is 0 for 0-1 day, 0.5 for 2 days, and 1 for 3 or more days in four weeks | Labor-force survey; employer and payroll records |
| 3. Income vulnerability | Earnings loss; care-spending share; no independent income; care-related debt or asset sale | Earnings loss is capped at 30%; care spending is 0 at 5% or less and 1 at 20% or more of disposable income; remaining items are binary | Household budget survey; tax and payment data |
| 4. Social-protection gap | No registered employment or credited status; contribution density; no care leave; no coverage during interruption; benefit non-take-up | Contribution risk = max[0, 1 - density/0.75] over 12 months; other applicable items are binary | Employment, pension, insurance, and benefit registries |
| 5. Health and psychosocial strain | Self-rated health; PHQ-2; musculoskeletal pain; sleep duration; unmet health care | Health and pain use 0/0.5/1; PHQ-2 is score divided by 6; sleep is 0 at 7 or more hours, 0.5 at 6-6.9, and 1 below 6; unmet care is binary | Health module; primary-care records with consent |
| 6. Access to support | Unmet need for home care, respite or day care, assistive technology, or training; travel barrier; no case manager | Unmet applicable needs are binary; travel is 0 at 30 minutes or less, 0.5 at 31-60 minutes, and 1 above 60 minutes or unavailable | Service records; geospatial data; social-protection registry |

Source: Developed by the authors. The full variable-level codebook and exact thresholds are provided in Appendix B.

## 5. Primary Empirical Strategy

### 5.1. Prospective common-start matched-district difference-in-differences design

The primary empirical design is a prospective common-start difference-in-differences evaluation in future expansion districts that have not yet received the integrated support package. National implementation may proceed in phases, but the evaluation cohort will use one synchronized service-activation date across 12 treatment districts after completion of baseline measurement; 12 matched comparison districts will remain unexposed through the 12-month primary follow-up. Matching variables will include pre-treatment demographics, disability prevalence, service capacity, urbanization, poverty, and employment structure. Existing service pilots in Samarkand and Fergana regions and Tashkent city are excluded from the primary causal sample because a true pre-service baseline can no longer be collected there; they may contribute descriptive implementation evidence and retrospective administrative histories only. The evaluated package will combine standardized functional assessment, mobile home care, day or respite services, caregiver training, assistive-technology referral, and digital case management.

The primary study population will include unpaid caregivers aged 18-64 who provide at least weekly assistance to adults aged 70 or older with documented ADL, IADL, cognitive, or supervision needs. Care intensity will be measured continuously and by pre-specified categories (<10, 10-19, 20-39, and >=40 hours per week). A separately recruited secondary sample will

include caregivers of working-age adults with severe disabilities; its estimates will not be pooled with the primary eldercare sample. A pre-specified dementia subgroup will identify diagnosed or suspected dementia, daily supervision hours, night supervision, wandering or other behavioral symptoms, medication and monitoring costs, and demand for respite care.

The planning target is 24 districts (12 treatment and 12 comparison) with 50 primary-sample caregivers per district at baseline (n = 1,200). Allowing for 15% attrition yields an expected 12-month sample of approximately 1,020 caregivers. Under equal allocation, a two-sided alpha of 0.05, and an intracluster correlation of 0.03, this planning design has approximately 80% power to detect an effect of about 0.26 standard deviations, equivalent to roughly 13 percentage points for a binary outcome with prevalence near 0.50. This is an ex ante planning calculation rather than a final power determination; the required sample will be updated using pilot variances, attrition, and pre-period outcome correlations. Because 24 districts remain a modest number of clusters, the primary cluster-robust estimates will be accompanied by wild-cluster-bootstrap confidence intervals and randomization or permutation inference.

For individual i in district d and period t, the primary estimating equation is:

$$Y_{idt} = \alpha + \beta(Treated_d \times Post_t) + \gamma X_{idt} + \mu_d + \lambda_t + \varepsilon_{idt} \quad (3)$$

Y includes employment, weekly paid hours, monthly earnings, formal-employment status, contribution density, CDWRI, caregiver health, and unmet ADL or IADL need. X contains baseline age, sex, education, household composition, pre-treatment employment, recipient functional and cognitive status, dementia indicators, and care intensity. The model includes district and period fixed effects, and standard errors are clustered at the district level. The coefficient beta estimates the intention-to-treat effect under the parallel-trends assumption. Hospital use and entry into residential care will be treated as secondary long-term outcomes with 24-36 months of administrative follow-up; the 12-month study is not presented as powered to establish effects on these relatively infrequent outcomes.

**Table 4. Pre-specified hypotheses and outcomes**

| Hypothesis | Expected effect | Primary outcome |
|---|---|---|
| H1 | The integrated support package increases caregiver employment and working hours. | Employment probability; weekly paid hours |
| H2 | The package reduces the risk of informalization and contribution interruption. | Formal contract; months contributed/months observed |
| H3 | Effects are larger for women, caregivers providing at least 20 hours per week, and caregivers of recipients with diagnosed or suspected dementia or intensive supervision needs. | Pre-specified sex, intensity, and dementia or supervision interactions |
| H4 | The integrated package reduces the recipient's unmet ADL and IADL care needs at 12 months. | Unmet ADL and IADL need; hospital use and residential-care entry are secondary 24-36-month outcomes |
| H5 | The integrated package reduces total CDWRI and its time-poverty, employment-disruption, and health-strain dimensions. | CDWRI total and six dimension scores; component take-up used for exploratory mechanism analysis |

*Source: Developed by the authors.*

The main identification risks are non-random district selection, concurrent reforms, caregiver migration, differential take-up, and limited cluster count. Mitigation measures include pre-treatment outcome histories, matched district selection, a public synchronized rollout calendar, an intention-to-treat primary analysis, and sensitivity checks for composition changes. An event-study graph will be used only as a diagnostic for pre-trends and dynamic effects, not as a separate identification strategy. Inference will report conventional district-clustered results together with wild-cluster-bootstrap and permutation-based sensitivity estimates.

### 5.2. Minimum linked-data architecture

The survey should be linked, with informed consent and secure pseudonymous identifiers, to employment and payroll records, pension and social-insurance contributions, social benefits, disability and functional assessments, use of mobile, day, and respite services, and regional provider availability. The 2026 care-system review reports that functional assessments already use the Barthel and Lawton scales and are recorded in the Unified National Social Protection System, providing an institutional starting point for measurement (UNDP, 2026a). The caregiver module will additionally record diagnosed or suspected dementia, supervision hours, night care, behavioral symptoms, medication and monitoring expenses, and respite-service use so that dementia-related caregiving can be analyzed as a pre-specified subgroup.

Data governance must specify purpose limitation, minimum necessary access, retention periods, audit trails, independent ethical review, and a prohibition on using the CDWRI as an automated exclusion rule. Public outputs should be aggregated and disclosure-controlled. Caregivers must be able to participate in services without consenting to research linkage.

## 6. Institutional Feasibility and Policy Tests

The proposed evaluation is anchored in reforms already under way. Uzbekistan's National Agency for Social Protection oversees care policies for older persons and persons with disabilities, while local "Inson" centers coordinate needs assessment and services. Cabinet of Ministers Resolution No. 316 of May 31, 2024 established Social Support Centers and authorized experimental mobile, day, short-term, and long-term social and rehabilitation services in Samarkand and Fergana regions and Tashkent city (Republic of Uzbekistan, 2024; UNDP, 2026a). Because these locations have already been exposed, they will not serve as prospective treatment districts in the primary difference-in-differences design. The common-start evaluation will instead

be embedded in future expansion districts not yet receiving the integrated package; current pilot locations may inform implementation protocols, cost categories, and service-quality measures.

Policy proposals should be separated by evidentiary status. Immediate measurement reforms are justified by documented data gaps. Pilot components should be tested before national expansion. Large-scale entitlements should be contingent on effectiveness, distributional impact, administrative feasibility, and fiscal analysis.

**Table 5. Evidence-to-policy roadmap**

| Stage | Instrument | Evidence status | Potential lead actors |
|---|---|---|---|
| Immediate measurement reform | Add caregiver and functional-need modules; establish operational caregiver definition; adopt linkage and privacy protocol | Measurement gap documented in UNDP and WHO frameworks | National Statistics Committee; NASP; Ministry of Health |
| Pilot service package | Mobile home care, respite/day services, training, assistive-technology referral, case management | Strong home-care preference and high care intensity; existing pilot institutions | NASP; Inson centers; local governments; accredited providers |
| Pilot employment protection | Emergency care leave and right to request temporary schedule flexibility in participating employers | International evidence that working conditions affect adult-care supply | Ministry of Employment; employers' and workers' organizations |
| Pilot social-insurance protection | Time-limited contribution credits for verified high-intensity caregiving | Cumulative contribution and pension risk; ILO policy framework | Ministry of Economy and Finance; social-insurance and pension authorities |
| Conditional scale-up | National financing, benefit rules, and provider expansion only after evaluation | Requires causal, fiscal, quality, and equity evidence | Cabinet of Ministers and responsible agencies |

*Source: Developed by the authors. Institutional assignments are proposed for discussion and do not assert a final governmental mandate.*

## 7. Discussion

The framework deliberately avoids presenting a proposed index as an accomplished measurement of hidden cost. Instead, it distinguishes descriptive evidence, a reproducible measurement instrument, and a pre-specified causal evaluation. This separation is essential because caregiving and labor-market attachment are jointly determined.

The Uzbekistan case has broader value for long-term-care economics. Much of the causal literature is based on high-income countries with mature administrative data and established care programs. Many middle-income countries face aging before they have comprehensive long-term-care financing or workforce systems. They also combine family-centered care, labor-market informality, and rapidly expanding digital social-protection systems. A low-cost caregiver module and governed record linkage can therefore generate internationally comparable evidence before large programs become institutionally fixed.

Several limitations remain. The cited household study is cross-sectional and does not provide the authors with microdata for independent re-estimation. Reported care hours may include overlapping household tasks. National administrative linkage requires legal authorization and technical testing. The provisional CDWRI thresholds require predictive and distributional validation. The proposed sample size and minimum detectable effect are planning values that must be recalculated with pilot variance, attrition, and intracluster-correlation estimates. Finally, service expansion may change both caregiver behavior and the reporting of unmet need. These limitations are incorporated into the proposed design rather than treated as completed analytical tasks.

## 8. Conclusion

Informal long-term care has high social value, but its labor-market cost should not remain invisible. Uzbekistan's population aged 65 and older doubled between 2013 and 2026, and nationwide household survey evidence indicates intensive, gendered eldercare. These facts establish urgency but do not by themselves identify causal employment losses or the number of persons needing long-term care.

The framework offers a defensible next step: functional-need measurement, a transparent formative CDWRI, linked employment and social-protection records, and a prospective common-start matched-district difference-in-differences evaluation in future expansion districts. The central test is whether home- and community-based support can reduce excessive care intensity and caregiver risk while maintaining or improving recipient outcomes. Families may choose to provide care, but policy should prevent that choice from being financed through avoidable losses of employment, income, health, and pension rights.

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## Appendix A. Minimum Caregiver Module and Dementia Addendum

The following minimum module is designed for baseline and follow-up interviews. Unless otherwise stated, the reference period is the previous four weeks. Administrative-linkage consent is requested separately and is not a condition for receiving services.

**Table A1. Minimum caregiver module**

| Variable/module | Question or content | Primary response/coding |
|---|---|---|
| A1. Caregiving screen | During the last four weeks, did you provide unpaid help to an adult because of age, chronic illness, disability, or cognitive limitation? | Yes/No. Continue only for Yes. |
| A2. Recipient profile | Recipient age, relationship, co-residence, and number of people to whom care is provided. | Age in years; categorical relationship; co-residence 0/1. |
| A3. Functional need | Difficulty with ADLs and IADLs; available Barthel and Lawton scores; need for supervision. | Item responses and linked scale scores; identify documented functional need. |
| A4. Dementia and cognition | Diagnosed dementia; suspected cognitive impairment; memory problems; wandering, agitation, or other behavioral symptoms. | Diagnosis 0/1; suspected impairment 0/1; symptoms by frequency. |
| A5. Care intensity | Usual weekly care hours, days per week, night-care nights, short-notice episodes, and supervision hours per day. | Continuous hours plus pre-specified categories; night and unpredictability coding in Appendix B. |
| A6. Competing time demands | Simultaneous childcare and weekly hours available for rest, personal needs, learning, and social participation. | Regular simultaneous childcare 0/1; discretionary hours per week. |
| A7. Employment adjustment | Care-related work exit, delayed job entry, paid-hours reduction, absence, job change, declined training or promotion, and early retirement. | Event indicators; timing and stated care-related reason. |
| A8. Earnings and care costs | Current earnings loss attributable to care; out-of-pocket spending on medication, transport, equipment, paid help, and monitoring. | Currency amounts and shares of personal earnings and household disposable income. |
| A9. Social protection | Registered employment or self-employment, contribution months, access to care leave, coverage during interruption, and eligible benefits received. | Administrative values where available; self-report otherwise. |
| A10. Caregiver health | Self-rated health, PHQ-2 items, musculoskeletal pain, average sleep duration, and unmet personal health care. | Standard response scales and thresholds in Appendix B. |
| A11. Service access and use | Home care, respite or day care, assistive technology, caregiver training, travel time, named case manager, and actual package-component use. | Need, availability, use, frequency, and travel minutes. |
| A12. Preferences and linkage | Preferred future care arrangement; desired amount of family care with adequate formal support; separate consent for secure record linkage. | Categorical preference; consent Yes/No. Service eligibility is independent of research consent. |

*Source: Developed by the authors. The module should be cognitively tested and translated through forward and backward translation before field use.*

## Appendix B. CDWRI Variable-Level Codebook

All item risks range from 0 (lowest observed policy risk) to 1 (highest). Dimension scores are arithmetic means of observed items when at least 60% are available. The primary overall CDWRI requires all six dimension scores and uses equal weights of one-sixth. 'Not applicable' is treated as missing rather than automatically coded as risk.

**Table B1. CDWRI item definitions and coding**

| Dimension | Variable | Raw measure | Exact primary risk coding (0-1) | Reference period |
|---|---|---|---|---|
| 1. Care intensity/time poverty | Weekly care hours | Usual hours/week | 0 if <10; (hours-10)/30 for 10-39.9; 1 if >=40 | Previous 4 weeks |
| 1. Care intensity/time poverty | Night care | Nights with care/supervision | 0 none; 0.5 for 1-2 nights/week; 1 for >=3 nights/week | Previous 4 weeks |
| 1. Care intensity/time poverty | Short-notice care | Frequency of unplanned episodes | 0 never/rarely; 0.5 sometimes; 1 often/always | Previous 4 weeks |
| 1. Care intensity/time poverty | Simultaneous childcare | Regular care of child under 14 while caregiving | 0 no; 1 yes | Current |
| 1. Care intensity/time poverty | Discretionary time | Hours/week for rest, personal needs, study, or social life | 0 if >=14; 0.5 if 7-13.9; 1 if <7 | Previous 4 weeks |
| 2. Employment disruption | Work exit | Left paid work because of care | 0 no; 1 yes | Previous 12 months |
| 2. Employment disruption | Paid-hours reduction | Percentage reduction attributable to care | 0 if <10%; 0.5 if 10-19%; 1 if >=20% | Previous 4 weeks |
| 2. Employment disruption | Care-related absence | Paid workdays missed | 0 for 0-1 day; 0.5 for 2 days; 1 for >=3 days | Previous 4 weeks |
| 2. Employment disruption | Job change | Changed job or occupation because of care | 0 no; 1 yes | Previous 12 months |
| 2. Employment disruption | Opportunity declined | Declined training or promotion because of care | 0 no; 1 yes | Previous 12 months |
| 2. Employment disruption | Early retirement | Retired earlier than planned because of care | 0 no; 1 yes | Previous 12 months |
| 3. Income vulnerability | Earnings loss | Care-attributable loss/current counterfactual earnings | 0 if no loss; loss share/0.30 up to 1; 1 at >=30% | Current month |
| 3. Income vulnerability | Care-spending burden | Out-of-pocket care spending/household disposable income | 0 if <=5%; (share-0.05)/0.15 for 5-20%; 1 if >=20% | Previous month |
| 3. Income vulnerability | No independent income | No personal labor, pension, or benefit income | 0 no; 1 yes | Current |
| 3. Income vulnerability | Debt or asset depletion | Borrowed, sold assets, or drew down savings because of care | 0 no; 1 yes | Previous 12 months |
| 4. Social-protection gap | Unregistered status | No registered employment/self-employment and no credited care period | 0 registered or credited; 1 neither | Current |
| 4. Social-protection gap | Contribution density | Months contributed/months observed | max[0, 1 - density/0.75]; 0 at density >=0.75 | Previous 12 months |
| 4. Social-protection gap | No care leave | No statutory or contractual care-leave access | 0 access; 1 no access | Current job |
| 4. Social-protection gap | No interruption coverage | No insurance/contribution protection during care-related interruption | 0 covered; 1 not covered | Most recent interruption |
| 4. Social-protection gap | Benefit non-take-up | Eligible caregiver/recipient benefit not received | 0 received; 1 eligible but not received; missing if not eligible | Current |
| 5. Health/psychosocial strain | Self-rated health | Very good to very poor | 0 good/very good; 0.5 fair; 1 poor/very poor | Current |
| 5. Health/psychosocial strain | PHQ-2 | Two-item score 0-6 | Score/6; additionally flag score >=3 | Previous 2 weeks |
| 5. Health/psychosocial strain | Musculoskeletal pain | Pain and activity limitation | 0 none/mild without limitation; 0.5 moderate; 1 severe or activity-limiting | Previous 4 weeks |
| 5. Health/psychosocial strain | Sleep duration | Average hours/night | 0 if >=7; 0.5 if 6-6.9; 1 if <6 | Previous 2 weeks |
| 5. Health/psychosocial strain | Unmet own health care | Needed but did not obtain care because of time, cost, or care duty | 0 no; 1 yes | Previous 12 months |
| 6. Access to support | Unmet home-care need | Assessed need but no accessible home-care service | 0 no unmet need; 1 unmet need | Current |
| 6. Access to support | Unmet respite/day-care need | Needed but unavailable/unaffordable | 0 no unmet need; 1 unmet need | Current |
| 6. Access to support | Unmet assistive-technology need | Assessed need but device not obtained | 0 no unmet need; 1 unmet need | Current |
| 6. Access to support | No caregiver training | No relevant information or training received | 0 received; 1 not received | Previous 12 months |
| 6. Access to support | Travel barrier | One-way travel to nearest relevant service | 0 <=30 min; 0.5 for 31-60 min; 1 >60 min or unavailable | Current |
| 6. Access to support | No case manager | No named service contact/case manager | 0 named contact; 1 none | Current |

*Source: Developed by the authors. Thresholds are pre-specified for the pilot and must be tested through sensitivity, predictive-validity, and distributional analyses before administrative use.*