Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Caregiver training, community long-term care service receipt, and family caregiver burden among older adults in Thailand: A secondary analysis of a national survey

Thitinan Duangjina

thitinan.d@cmu.ac.th

Faculty of Nursing, Chiang Mai University

Mia Cajita

College of Nursing, University of Illinois Chicago

Jittawadee Rhiantong

Faculty of Nursing, Chiang Mai University

Phanida Juntasopeepun

Faculty of Nursing, Chiang Mai University

Research Article

Keywords: caregiver burden, family caregivers, long-term care, home care services, caregiver training, activities of daily living, aged, cross-sectional studies, Thailand

Posted Date: November 25th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11240337/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Family caregivers provide most long-term care for older adults in Thailand. Previous analyses of the 2021 National Survey of Older Persons identified correlates of caregiver burden but did not separate caregiver-directed training from care-recipient-directed services, and whether reported formal training is associated with lower burden independently of care demands, and across levels of functional dependency, is unknown. We examined these questions and the association between receipt of community long-term care services and burden.

Methods

A cross-sectional secondary analysis of the 2021 (7th) National Survey of Older Persons in Thailand included 2,994 family caregiver–older adult dyads, representing approximately 975,070 older adults. Caregiver burden was measured on a 0–10 global scale. Covariates were prespecified using the Pearlin Stress Process Model. Survey-weighted fractional logistic regression accounted for the complex sampling design, with average marginal effects (AMEs) and bootstrap 95% confidence intervals (CIs).

Results

Most caregivers had received no training (87.7%); 5.7% reported formal and 6.6% informal training. Reported formal training was associated with lower burden (AME = − 1.23 points; 95% CI: −1.79 to − 0.68), whereas informal training was not (AME = − 0.12; 95% CI: −0.60 to 0.37). The association differed by functional dependency (interaction p = 0.020): formal training was associated with lower burden among caregivers of socially active older adults (independent in daily activities) but estimates among caregivers of home-bound and bed-bound older adults were imprecise (24 and 29 formally trained caregivers, respectively). Receipt of community long-term care services was not associated with burden. Leaving paid employment (AME = + 1.07; 95% CI: 0.61 to 1.52) and greater functional dependency (AMEs + 0.80 and + 1.02) were associated with higher burden.

Conclusions

Reported formal training was associated with lower caregiver burden, whereas receipt of community long-term care services was not. The training association was estimated with precision only among caregivers of socially active older adults. The adjusted association was robust to model specification but, because training uptake is selective and the design is cross-sectional, does not establish an effect of training. Prospective studies should evaluate caregiver training across levels of care demand and modes of delivery.

Background

Most older adults in Thailand who need help with daily activities are cared for at home by a family member, often a daughter or spouse with limited formal education and little preparation for the caregiving role [1]. Family caregivers carry out the continuous work of bathing, lifting, feeding, monitoring symptoms, managing medicines, and deciding when professional help is needed. As the number of older adults requiring assistance with daily activities is projected to increase several-fold over the next two decades [2], the demands placed on families will become more consequential for long-term care planning. Family caregiving therefore creates a dual policy concern: the family member is both a principal source of care and a person exposed to its demands. Caregiver burden, the caregiver's global appraisal of how difficult caregiving has become [3], is relevant to long-term care because caregiver-directed training, assessment, and support are potentially actionable, while community services can be organized around the older adult's care needs [4, 5].

Thailand has invested substantially in long-term care for dependent older adults. Since 2016, the national long-term care benefit has supported home- and community-based care delivered through trained caregivers, care managers, and village health volunteers; by 2018, approximately 77,000 caregivers and 12,800 care managers had been trained [6, 7]. The family caregiver, however, remains the person continuously present in the home and may or may not receive training specifically for that role.

Caregiver burden is generally higher when older adults are more functionally dependent and caregiving is more intensive, and it is associated with disruption of the caregiver's employment and other roles [4, 8–10]. Caregiver preparedness and social support, in contrast, have been associated with lower burden in some studies [5, 11, 12]. Caregiver training may represent one modifiable pathway through which caregivers acquire knowledge and skills relevant to preparedness, although training and preparedness are conceptually distinct constructs [13, 14]. Training has been proposed as a potentially modifiable form of support because it can provide knowledge and practical skills for managing daily care tasks, symptoms, and care-related decisions. Intervention studies in settings outside Thailand have reported improvements in caregiver preparedness and, in some cases, in caregiver burden and distress following educational or skills-based interventions [5, 15–17]; however, the content, delivery, and intensity of training vary substantially across settings, and evidence from observational, population-based studies remains limited. Although caregiver training and community long-term care services may both be described broadly as forms of caregiving support [11, 12], they represent distinct health-system inputs: training is directed to the caregiver, whereas community long-term care services are directed primarily to the care recipient. Distinguishing these inputs is important because their relationships with caregiver burden may operate through different pathways.

In Thailand, the National Survey of Older Persons (NSOP) provides the principal nationally representative source for measuring caregiver burden. Two studies have analysed the burden item introduced in the 2021 wave [18, 19]. One identified correlates of burden across caregiver, family, and older-adult domains, reporting higher burden among caregivers who had left the workforce and among those caring for older

adults in poorer health or with greater dependency [18]; the other compared burden across types of sensory impairment [19]. Both were designed to identify correlates of burden, and the caregiver module has otherwise been used less extensively than the survey's modules on older adults [20, 21]. Neither separated formal from informal caregiver training, treated training as an exposure of interest, incorporated the complex survey design into estimation, or retained the original 0–10 burden scale, which they dichotomized or split at the median. It therefore remains unknown whether caregiver-directed training is associated with lower burden at the population level, after accounting for the older adult's dependency and caregiving intensity, and whether this association is similar across levels of functional dependency within Thailand's community-based long-term care system. The present study addresses this gap by distinguishing caregiver-directed training from care-recipient-directed community services, retaining the bounded burden scale, incorporating the national survey design, and testing whether the training–burden association varies by functional dependency.

We used Pearlin's Stress Process Model as a theory-informed framework for organizing study variables and prespecifying covariates rather than as a causal model to be empirically tested [22]. The model distinguishes background and contextual characteristics, primary stressors arising from the caregiving situation, secondary stressors that extend into other social roles, and mediating resources such as coping and social support. Functional dependency, caregiving hours, and care-recipient health conditions were treated as primary stressors, and leaving paid employment as a secondary stressor because caregiving had extended into the occupational role. Caregiver, family, household, and socioeconomic characteristics and receipt of community long-term care services were treated as background and context; service receipt was not classified as social support because the NSOP records an externally provided service rather than caregivers' perceived support, a distinction Pearlin and colleagues drew explicitly. Its placement therefore reflects the measurement available in the NSOP rather than an assumption that service receipt cannot function as a resource in the caregiving process. Three departures from the model should be noted. Caregiver training is not an explicit construct in the model and was placed in the background and context domain as a characteristic brought to the caregiving role, a placement intended to guide variable selection rather than to imply a mechanism. The NSOP measures neither coping nor perceived social support, so the mediator domain could not be examined, and it measures neither cognitive status nor problematic behavior. Finally, the burden item is a global subjective appraisal rather than one of Pearlin's specified outcomes. Additional file 1: Table S1 maps each variable to its domain.

This study therefore aimed, in a nationally weighted sample of Thai family caregivers, (1) to examine whether caregiver burden is associated with reported formal or informal caregiver training and with receipt of community long-term care services, after accounting for caregiving demands; (2) to test whether the association between formal training and burden differs by the older adult's level of functional dependency; and, as a secondary analysis, (3) to quantify the extent to which the association between dependency and burden is attenuated after accounting for the caregiver having left paid employment to provide care and for weekly caregiving hours.

Methods

Study design and data source

This was a cross-sectional secondary analysis of the 2021 (7th) Thailand National Survey of Older Persons, reported according to the STROBE statement [23]. The NSOP is conducted by the National Statistical Office of Thailand using a stratified two-stage sampling design. Provinces, cross-classified by municipal and non-municipal area, form the strata; enumeration areas (blocks or villages) are selected at the first stage and private households at the second. The 2021 survey enumerated 209,409 individuals in sampled households nationwide. Section 8 of the questionnaire is administered when an older person is identified as requiring assistance and a primary caregiver can be identified; the caregiver is then interviewed directly.

Sample

Eligibility for the present analysis was (a) a primary caregiver identified and successfully interviewed (n = 3,724); (b) care recipient aged 60 years or older (n = 3,310); (c) a family caregiver, defined as spouse, child or child-in-law, grandchild, sibling or other relative, or parent (n = 3,243), excluding 67 dyads whose primary caregiver was a paid employee, domestic worker, neighbor, or health worker; and (d) a caregiver aged 20 years or older, as specified in the approved protocol (n = 3,206), excluding 36 dyads with a younger caregiver and one whose caregiver's age was not recorded. Caregiver burden was recorded for all 3,206 dyads. A further 212 dyads (6.6%) had missing data on one or more model covariates, leaving 2,994 dyads for complete-case analysis, representing an estimated 975,070 older adults with an identified family primary caregiver when survey weights are applied (Figure 1).

Missingness was confined to eight covariates and did not exceed 2.9% for any of them; burden, training, caregiving hours, and employment cessation were complete. Excluded and included dyads were similar in caregiver and care-recipient age and in household size, but excluded dyads had slightly higher mean burden (unweighted 3.67 vs. 3.19), more bed-bound care recipients (23.4% vs. 13.7%), and less formal training (1.4% vs. 6.0%; Additional file 1: Table S2). Because this pattern was not consistent with data missing completely at random, complete-case analysis was retained as the prespecified primary analysis to preserve a directly observed analytic sample, and multiple imputation was used to assess sensitivity to potentially informative missingness.

Study variables

Outcome. Caregiver burden was measured with a single global item: "How much does the caregiver feel that caring for the older person is a burden or difficulty?", scored from 0 (none) to 10 (the most). Single global burden items are used in population surveys when respondent burden and questionnaire length constrain longer instruments [24].

Caregiver-directed training. The caregiver was asked, "Has [name] received training in older persons care?", with four response options: never; formal training of less than 3 days; formal training of 3 days or more; and informal training. The two formal-training categories were combined because of small numbers, giving three levels: none, reported formal training, and informal training. The distinction between formal and informal training was retained because Thailand's long-term care system differentiates structured caregiver training from less formal orientation [6]. The relevant national context is the Department of Health's standardized caregiver curriculum, a 70-hour course combining theoretical instruction and supervised practice that prepares caregivers to support dependent older adults in home- and community-based long-term care, alongside a longer 420-hour curriculum for professional caregivers [25]. The NSOP recorded training duration only as less than or at least 3 days and did not record the curriculum, provider, content, timing relative to the start of caregiving, or refresher training. Reported formal training therefore cannot be equated with completion of the national curriculum and was analysed as reported receipt only.

Care-recipient-directed community services. For the previous 12 months, the survey recorded whether the dyad had received (a) home or community care or advice to relatives and caregivers from public health officials, (b) services from the Local Administrative Organization, and (c) care from community volunteers, older-person caregivers, or assistant caregivers. For each domain, non-receipt was classified according to the reported reason as unmet need (inaccessibility of entitlement or lack of information) or no expressed need (did not want the service or had previously received it). These responses were combined into a four-level dyad-level typology used consistently across analyses.

Primary stressors. Care-recipient functional status was classified using the NSOP's standard activities of daily living categories: socially active (independent in daily activities and able to leave the home), home-bound (able to manage within the home but unable to go out unaided), and bed-bound (confined to bed or chair). These labels describe functional status, not social participation. Additional indicators were poor or very poor self-rated health; vision, hearing, and chewing impairment; any fall in the previous six months; caregiving hours per week (<1, 1–8, 9–20, 21–40, >41); and care-recipient age and sex.

Secondary stressor. The survey asked whether the caregiver had left paid employment to provide care. This represents role exit rather than the ongoing job–caregiving conflict measured in Pearlin's original work.

Background and context. Caregiver sex, age, and education; relationship to the care recipient; co-residence; household size; caregiver monthly income; household debt; region; and municipal area were treated as contextual characteristics. Caregiver sex was retained as a prespecified covariate because it is itself associated with reported burden [26]. Income and household debt were retained as indicators of current socioeconomic position rather than caregiving-related economic strain, because the NSOP does not measure changes in income attributable to caregiving.

Data analysis

All estimates incorporated the complex survey design using Taylor-series linearization: population weights, strata defined by province × municipal area (153 strata), and households as primary sampling units. Because enumeration-area identifiers were unavailable in the released microdata, variance estimation could not account for clustering below the household level. Analyses used R 4.3.3 with the *survey* package [27].

Because the outcome is bounded on [0, 10] with 28.3% of observations at the lower bound, the primary model was a survey-weighted fractional logistic regression (quasi-binomial generalized linear model with a logit link) fitted to burden rescaled to [0, 1] [28]. This approach requires only that the conditional mean be correctly specified, respects the bounds of the scale, and yields predictions that cannot fall outside them. Ordinal, beta [29], and two-part alternatives were considered and the reasons for not adopting them are set out in Additional file 1: Note S2. Results are reported as coefficients and as average marginal effects (AMEs) on the original 0–10 scale. Confidence intervals for AMEs and all derived quantities came from 400 subbootstrap replicate weights generated from the survey design using Rao and Wu's rescaled bootstrap for stratified multistage designs [30], chosen because many strata contained few sampled households; Monte Carlo precision is reported in Additional file 1: Note S1.

The covariate set was specified in advance from the conceptual framework and entered as a single model. No variable was selected, retained, or removed on the basis of a *p*-value, and no stepwise or bivariate screening was performed. One interaction, formal training × functional dependency, was prespecified because the association between training and burden may differ according to the intensity of care demand; it was tested with a design-based Wald test and, if supported, followed by preplanned stratified estimation, interpreted cautiously where the number of formally trained caregivers was small.

A secondary analysis quantified how much of the fitted association between functional dependency and burden was accounted for by two measured secondary strains, leaving paid employment and weekly caregiving hours, using regression-based statistical apportionment with the full covariate set. We use "component" or "apportionment" rather than "mediation" because the cross-sectional data do not satisfy the temporal and confounding assumptions required for causal mediation: dependency was measured at interview, whereas employment cessation was reported retrospectively and had occurred a median of three years earlier. Every equation is a weighted linear model fitted to the same dyads with the same covariates, so that the components sum to the total exactly; dependency was modeled as an ordered three-level variable with each one-level increase assumed to have the same effect, whereas the primary model retains dependency as categorical. Because caregiver income may itself be affected by employment cessation, a sensitivity analysis excluded income from the adjustment set. The full formulation is given in Additional file 1: Note S3.

Missing covariate data were addressed in sensitivity analysis by multiple imputation by chained equations [31]: 20 imputed datasets over 10 iterations, with predictive mean matching for continuous, logistic regression for binary, and polytomous regression for unordered categorical variables. The imputation model contained every analysis variable, including the outcome, and the logarithm of the

sampling weight. The primary model was fitted to each imputed dataset with the full design and estimates were combined by Rubin's rules [32]. Further sensitivity analyses addressed alternative outcome specifications (proportional-odds ordinal regression, survey-weighted linear regression, and threshold-specific logistic models at each burden cut-point), survey-design assumptions (an unweighted model and a weighted model without strata or clustering), sample restrictions (inclusion of caregivers aged under 20 years; restriction to home-bound and bed-bound dyads), and covariate specification (omission of employment cessation, of income and debt, addition of a proxy-reported speaking, hearing, or memory problem, and a minimally adjusted model). Results were interpreted with reference to effect estimates, confidence intervals, and clinical relevance rather than statistical significance alone.

Ethics statement

The analysis used de-identified secondary data obtained under written permission from the National Statistical Office of Thailand, which obtained informed consent from participants at the time of the original survey. The secondary analysis was reviewed and granted exemption by the research ethics committee of the authors' institution (Protocol No. 2569-EXEM012).

Use of large language models

During the preparation of this manuscript, the authors used ChatGPT (OpenAI) to assist with language editing, formatting of the manuscript to the journal's requirements, and preparation of figures from the authors' analytical output. The tool was not used to generate study content, conduct analyses, or interpret findings. The authors reviewed and revised all AI-assisted material and take full responsibility for the accuracy, integrity, and content of the publication.

Results

Sample characteristics

Table 1 presents the survey-weighted characteristics of the 2,994 caregiver–older adult dyads. Care recipients had a mean age of 78.2 years and 61.8% were women; 68.7% were socially active, 18.8% home-bound, and 12.5% bed-bound. Caregivers had a mean age of 54.2 years and 77.0% were women. Most had primary education or less (54.0%), were adult children or children-in-law (62.0%), and lived with the care recipient (91.7%). Mean caregiver burden was 3.08 (95% CI: 2.94–3.22) on the 0–10 scale. The distribution was right-skewed, with 28.3% reporting no burden and 13.5% reporting scores of 7 or higher (Figure 2).

Table 1 Weighted characteristics of Thai family caregiver–older adult dyads, 2021 National Survey of Older Persons (n = 2,994 dyads; weighted N ≈ 975,070)

Characteristic	n	Weighted % or mean (SE)
Care recipient age, years (mean)	2,994	78.18 (0.23)
Care recipient female	1,833	61.8 (1.15)
Functional dependency		
Socially active	2,049	68.7 (1.24)
Home-bound	535	18.8 (1.11)
Bed-bound	410	12.5 (0.78)
Poor/very poor self-rated health	1,505	49.0 (1.32)
Vision impairment	1,188	39.3 (1.22)
Hearing impairment	1,165	38.8 (1.26)
Chewing impairment	1,969	65.9 (1.25)
Any fall, previous 6 months	376	12.8 (0.88)
Caregiver age, years (mean)	2,994	54.15 (0.32)
Caregiver female	2,255	77.0 (1.08)
Caregiver education		
Primary or less	1,654	54.0 (1.31)
Secondary	892	29.7 (1.25)
Tertiary	448	16.3 (1.06)
Relationship to care recipient		
Spouse	757	24.4 (1.18)
Child or child-in-law	1,819	62.0 (1.32)
Other relative	418	13.6 (0.89)
Co-resident with care recipient	2,749	91.7 (0.80)
Household size (mean)	2,994	3.65 (0.05)
Caregiver training in older-person care		
None	2,699	87.7 (0.91)
Formal training	114	5.7 (0.73)
Informal training	181	6.6 (0.64)
Caregiving hours per week		

Characteristic	n	Weighted % or mean (SE)
<1	245	7.7 (0.71)
1–8	1,622	54.6 (1.33)
9–20	517	17.6 (1.07)
21–40	305	9.9 (0.76)
>41	305	10.1 (0.82)
Left paid employment to provide care	217	7.5 (0.66)
Caregiver monthly income (Baht)		
No income	342	13.3 (0.99)
1–3,000	522	15.6 (0.90)
3,001–6,000	786	25.4 (1.16)
6,001–12,000	734	24.2 (1.14)
>12,000	610	21.5 (1.11)
Household debt	1,415	50.8 (1.32)
Community service / unmet-need status		
Services received, no unmet need	2,025	63.1 (1.27)
Services received, unmet need in another domain	521	17.4 (0.99)
No services, no unmet need	266	11.0 (0.90)
No services, unmet need	182	8.5 (0.82)
Region		
Bangkok	133	8.7 (0.40)
Central	801	27.6 (0.64)
Northern	686	16.4 (0.42)
Northeastern	880	33.5 (0.59)
Southern	494	13.7 (0.33)
Municipal area	1,565	41.9 (0.66)

Note: Percentages are weighted to the national population of older adults aged ≥60 years with an identified family primary caregiver; n values are unweighted counts. SE = linearized standard error accounting for stratification, clustering, and weighting.

Coverage of community services and caregiver training

Community services were widely received. During the previous 12 months, 67.8% of dyads had received home or community care or advice from public health officials, 69.0% had received care from community volunteers, and 40.2% had received services from the Local Administrative Organization. For these same domains, unmet need attributable to inaccessible entitlement or lack of information was reported by 10.2%, 9.0%, and 23.5% of dyads, respectively. Overall, 63.1% of dyads had received services with no unmet need, 17.4% had received services with unmet need in another domain, 11.0% had received no services and reported no unmet need, and 8.5% had received no services but reported unmet need (Table 2). Caregiver-directed training was less common: 5.7% of caregivers reported formal training and 6.6% informal training, whereas 87.7% reported none. The proportion reporting formal training was higher among caregivers of bed-bound than of socially active older adults (9.5% vs. 5.2%). Caregivers reporting formal training differed from those reporting no training on several characteristics (Additional file 1: Table S9): they were more often women (89.0% vs. 75.6%), less often co-resident with the care recipient (75.7% vs. 92.7%), more often in higher income categories, and more often living in the Northeastern region (60.6% vs. 31.4%). They also more often cared for bed-bound older adults (20.7% vs. 11.1%) or older adults who had fallen in the previous six months (31.8% vs. 12.0%). The unadjusted mean burden was 1.82 among caregivers reporting formal training and 3.13 among those reporting no training.

Table 2 Receipt of, and unmet need for, community long-term care services in the previous 12 months (n = 2,994)

Service domain and status	n	Weighted % (SE)
Home/community care or advice to relatives and caregivers, by public health officials		
Received	2,190	67.8 (1.24)
Unmet need (inaccessible entitlement or lack of information)	242	10.2 (0.86)
No expressed need	562	21.9 (1.16)
Services from the Local Administrative Organization		
Received	1,265	40.2 (1.17)
Unmet need (inaccessible entitlement or lack of information)	632	23.5 (1.15)
No expressed need	1,097	36.3 (1.26)
Care by community volunteers, older-person caregivers or assistant caregivers		
Received	2,207	69.0 (1.16)
Unmet need (inaccessible entitlement or lack of information)	205	9.0 (0.86)
No expressed need	582	22.1 (1.07)

Note: “Unmet need” comprises non-receipt attributed to inaccessibility of entitlement or to lack of information; “no expressed need” comprises not wanting the service and having previously received it.

Adjusted associations with caregiver burden

Table 3 presents the primary survey-weighted fractional logistic model; the corresponding AMEs are displayed graphically in Figure 3. Formal caregiver training was associated with lower burden, an adjusted difference of −1.23 points (95% CI: −1.79 to −0.68; β = −0.696; 95% CI: −1.062 to −0.330). Informal training was not associated with burden (AME = −0.12; 95% CI: −0.60 to 0.37).

Several indicators of care demand were associated with higher burden. Compared with caregivers of socially active older adults, burden was higher among caregivers of home-bound (+0.80 points; 95% CI: 0.41–1.20) and bed-bound (+1.02; 95% CI: 0.57–1.46) older adults. Poor or very poor care-recipient self-rated health was associated with +0.87 points (95% CI: 0.54–1.19) and chewing impairment with +0.57 points (95% CI: 0.26–0.89), whereas vision impairment, hearing impairment, and recent falls were not. Caregiving hours were associated with higher burden across all categories above one hour per week, with the largest estimate at 21–40 hours (+1.24 points; 95% CI: 0.62–1.87). Leaving paid employment to provide care was associated with higher burden (+1.07 points; 95% CI: 0.61–1.52). Tertiary caregiver education (−0.55 points; 95% CI: −0.99 to −0.12) and larger household size (−0.13 points per additional member; 95% CI: −0.20 to −0.05) were associated with lower burden, whereas co-residence was

associated with higher burden (+0.57 points; 95% CI: 0.04–1.09). Caregiver income and household debt were not associated with burden after adjustment.

Community service receipt was generally not associated with caregiver burden, either when the three domains were modeled separately or in the composite typology. Dyads reporting no services and unmet need had lower burden than the reference group (AME = −0.62; 95% CI: −1.12 to −0.12); however, this association was not robust across sensitivity analyses and was therefore interpreted cautiously as an exploratory finding.

Table 3 Survey-weighted fractional logistic regression of caregiver burden on the prespecified covariate set (n = 2,994), ordered by domain of the Stress Process Model

Term	β (95% CI)	AME, 0–10 points (95% CI)	p
Caregiver-directed training [Pearlin domain: background and context — caregiving history; extension to the original model]			
Formal training (vs none)	-0.696 (-1.062, -0.330)	-1.23 (-1.79, -0.68)	<0.001
Informal training (vs none)	-0.057 (-0.293, 0.179)	-0.12 (-0.60, 0.37)	0.636
Care-recipient-directed community services [Pearlin domain: background and context — service availability] (ref: services received, no unmet need)			
Services received, unmet need in another domain	0.011 (-0.165, 0.188)	0.02 (-0.33, 0.37)	0.901
No services, no unmet need	-0.060 (-0.288, 0.169)	-0.12 (-0.59, 0.35)	0.608
No services, unmet need	-0.325 (-0.584, -0.066)	-0.62 (-1.12, -0.12)	0.014
Primary stressors [objective indicators of care demand]			
Home-bound (vs socially active)	0.387 (0.210, 0.563)	0.80 (0.41, 1.20)	<0.001
Bed-bound (vs socially active)	0.483 (0.288, 0.678)	1.02 (0.57, 1.46)	<0.001
Poor/very poor self-rated health	0.407 (0.262, 0.553)	0.87 (0.54, 1.19)	<0.001
Vision impairment	-0.076 (-0.229, 0.077)	-0.15 (-0.45, 0.15)	0.330
Hearing impairment	0.049 (-0.110, 0.209)	0.10 (-0.22, 0.42)	0.544
Chewing impairment	0.274 (0.122, 0.427)	0.57 (0.26, 0.89)	<0.001

Term	β (95% CI)	AME, 0–10 points (95% CI)	p
Any fall, previous 6 months	-0.091 (-0.281, 0.098)	-0.18 (-0.54, 0.18)	0.344
1–8 h/week (vs <1)	0.464 (0.184, 0.745)	0.86 (0.40, 1.32)	0.001
9–20 h/week	0.561 (0.250, 0.873)	1.06 (0.50, 1.61)	<0.001
21–40 h/week	0.649 (0.308, 0.990)	1.24 (0.62, 1.87)	<0.001
>41 h/week	0.382 (0.061, 0.703)	0.69 (0.11, 1.27)	0.020
Care recipient age (per year)	-0.015 (-0.023, -0.007)	-0.03 (-0.05, -0.01)	<0.001
Care recipient female	-0.177 (-0.313, -0.040)	-0.34 (-0.60, -0.09)	0.011
Secondary stressors [role strain at the caregiving–occupation juncture]			
Left paid employment to provide care	0.495 (0.287, 0.704)	1.07 (0.61, 1.52)	<0.001
Background and context [SES characteristics, caregiving history, family and network composition]			
Caregiver female	0.022 (-0.136, 0.181)	0.04 (-0.29, 0.37)	0.784
Caregiver age (per year)	0.002 (-0.006, 0.010)	0.00 (-0.01, 0.02)	0.659
Secondary (vs primary or less)	-0.022 (-0.196, 0.152)	-0.04 (-0.39, 0.30)	0.805
Tertiary (vs primary or less)	-0.285 (-0.518, -0.052)	-0.55 (-0.99, -0.12)	0.016

Term	β (95% CI)	AME, 0–10 points (95% CI)	p
Child or child-in-law (vs spouse)	-0.027 (-0.266, 0.212)	-0.05 (-0.55, 0.44)	0.822
Other relative	0.136 (-0.142, 0.414)	0.28 (-0.29, 0.85)	0.338
Co-resident with care recipient	0.272 (0.020, 0.523)	0.57 (0.04, 1.09)	0.035
Household size (per member)	-0.064 (-0.102, -0.025)	-0.13 (-0.20, -0.05)	0.001
1–3,000 Baht (vs no income)	-0.185 (-0.445, 0.075)	-0.38 (-0.91, 0.16)	0.163
3,001–6,000 Baht	-0.120 (-0.359, 0.119)	-0.25 (-0.74, 0.25)	0.327
6,001–12,000 Baht	-0.132 (-0.367, 0.102)	-0.27 (-0.76, 0.22)	0.269
>12,000 Baht	-0.178 (-0.435, 0.080)	-0.36 (-0.91, 0.19)	0.177
Household debt	-0.105 (-0.246, 0.036)	-0.21 (-0.48, 0.07)	0.145
Central (vs Bangkok)	-0.214 (-0.487, 0.059)	-0.45 (-1.09, 0.18)	0.124
Northern	-0.440 (-0.712, -0.168)	-0.90 (-1.47, -0.33)	0.002
Northeastern	-0.274 (-0.541, -0.008)	-0.57 (-1.17, 0.02)	0.043
Southern	-0.350 (-0.638, -0.062)	-0.72 (-1.36, -0.09)	0.017

Term	β (95% CI)	AME, 0–10 points (95% CI)	p
Municipal area	-0.019 (-0.156, 0.119)	-0.04 (-0.29, 0.21)	0.788

Note: Outcome is caregiver burden rescaled to [0, 1]; β are quasi-binomial logit coefficients. AME = average marginal effect expressed in points on the original 0–10 burden scale, with 95% confidence intervals from 400 bootstrap replicate weights. Domain assignments follow Additional file 1: Table S1. All covariates were prespecified and retained regardless of statistical significance; no variable selection was performed.

Formal training and functional dependency

The prespecified formal training × functional dependency interaction was supported (F[2, 2561] = 3.92, p = 0.020; Additional file 1: Figure S1). Among caregivers of socially active older adults, formal training was associated with lower burden (β = −1.07; 95% CI: −1.49 to −0.65). The association was not statistically supported among caregivers of home-bound (β = −0.69; 95% CI: −1.56 to 0.18) or bed-bound older adults (β = 0.15; 95% CI: −0.48 to 0.78). The interaction coefficients were 0.18 (95% CI: −0.82 to 1.18) for home-bound × formal training and 1.04 (95% CI: 0.31 to 1.78) for bed-bound × formal training, indicating that the departure from the socially active stratum was concentrated among caregivers of bed-bound older adults and that the home-bound estimate was too imprecise to be informative. Adjusted predicted burden among untrained versus formally trained caregivers was 2.88 versus 1.27 for socially active dyads, 3.68 versus 2.01 for home-bound dyads, and 3.74 versus 3.73 for bed-bound dyads. These stratum-specific estimates rest on 24 formally trained caregivers of home-bound and 29 of bed-bound older adults; the confidence intervals in both strata are wide and include zero, and the interaction itself is determined by the bed-bound stratum.

Sensitivity analyses

The principal findings were consistent across alternative outcome specifications, survey-design assumptions, sample restrictions, and missing-data handling (Additional file 1: Tables S3, S4, and S8). Formal training remained associated with lower burden in the ordinal model (OR = 0.43; 95% CI: 0.27–0.68), the survey-weighted linear model (B = −1.23; 95% CI: −1.78 to −0.67), and under multiple imputation (β = −0.685; 95% CI: −1.039 to −0.332), with a fraction of missing information of 9% or less for every coefficient. Informal training remained null across specifications, and the formal training × functional dependency interaction remained statistically supported across the sensitivity analyses. Ignoring the survey design attenuated the formal-training association (unweighted B = −0.55; 95% CI: −1.06 to −0.04) and reversed the direction of the informal-training estimate, whereas removing strata and clustering while retaining the weights left estimates essentially unchanged. Community volunteer

care was unrelated to burden in every design-based specification but appeared protective when the design was ignored. Co-residence was the only caregiver- or household-level association whose confidence interval changed from excluding to including the null under imputation (β = 0.272; 95% CI: 0.020–0.523, to β = 0.181; 95% CI: −0.066 to 0.429), and it should be regarded as the least secure of these associations.

In exploratory threshold-specific models (Additional file 1: Figure S2), reported formal training was associated with lower odds of burden at cut-points from 1 to 6 (ORs 0.31–0.50), but the association was not statistically supported at the highest threshold (≥7: OR = 0.51; 95% CI: 0.22–1.22). Leaving paid employment was associated with approximately twofold higher odds across nearly the full burden range (ORs 1.87–2.44 at cut-points 1 to 8), whereas the association for bed-bound status was stronger at higher thresholds (≥8: OR = 3.12; 95% CI: 1.94–5.03).

Statistical apportionment of the dependency–burden association

Each one-category increase in the ordered dependency gradient was associated with a 5.1 percentage-point higher probability of having left paid employment (95% CI: 2.6–7.3), and leaving paid employment was associated with 1.16 additional burden points (95% CI: 0.66–1.65). The total dependency–burden association was 0.685 burden points per one-category increase (95% CI: 0.467–0.907). The component associated with employment cessation was 0.059 points (95% CI: 0.024–0.104), corresponding to 8.6% of the total association (95% CI: 3.6–16.5); the component associated with weekly caregiving hours was smaller and statistically compatible with zero (0.019 points; 95% CI: −0.018 to 0.065). Together, these components represented 11.3% of the total association (95% CI: 4.1–21.5) (Figure 4; Additional file 1: Table S7). These are model-implied components of a cross-sectional association and should not be interpreted as causally identified mediation effects.

Discussion

In this nationally weighted analysis of family caregivers of older adults in Thailand, reported formal training was associated with lower caregiver burden after adjustment for caregiving demands, whereas receipt of community long-term care services was not. The training–burden association varied by functional dependency, but estimates were precise only among caregivers of socially active older adults; estimates for home-bound and bed-bound older adults were imprecise. Greater functional dependency, higher caregiving intensity, and leaving paid employment were associated with higher burden. In a secondary analysis, employment cessation accounted for approximately 8.6% of the dependency–burden association.

Only 5.7% of caregivers reported formal training, and their adjusted burden was 1.23 points lower on the 0–10 scale than that of caregivers without formal training. Formally trained caregivers differed from untrained caregivers in several characteristics, including sex, co-residence, income, and region (Additional file 1: Table S9). Adjustment for these measured characteristics did not remove the

association, but training uptake may also reflect motivation, access, preparedness, or burden experienced before training, none of which were fully captured by the survey. Because the data are cross-sectional, temporal ordering cannot be established. The estimate should therefore be interpreted as an adjusted population association rather than evidence of a causal effect of training. It nevertheless suggests that caregiver-directed training and care-recipient-directed services may represent distinct components of long-term care support: training was associated with burden whereas service receipt was not.

Caregiver training and functional dependency

The interaction should be interpreted in light of the distribution and precision of the trained groups. Formal training was associated with lower burden among caregivers of socially active older adults (β = −1.07; 95% CI: −1.49 to − 0.65), who comprised most formally trained caregivers. In the home-bound stratum, 24 caregivers had received formal training and the estimate was in the same direction but imprecise (β = −0.69; 95% CI: −1.56 to 0.18). In the bed-bound stratum, 29 caregivers had received formal training and the estimate was close to zero (β = 0.15; 95% CI: −0.48 to 0.78). Thus, the interaction was driven largely by the bed-bound stratum (interaction coefficient 1.04; 95% CI: 0.31 to 1.78), and the confidence intervals in the two high-dependency strata remain compatible with a range of associations. The finding is better understood as evidence that the association observed among caregivers of socially active older adults cannot be assumed to extend to caregivers of bed-bound older adults, rather than as evidence that training is less effective for them.

Formal training was not clearly associated with the highest burden thresholds (≥ 7). One possible explanation is that training increases perceived preparedness for routine care tasks [13, 14, 33], while education and skills-based interventions may be more useful when they address practical caregiving needs [15, 16]. Caregivers of bed-bound older adults may face demands that routine skills training does not adequately address. The national 70-hour curriculum, which combines theoretical and practical components and is designed for the care of dependent older adults [25], provides relevant context, but the NSOP did not record curriculum, provider, or timing; it recorded only whether formal training lasted less than or at least 3 days. The present association therefore concerns reported formal training rather than completion of the national program. Selection may also contribute: one in four formally trained caregivers did not live with the care recipient, compared with fewer than one in ten untrained caregivers, and some may have been relatives working as trained caregivers within the long-term care program, a role the NSOP caregiver module cannot distinguish.

Community long-term care services and unmet need

Receipt of community long-term care services was not associated with caregiver burden after adjustment. This finding should not be interpreted as evidence that services are ineffective. Service receipt is likely related to care needs and local availability, while the NSOP recorded receipt but not frequency, intensity, or adequacy. These dimensions are relevant to caregiver outcomes [34], and a binary

indicator may therefore be insufficient to identify meaningful differences in support. Future evaluations should assess service intensity and adequacy in addition to receipt.

Caregivers who received no services but reported unmet need had lower burden than the reference group, but this estimate was not robust across specifications and is not interpreted further. Unmet need may reflect awareness, expectations, or help-seeking as well as care demands. It remains an important outcome: national evidence has documented substantial unmet need for assistance with daily activities among older adults [35], systematic review evidence has identified persistent gaps between care needs and available support [36], and variation in local implementation capacity contributes to differences in access to long-term care in Thailand [37]. Previous analyses of Thai national survey data have also highlighted disparities in service use and unmet need [20, 21]. Evaluations should therefore consider receipt, unmet need, adequacy, and intensity together.

Employment disruption and caregiving intensity

Leaving paid employment was associated with higher burden. The secondary apportionment analysis indicated that employment cessation accounted for approximately 8.6% of the dependency–burden association, whereas the contribution of caregiving hours was small and included zero. This suggests that the relationship between dependency and burden may extend beyond time spent providing care. Employment disruption may involve loss of income, changes in daily structure and social roles, or greater immersion in the caregiver role; intensive family caregiving has been linked with reduced labor-market participation, role-related strain, and role captivity [38–40], while social support may influence caregivers' ability to manage these demands [41]. The 8.6% estimate is a statistical apportionment of a cross-sectional association, not causal mediation, and the mechanisms were not measured directly. Most of the dependency–burden association remained unexplained, potentially reflecting cognitive and behavioral symptoms of the older adult, caregiver coping resources, and social support.

Relationship to previous findings and to the Stress Process Model

The present study addresses a different question from the two earlier analyses of this survey wave [18, 19]. Rather than describing correlates of burden, it examined whether caregiver-directed training was associated with burden after accounting for care demands and whether this association varied by dependency. The finding differs from the earlier analysis that did not identify a clear association between caregiver training and burden [18]. The difference is consistent with several analytic distinctions: separation of formal from informal training, adjustment for caregiver and older-adult characteristics, incorporation of the complex survey design and population weights, and use of a model appropriate for the bounded outcome. The attenuation of the unadjusted training–burden association after accounting for functional dependency and caregiving intensity further illustrates the importance of the analytic specification (Additional file 1: Tables S5 and S6).

The findings are broadly compatible with the Stress Process Model, which was used here as an organizing framework rather than formally tested. Functional dependency, caregiving intensity, and employment disruption represent characteristics of the caregiving stress process, while caregiver training can be considered a resource that may alter how caregiving demands are experienced. However, coping and social support were not measured, cognitive status and problematic behaviors were not assessed, and training represents an extension of the original model rather than a tested pathway. Community long-term care services can be viewed as a contextual resource, but their null association in this analysis does not provide evidence about the role of perceived social support [41, 42].

Strengths and limitations

This study used a nationally weighted probability sample and incorporated population weights and the complex survey design to obtain population-relevant estimates. The bounded burden outcome was addressed with an appropriate fractional-response model, the covariate structure was prespecified, findings were examined across alternative outcome specifications, design assumptions, sample restrictions, and missing-data approaches, and statistical apportionment was distinguished from causal mediation.

Several limitations should be considered. First, the cross-sectional design prevents determination of temporal ordering and causal effects. Second, caregiver burden was measured with a single global 0–10 item rather than a multidimensional validated instrument [3], which limits construct validity and comparability with studies using instruments such as the Zarit Burden Interview. Third, formal training was reported by few caregivers and its uptake is selective; the survey recorded training duration only as less than or at least 3 days and did not capture curriculum, content, provider, timing, or caregiver preparedness, and unmeasured confounding by motivation, access, or prior burden cannot be excluded. The interaction estimates in the home-bound and bed-bound strata rest on 24 and 29 trained caregivers, respectively, and their confidence intervals are wide. Fourth, community service receipt did not capture intensity, quality, continuity, or adequacy. Fifth, enumeration-area identifiers were unavailable, preventing adjustment for clustering below the household level. Finally, although multiple imputation produced similar estimates, differential missingness related to unmeasured characteristics cannot be excluded, and generalization to other long-term care systems in the region should be considered cautiously [41].

Implications for practice and policy

Formal caregiver training was infrequently reported in this nationally representative sample, while its association with caregiver burden varied by the functional dependency of older adults. These findings suggest that nurses and long-term care practitioners should assess caregivers' training history, perceived preparedness, caregiving demands, and unmet support needs rather than assuming that all caregivers have similar training needs. Caregiver training may be considered as one component of individualized caregiver support, alongside assessment of caregiver burden and employment-related constraints.

The findings also highlight the importance of considering older adults' functional dependency when assessing caregiver support needs. However, the subgroup estimates among caregivers of home-bound and bed-bound older adults were imprecise, and the cross-sectional design precludes causal conclusions. Home-based or digital training approaches may warrant further evaluation for caregivers facing substantial care demands. Future research should examine access to and uptake of training, the content and timing of training, and whether specific training approaches are associated with caregiver outcomes across levels of functional dependency. Low reported training prevalence alone should not be interpreted as evidence of unmet training need without further assessment of caregivers' needs and access to services.

Conclusions

In this nationally weighted cross-sectional analysis of family caregivers of older adults in Thailand, reported formal caregiver training was associated with lower caregiver burden, whereas receipt of community long-term care services was not associated with burden. The association between formal training and burden varied by functional dependency, although estimates among caregivers of home-bound and bed-bound older adults were imprecise because few caregivers in these groups reported training. These findings indicate statistical heterogeneity in the observed associations but do not establish differences in training effectiveness. Although the association between formal training and burden was robust to model specification, selective training uptake and the cross-sectional design preclude causal inference. Employment cessation, greater caregiving intensity, and higher functional dependency were also associated with greater burden. Longitudinal and intervention studies are needed to determine whether caregiver training reduces burden and to evaluate approaches for reaching caregivers of home-bound and bed-bound older adults.

Abbreviations

ADL
activities of daily living
AME
average marginal effect
CI
confidence interval
LAO
Local Administrative Organization
LTC
long-term care
MICE
multiple imputation by chained equations
NSO
National Statistical Office of Thailand

NSOP
National Survey of Older Persons
STROBE
Strengthening the Reporting of Observational Studies in Epidemiology.

Declarations

Ethics approval and consent to participate

This study is a secondary analysis of de-identified microdata collected by the National Statistical Office of Thailand, which obtained informed consent from participants at the time of the original survey. The secondary analysis was reviewed and granted exemption by the Research Ethics Committee, Faculty of Nursing, Chiang Mai University (Protocol No. 2569-EXEM012). The microdata were obtained under written permission from the National Statistical Office of Thailand. All methods were carried out in accordance with the Declaration of Helsinki and relevant national regulations.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests. Two authors (JR and PJ) are co-authors of a previously published analysis of the same survey wave [18], which the present study extends by separating formal from informal caregiver training, incorporating the complex survey design, and modelling the full 0–10 burden scale.

Authors' information

TD, PhD, RN, is an Instructor in the Department of Medical Nursing, Faculty of Nursing, Chiang Mai University, Thailand; she completed her PhD at the College of Nursing, University of Illinois Chicago, and her research focuses on gerontological nursing, family caregiving, and caregiver burden. MC, PhD, RN, is an Assistant Professor at the College of Nursing, University of Illinois Chicago, USA, with expertise in secondary analysis of national survey data and advanced statistical methods and a research focus on cardiovascular health and health literacy. JR, PhD, RN, is an Assistant Professor at the Faculty of Nursing, Chiang Mai University, Thailand; her research focuses on nursing care of older adults with chronic and cardiovascular conditions and family caregiving. PJ, PhD, RN, is an Associate Professor at the Faculty of Nursing, Chiang Mai University, Thailand; her research focuses on population-based analyses of family caregiving and caregiver burden in Thailand.

Supplementary information

Additional file 1: Supplementary Notes S1–S3, Tables S1–S9 and Figures S1–S2 (DOCX).

Additional file 2: STROBE checklist for cross-sectional studies (DOCX).

Funding

The authors received no specific funding for this work.

Author Contribution

TD, PhD, RN, is an Instructor in the Department of Medical Nursing, Faculty of Nursing, Chiang Mai University, Thailand; she completed her PhD at the College of Nursing, University of Illinois Chicago, and her research focuses on gerontological nursing, family caregiving, and caregiver burden. MC, PhD, RN, is an Assistant Professor at the College of Nursing, University of Illinois Chicago, USA, with expertise in secondary analysis of national survey data and advanced statistical methods and a research focus on cardiovascular health and health literacy. JR, PhD, RN, is an Assistant Professor at the Faculty of Nursing, Chiang Mai University, Thailand; her research focuses on nursing care of older adults with chronic and cardiovascular conditions and family caregiving. PJ, PhD, RN, is an Associate Professor at the Faculty of Nursing, Chiang Mai University, Thailand; her research focuses on population-based analyses of family caregiving and caregiver burden in Thailand.

Acknowledgement

The authors thank the National Statistical Office of Thailand for access to the microdata of the 2021 Survey of Older Persons. The use of a large language model for language editing and formatting is described in the Methods.

Data Availability

This study is a secondary analysis of de-identified microdata collected by the National Statistical Office of Thailand, which obtained informed consent from participants at the time of the original survey. The microdata analysed in this study are the property of the National Statistical Office of Thailand and were obtained under written permission; they are available from the National Statistical Office (https://www.nso.go.th) on request, subject to its data-access procedures. Analysis code is available from the corresponding author on reasonable request.

References

1. Knodel J, Teerawichitchainan B, Pothisiri W. Caring for Thai older persons with long-term care needs. J Aging Health. 2018;30(10):1516–35. https://doi.org/10.1177/0898264317726457.
2. Glinskaya E, Walker T, Wanniarachchi T. Caring for Thailand's aging population. Washington (DC): World Bank; 2021. Available from: https://documents1.worldbank.org/curated/en/249641622725700707/pdf/Labor-Markets-and-Social-Policy-in-a-Rapidly-Transforming-Caring-for-Thailand-s-Aging-Population.pdf
3. Zarit SH, Reever KE, Bach-Peterson J. Relatives of the impaired elderly: Correlates of feelings of burden. Gerontologist. 1980;20(6):649–55. https://doi.org/10.1093/geront/20.6.649.
4. Li J, Alavi K, Shaari AAH. Primary and secondary stressors affecting family caregiver burden for disabled older adults: A systematic review. Health Soc Care Commun. 2025;2025:5109659. https://doi.org/10.1155/hsc/5109659.
5. Uhm KE, Jung H, Woo MW, Kwon HE, Oh-Park M, Lee BR, et al. Influence of preparedness on caregiver burden, depression, and quality of life in caregivers of people with disabilities. Front Public Health. 2023;11:1153588. https://doi.org/10.3389/fpubh.2023.1153588.
6. National Health Security Office. Long-term care for dependent elderly in the national health security system. National Health Security Office, Thailand. 2020. Available from: https://media.nhso.go.th/assets/portals/1/files/63-1_LTC_Book(Eng).pdf
7. Pagaiya N, Noree T, Hongthong P, Gongkulawat K, Padungson P, Setheetham D. From village health volunteers to paid care givers: The optimal mix for a multidisciplinary home health care workforce in rural Thailand. Hum Resour Health. 2021;19:2. https://doi.org/10.1186/s12960-020-00542-3.
8. Bom J, Stöckel J. Is the grass greener on the other side? The health impact of providing informal care in the UK and the Netherlands. Soc Sci Med. 2020;269:113562. https://doi.org/10.1016/j.socscimed.2020.113562.
9. Longacre ML, Valdmanis VG, Handorf EA, Fang CY. Work impact and emotional stress among informal caregivers for older adults. Journals Gerontology: Ser B. 2017;72(3):522–31. https://doi.org/10.1093/geronb/gbw027.
10. Mello JDA, Macq J, Van Durme T, Cès S, Spruytte N, Van Audenhove C, et al. The determinants of informal caregivers' burden in the care of frail older persons: A dynamic and role-related perspective. Aging Ment Health. 2017;21(8):838–43. https://doi.org/10.1080/13607863.2016.1168360.
11. Ong HL, Vaingankar JA, Abdin E, Sambasivam R, Fauziana R, Tan ME, et al. Resilience and burden in caregivers of older adults: Moderating and mediating effects of perceived social support. BMC Psychiatry. 2018;18(1):27. https://doi.org/10.1186/s12888-018-1616-z.
12. Xu L, Liu Y, He H, Fields NL, Ivey DL. Caregiving intensity and caregiver burden among caregivers of people with dementia: The moderating roles of social support. Arch Gerontol Geriatr. 2021;94:104334. https://doi.org/10.1016/j.archger.2020.104334.
13. Archbold PG, Stewart BJ, Greenlick MR, Harvath T. Mutuality and preparedness as predictors of caregiver role strain. Res Nurs Health. 1990;13(6):375–84. https://doi.org/10.1002/nur.4770130605.

14. Schumacher KL, Stewart BJ, Archbold PG, Caparro M, Mutale F, Agrawal S. Effects of caregiving demand, mutuality, and preparedness on family caregiver outcomes during cancer treatment. Oncol Nurs Forum. 2008;35(1):49–56. https://doi.org/10.1188/08.ONF.49-56.
15. Belle SH, Burgio L, Burns R, Coon D, Czaja SJ, Gallagher-Thompson D, et al. Enhancing the quality of life of dementia caregivers from different ethnic or racial groups: A randomized, controlled trial. Ann Intern Med. 2006;145(10):727–38. https://doi.org/10.7326/0003-4819-145-10-200611210-00005.
16. Pinquart M, Sörensen S. Helping caregivers of persons with dementia: Which interventions work and how large are their effects? Int Psychogeriatr. 2006;18(4):577–95. https://doi.org/10.1017/S1041610206003462.
17. Sörensen S, Pinquart M, Duberstein P. How effective are interventions with caregivers? An updated meta-analysis. Gerontologist. 2002;42(3):356–72. https://doi.org/10.1093/geront/42.3.356.
18. Juntasopeepun P, Bliss DZ, Deeluea J, Rhiantong J. Exploring family caregiver burden using the ecological model: Insights from Thailand's older population. Nurs Health Sci. 2025;27(1):e70057. https://doi.org/10.1111/nhs.70057.
19. Vapattanawong P, Phetsitong R. Sensory impairments and caregiver burden: A population-based study of older adults in Thailand. BMC Geriatr. 2026;26:584. https://doi.org/10.1186/s12877-026-07352-7.
20. Phetsitong R, Vapattanawong P, Sunpuwan M, Völker M. State of household need for caregivers and determinants of psychological burden among caregivers of older people in Thailand: An analysis from national surveys on older persons. PLoS ONE. 2019;14(12):e0226330. https://doi.org/10.1371/journal.pone.0226330.
21. Phetsitong R, Vapattanawong P. Household need and unmet need for caregivers of older persons in Thailand. J Aging Soc Policy. 2023;35(6):824–41. https://doi.org/10.1080/08959420.2022.2132081.
22. Pearlin LI, Mullan JT, Semple SJ, Skaff MM. Caregiving and the stress process: An overview of concepts and their measures. Gerontologist. 1990;30(5):583–94. https://doi.org/10.1093/geront/30.5.583.
23. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: Guidelines for reporting observational studies. Lancet. 2007;370(9596):1453–7. https://doi.org/10.1016/S0140-6736(07)61602-X.
24. Bowling A. Just one question: If one question works, why ask several? J Epidemiol Community Health. 2005;59(5):342–5. https://doi.org/10.1136/jech.2004.021204.
25. Department of Health, Ministry of Public Health. Curriculum and training manual for caregivers of older persons, 70-hour course [in Thai]. Nonthaburi: Bureau of Elderly Health, Department of Health; [year]. Available from: https://eh.anamai.moph.go.th/th/ltc/
26. Duangjina T, Jeamjitvibool T, Park C, Raszewski R, Gruss V, Fritschi C. Sex and gender differences in caregiver burden among family caregivers of persons with dementia: A systematic review and meta-analysis. Arch Gerontol Geriatr. 2025;138:105977. https://doi.org/10.1016/j.archger.2025.105977.

27. Lumley T. Analysis of complex survey samples. J Stat Softw. 2004;9(8):1–19. https://doi.org/10.18637/jss.v009.i08.
28. Papke LE, Wooldridge JM. Econometric methods for fractional response variables with an application to 401(k) plan participation rates. J Appl Econom. 1996;11(6):619–32. https://doi.org/10.1002/(SICI)1099-1255(199611)11:6%3C619::AID-JAE418%3E3.0.CO;2-1.
29. Ferrari SLP, Cribari-Neto F. Beta regression for modelling rates and proportions. J Applied Statistics. 2004;31(7):799–815. https://doi.org/10.1080/0266476042000214501.
30. Rao JNK, Wu CFJ. Resampling inference with complex survey data. J Am Stat Assoc. 1988;83(401):231–41. https://doi.org/10.1080/01621459.1988.10478591.
31. van Buuren S, Groothuis-Oudshoorn K. mice: Multivariate imputation by chained equations in R. J Stat Softw. 2011;45(3):1–67. https://doi.org/10.18637/jss.v045.i03.
32. Rubin DB. Multiple imputation for nonresponse in surveys. Wiley; 1987. https://doi.org/10.1002/9780470316696.
33. Andrés-Pérez F, Bru-Luna LM, Hidalgo-Fuentes S, Martí-Vilar M. Impact of self-efficacy and self-esteem on caregiver burden in formal and informal caregivers of people with dependency: A systematic review. Healthcare. 2026;14(15):2267. https://doi.org/10.3390/healthcare14152267.
34. Zarit SH, Kim K, Femia EE, Almeida DM, Savla J, Molenaar PCM. Effects of adult day care on daily stress of caregivers: A within-person approach. Journals Gerontology: Ser B. 2011;66B(5):538–46. https://doi.org/10.1093/geronb/gbr030.
35. Beach SR, Schulz R. Family caregiver factors associated with unmet needs for care of older adults. J Am Geriatr Soc. 2017;65(3):560–6. https://doi.org/10.1111/jgs.14547.
36. Huang J, Qian X, Choi EPH, Chau PH. The consequences of unmet needs for assistance with daily life activities among older adults: A systematic review. Med Care Res Rev. 2024;81(4):295–310. https://doi.org/10.1177/10775587241233798.
37. Thongngun T, Tiraphat S. Provincial lessons on long-term care implementation in Thailand: Motivation and managerial capacities within a decentralized health system in a middle-income country. BMC Health Serv Res. 2026;26:778. https://doi.org/10.1186/s12913-026-14571-6.
38. Aneshensel CS, Pearlin LI, Mullan JT, Zarit SH, Whitlatch CJ. Profiles in caregiving: The unexpected career. Academic; 1995.
39. Skaff MM, Pearlin LI. Caregiving: Role engulfment and the loss of self. Gerontologist. 1992;32(5):656–64. https://doi.org/10.1093/geront/32.5.656.
40. Van Houtven CH, Coe NB, Skira MM. The effect of informal care on work and wages. J Health Econ. 2013;32(1):240–52. https://doi.org/10.1016/j.jhealeco.2012.10.006.
41. Nemcikova M, Katreniakova Z, Nagyova I. Social support, positive caregiving experience, and caregiver burden in informal caregivers of older adults with dementia. Front Public Health. 2023;11:1104250. https://doi.org/10.3389/fpubh.2023.1104250.

42. Duangjina T, Hershberger PE, Gruss V, Fritschi C. Resilience in family caregivers of Asian older people with dementia: An integrative review. J Adv Nurs. 2025;81(1):156–70. https://doi.org/10.1111/jan.16272.

Figures

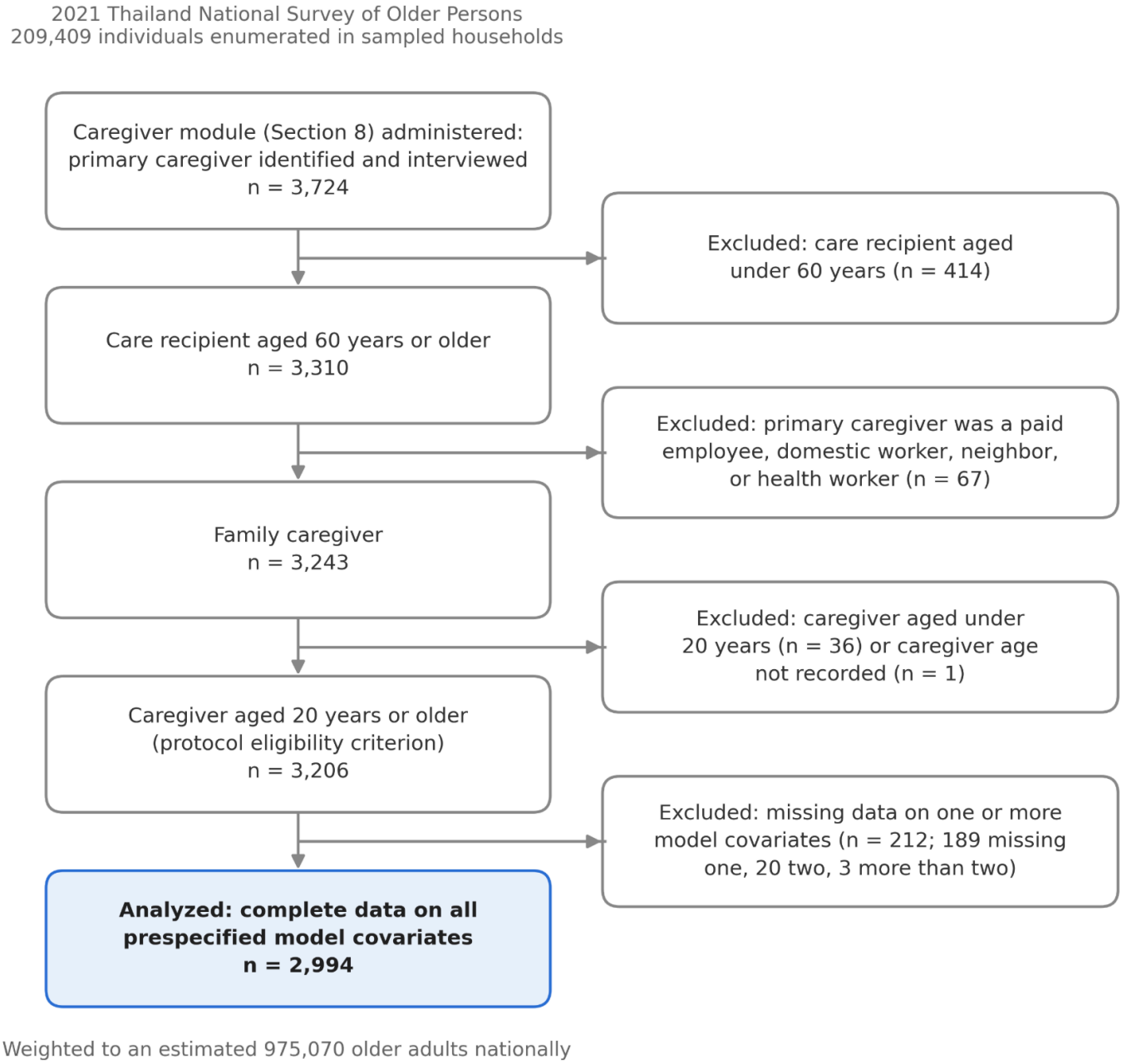


Figure 1

Derivation of the analytic sample, 2021 Thailand National Survey of Older Persons. Counts are unweighted. Eligibility criteria are applied in the order specified in the approved protocol. The analytic sample of 2,994 dyads represents an estimated 975,070 older adults with an identified family primary caregiver when the survey weights are applied.

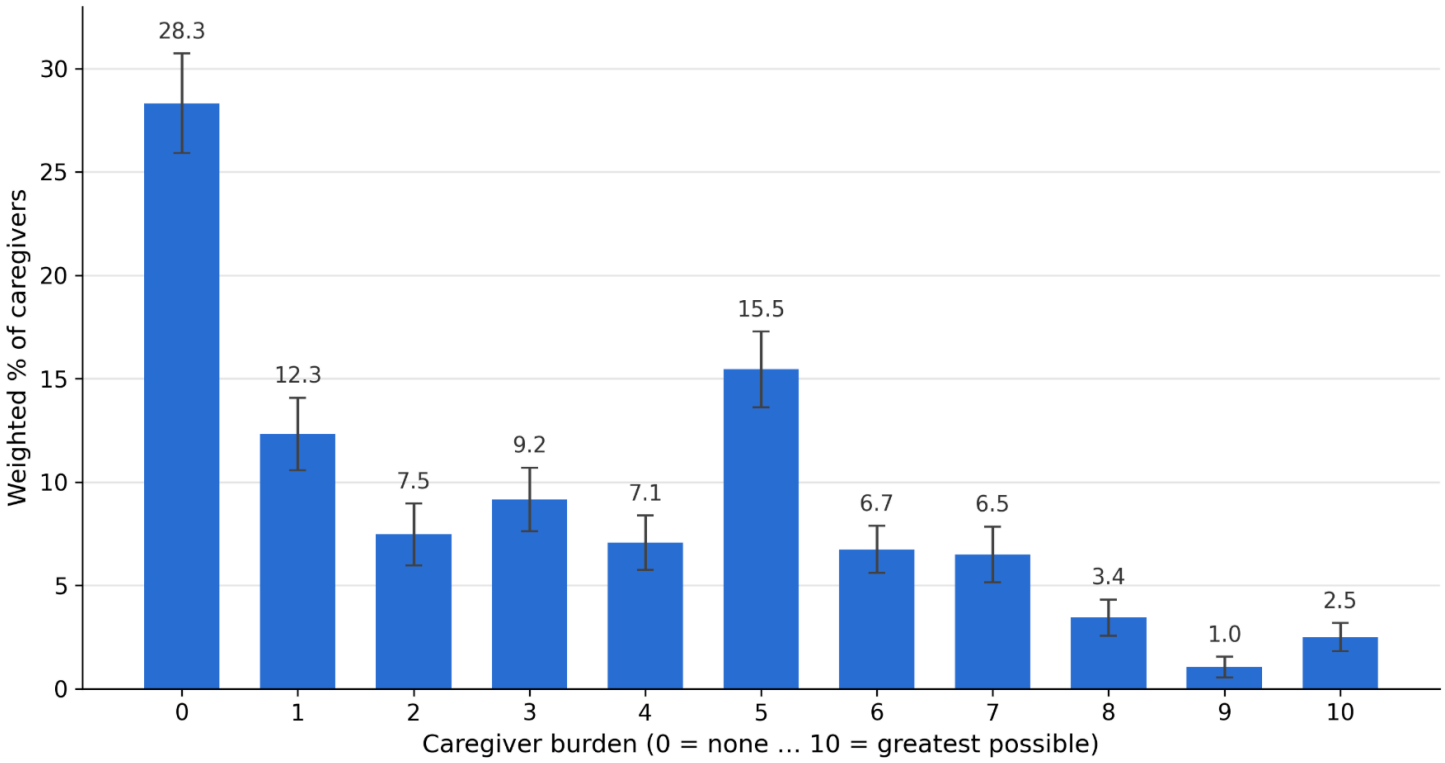


Figure 2

Weighted distribution of caregiver burden (0–10) among Thai family caregivers of older adults, 2021 National Survey of Older Persons (n = 2,994). Error bars are 95% confidence intervals.

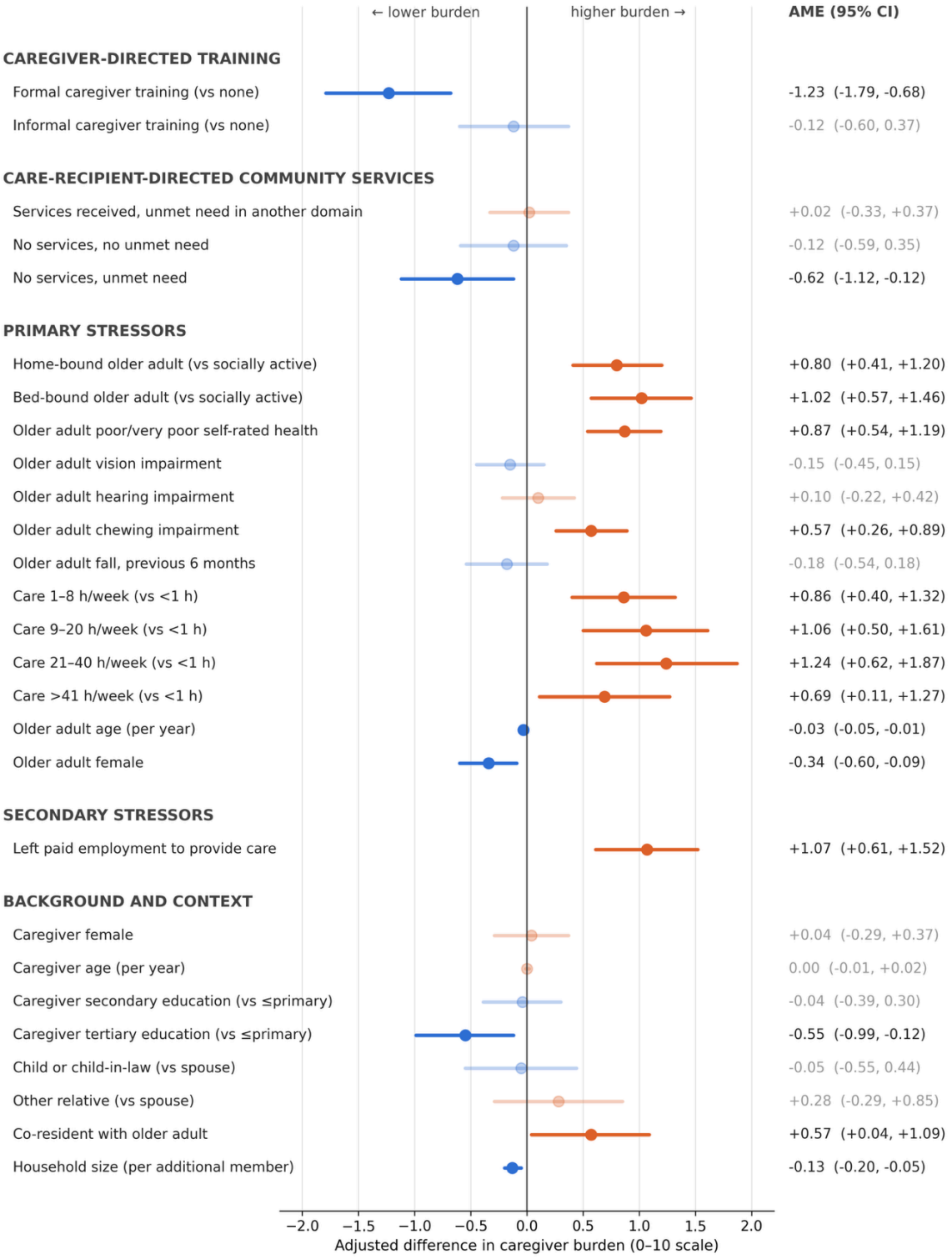


Figure 3

Adjusted average marginal effects on caregiver burden (0–10 scale), survey-weighted fractional logistic regression (n = 2,994). Points are average marginal effects and lines are 95% confidence intervals from 400 bootstrap replicate weights. Faded estimates have confidence intervals including zero. Terms are grouped and ordered by domain of the Stress Process Model as in Table 3. All terms were prespecified;

estimates for caregiver monthly income, household debt, region, and municipal area, which were included in the model, are given in Table 3.

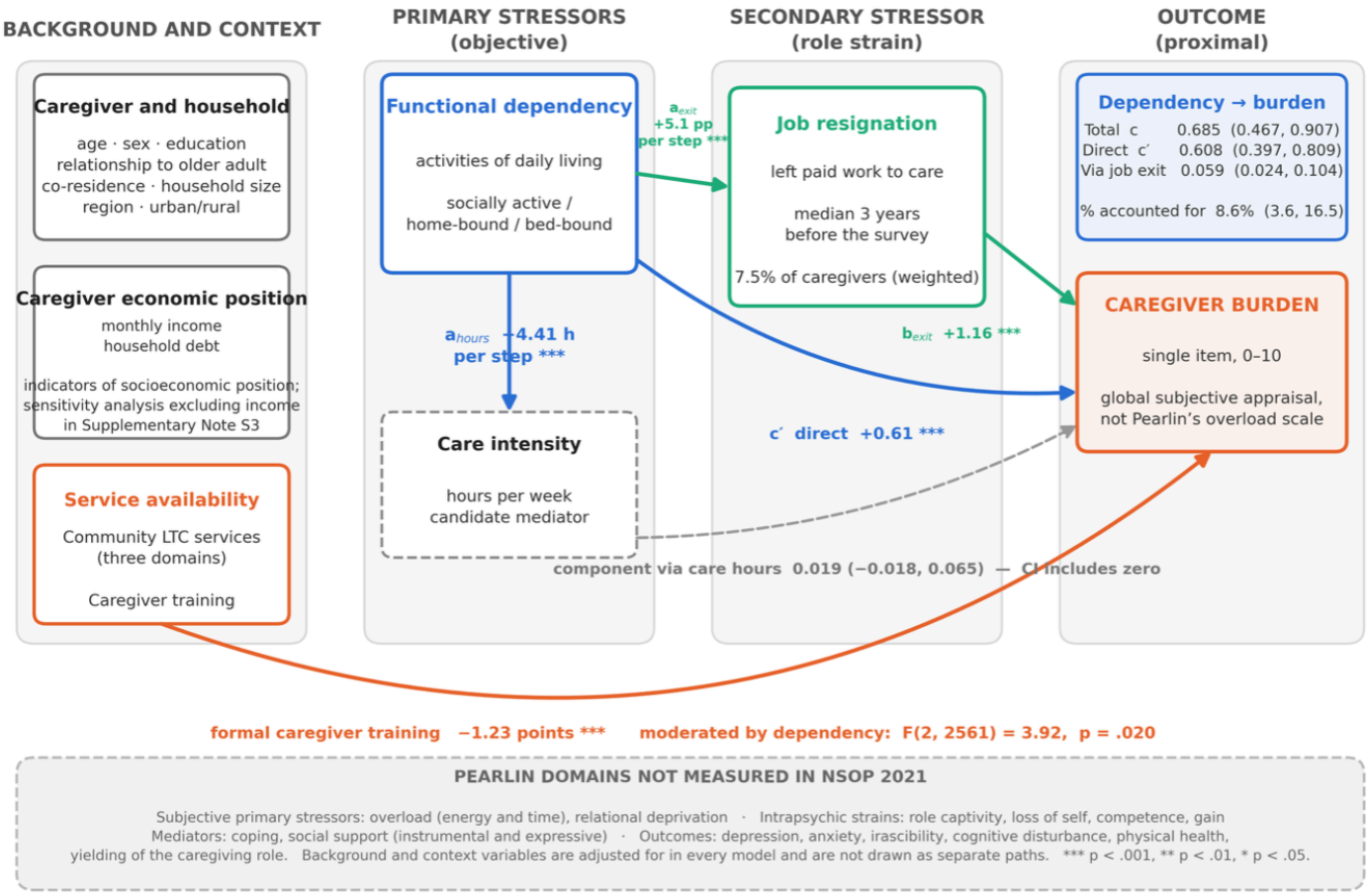


Figure 4

Conceptual framework and model-implied apportionment of the dependency–burden association, mapped onto the domains of Pearlin's Stress Process Model (n = 2,994 for every component). Solid arrows denote associations whose confidence intervals excluded zero; the dashed gray arrow denotes a component whose confidence interval included zero. Arrows represent the structure of the fitted model and the direction assumed by the Stress Process Model, not empirically established causal effects. Estimates are design-based, with 95% confidence intervals from 400 subbootstrap replicate weights. Domains of the model that the 2021 survey does not measure are listed at the foot of the figure.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- BMC2Additionalfile1Supplementarymaterialrevised.docx