Title

Development and Validation of a Carer Need Screening Tool (CNST-11) for Carers of Older Adults: A Need Stratified Tool for Services Matching

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Abstract

Background and Objectives

Carers play an imperative role in enabling older adults to age in place. Enhancing support for carers is increasingly recognised as essential to the social welfare system. The study aims to develop and validate a short self-administration Carer Need Screening Tool (CNST-11) to enable carers' understanding of their needs in caring for older adults and inform service providers for need-stratified intervention matching.

Research Design and Methods

The scale was developed through a three-phase approach. Items were generated via literature review, two rounds of Delphi study with 48 experts and a focus group with 10 carers of older adults at Phase I. Survey data of 803 carers was used to perform item reduction analysis at Phase II. Need stratification and psychometric property analysis were performed at Phase III.

Results

The CNST-11 consists of 11 items from the 37 items generated at Phase I. A revised two-factor model considering clinical applicability was adapted based on exploratory factor analysis (EFA) and supported by confirmatory factor analysis (CFA) with excellent fit (CFI=0.955, RMSEA=0.052). Cronbach's alpha of the CNST-11 was 0.818. Concurrent and divergent validity were achieved.

Discussion and Implications

The CRNT-11 is the first screening tool for carers of older adults, developed by considering both stakeholders' opinions and validated empirical data, that adopted an outcome-oriented approach in item selection. It provides helping professionals with a brief and reliable tool for quick screening and need-stratification, which enables the provision of timely and accurate support services to carers in different caregiving stages.

Keywords

Family caregivers, Caregiving burden, Brief scale, Psychometrics, Scale development

Introduction

The surging older population and shrinking younger population join forces to exacerbate the pressure of caregiving for older adults, and the worldwide old-age dependency ratio is forecasted to increase from 17% in 2021 to 29% in 2050 (United Nations, 2023). It led to an inevitable increase in the demand for informal care from all kin and non-kin members (e.g., spouses, children, grandchildren, other relatives, and friends). Across OECD countries, 60% of older adults aged 65 or above who were receiving care solely relied on family (Rocard & Llena-Nozal, 2022). The success of ageing in place, as advocated worldwide, substantially relies on ongoing care and support from family carers (Bangerter et al., 2024). Valuing and recognizing their contributions have been advocated internationally to support sustainable care systems across governments and organizations (International Alliance of Carer Organizations, 2021).

However, the intensity of care for older adults can continuously pose challenges to family carers' health and well-being. Springing from the incessant and progressive care demands of older adults, the risk of developing physical, social and mental health problems has risen correspondingly (del-Pino-Casado et al., 2021). Compared to non-carers, older adults' carers experienced more depressive symptoms and anxiety, higher levels of loneliness, lower life satisfaction, and poorer physical health (Lacey et al., 2022; Luchetti et al., 2021). Various interventions and community-based services have been developed to mitigate their burden and improve their overall well-being (Aksoydan et al., 2019; Cheng & Zhang, 2020). Given the multiple challenges that arise from caregiving responsibilities, interventions focusing on stress management and emotional regulation (Liu et al., 2024; Mårtensson et al., 2023), accessibility of available resources and social support (Gitlin et al., 2017) or facilitating functional communication between carers and families (Stedje et al., 2023) were developed. With the caution that resources are always limited, providing need-level matching interventions and services is argued to be essential and critical according to a systematic review of the cost-effectiveness of services and interventions (Pelone et al., 2022). To achieve that, a short and convenient screening tool is needed to provide a quick overview of carers' need for informing services matching.

Since 1980s, efforts have been put in developing carer-targeted assessment tools, which aim to identify different dimensions of impact on family carers of older adults and associated factors, including Carers of Older People in Europe (COPE) Index, Caregiver Risk Evaluation (CaRE) decision tree, Caregiver Needs and Resources Assessment (CNRA), and some primary care checklists for carers (Guthrie et al., 2021; Li et al., 2023; McKee et al., 2003; Mosquera et al., 2016; Riffin et al., 2024).

A critical review of the existing tools revealed three major limitations on their development and application as a screening tool. First, caregiving process is affected by three interwoven dimensions, including carer, care recipient, and caregiving dyad (Leung et al., 2023). However, some tools focused mainly on the experience of carers, overlooking the impact of care recipients' conditions and dynamics of the caregiving dyad, such as the COPE (McKee et al., 2003).

Second, the development and validation of the existing tools skipped some of the important steps in constructing valid and reliable scales (Boateng et al., 2018). Some tools either relied largely on experts' and stakeholders' opinions or left out the process of evaluating individual item functionality for the purpose of screening, such as the checklist for carers in primary care (Riffin et al., 2024). Selecting items based on experts' opinions and exploratory factor analysis and/or confirmatory factor analysis

could be an optimal method for constructing psychological scales but not for assessment tools with concrete objectives in screening. It could predispose the identification and interpretation of important screening items to a subjective understanding of the subject matter.

Lastly, a brief screening tool requires the least assessment burden to achieve quick and timely action. Tools with a long item list may prohibit carers and helping professionals from obtaining a quick and simple assessment for identifying in-need carers and providing timely and responsive support services. Considering the length and design of these tools like the CNRA (Li et al., 2023), self-administration screening was a challenge among carers who are busy with caregiving, however important, given that the constantly reducing formal service capacity can hardly cater for the need of the rapidly increasing number of carers (Rocard & Llena-Nozal, 2022).

As a super-aged society with 22.8% of the population aged 65 or above in 2023, the old-age dependency ratio in Hong Kong was projected to double from 30% in 2021 to 63.2% in 2046 (Baba, 1993; Census and Statistics Department, 2023, 2024). In light of that, the government of the study site – Hong Kong, has continued to enhance support for family carers' various needs in the past four decades. In the 2023-2024 Budget released on February 22, 2023, the government announced the establishment of a dedicated carer support hotline in the third quarter of 2023 to address carers' emotional and emergency needs (HKSAR Government, 2023). It also included regularizing two financial assistance schemes for carers from low-income families and raising the amount of monthly allowance starting from October 2023. One of the recommendations accepted by the government in principle derived from the report of '*Consultancy Study on Needs and Support Required of Carers of Elderly Persons and of Persons with Disabilities in Hong Kong*' was to develop a local self-administered assessment tool for increasing the knowledge of carers in their needs and available services for carer support (HKSAR Government, 2022). Hence, The Hong Kong Jockey Club Charities Trust initiated and funded The Jockey Club Carer Space Project (2024) in 2023 for five years, which pilots a carer-centric service model in multi-site centers located at six districts in Hong Kong to understand carers' needs in different caregiving stages through a carer need screening tool validated in this study and offer needs-stratified service recommendations.

The present implementation research aims to fill the research and service gaps by developing a Carer Need Screening Tool (CNST-11) to inform a screening-guided needs-stratified service model. To address the limitations in the development of existing screening tools, the current study employed the comprehensive 9-step scale development and validation approach manifested in three phases proposed by Boateng et al. (2018). Phase I aimed to develop an item pool, Phase II achieved item deduction, and Phase III tested the psychometric properties and developed a need-stratification approach for the CNST-11.

Phase I – Item Pool Generation for the CNST

Study Design and Process of Item Pool Generation

The item pool was systematically created using a modified 4-stage Delphi method (McPherson et al., 2018). The four stages were (1) identification of caregiving-related dimensions, (2) two rounds of Delphi study, (3) stakeholder consensus meeting, and (4) carer focus group.

Adopting Pearlin's stress process model (Pearlin et al., 1990), the first stage involved identifying relevant dimensions from the literature and stakeholders' discussion to generate a preliminary pool of items. The model provided a structural framework putting contextual factors, primary stressors, secondary strains, mediating intrinsic and extrinsic resources, and subsequent outcomes into consideration. Instead of solely focusing on the stressors stemming from the caregiving role of carers, a carer and care recipient parallel model was applied to the Pearlin's model (1990) to better cover factors related to care recipients and the dynamics of care arrangement. This parallel stress process model provided two sets of frameworks related to carers and care recipients, considering the interrelatedness of all factors in the caregiving dyad. A stakeholder panel of 48 experts from the social and medical services, policy, and academic sectors was formed. An initial pool of items covering carer-, care recipient-, and caregiving dyad-related dimensions that influence carers' well-being was generated.

At stage two, the stakeholders were invited to participate in two rounds of the Delphi study to evaluate the importance of each item and finalize the item list for further distillation and validation. The first Delphi questionnaire with the preliminary item pool was emailed to the stakeholders, inviting them to rate the importance of each item. The items were rated on a 9-point Likert scale, from 1 (very unimportant) to 9 (very important). A score of 7 or higher represents an important item, and items with a consensus rate of 70% or higher in being important were retained for the second round of the Delphi study. Participants were also invited to suggest additional items to the item pool, and these items were then reviewed by 15 experienced carer support service providers. Items with a 70% consensus for inclusion were added to the item pool. The second Delphi questionnaire with the additional items was emailed to the stakeholders. A consensus rate of 70% was required to retain the item for the next phase; items with a 65% to 69% consensus rate were regarded as marginal items for further discussion.

At stage three, an online stakeholder meeting was held to discuss the marginal items and finalize the item pool. A 70% consensus for inclusion was required to retain an item. At stage four, a semi-structured focus group was conducted with 10 carers to collect their opinions on important support for carers and feedback on the rating scale and phrasing of the selected items, ensuring the relevancy of items to their situation from a user's perspective.

Results of Item Pool Generation

The attendance rate of the first stakeholders meeting was 83.3% (40 out of 48 experts) and an initial pool of 51 items was created at stage one, covering three major scopes: (1) carer, (2) care recipient, and (3) caregiving dyad. At stage two, 40 experts (83.3%) participated in the first Delphi study, and 39 new items were proposed. Eleven out of the 39 new items reached the 70% consensus threshold among 15 experienced carer support service providers and were included in the second Delphi study. In the second Delphi study, 39 experts (81.0%) rated the importance of 62 items. Thirty-five items were rated as important by more than 70% of stakeholders. Another 10 items receiving a 65% to 69% importance rating were further discussed in the stakeholders meeting at stage three. Overall, 36 stakeholders (75.0%) completed both rounds of Delphi study.

At stage three, a total of 20 (41.7%) stakeholders attended the meeting, and two marginal items reached the 70% consensus threshold for inclusion. At stage four, the list of 37 items was presented to 10 carers in a semi-structured focus group. All items received support from these carers in their functionality for identifying carers' needs.

In summary, the 37 items generated went through four stages to ensure items were developed based on a solid theoretical foundation with extensive literature review and practical implications with opinions from different stakeholders. Content validity has been achieved in each item with a minimum of 70% consensus on their importance in the caregiving context. This preliminary 37-item Carer Need Screening Tool (CNST-37) provided a strong foundation for developing a valid and reliable screening tool for carer services.

Phase II – Item-Reduction and Scale Development

Study Design and Process of the Validation Study for Scale Development

This phase included a validation study for the screening tool finalization. Family carers aged 18 or above who were taking care of their family members aged 60 or above for at least 6 hours per week were recruited through 15 local non-governmental organizations (NGOs) and public recruitment. Eligible respondents were invited to complete an online questionnaire, with the option to use a paper-and-pencil version. Online or written informed consent was obtained from all participants. A supermarket voucher valued at US$6.4 (HK$50) was provided as a token of appreciation upon completion of the questionnaire.

A total of 907 carers completed the questionnaire between June and September 2023. Ineligible cases (n=47) were excluded, including those who were not caring for older adults aged 60 or above and those who were not the primary caregivers of the older adults. Then invalid cases (n=57) with straight-lining responses in over 50% of the scales or inconsistent and contradictory responses within or across scales were further excluded. Finally, a valid sample of 803 carers was used for the analysis in this study, with 684 recruited through NGOs and 119 recruited through public recruitment.

Measurements for Item Deduction Analysis

The 37-item Carer Need Screening Tool (CNST-37). The CNST-37 includes 37 interim items addressing carers' needs in their caregiving role. The screening tool applies a 4-point scoring system: 0 = *Not applicable*, 1 = *Somewhat applicable or occasionally applicable*, 2 = *Very applicable or frequently applicable*, and 3 = *Most applicable or constantly applicable*. Higher scores indicate an increased level of carer need.

Depression Anxiety Stress Scales (DASS-21). The DASS-21 is a 21-item scale measuring the severity of three aspects of mental health over the past week, they are depression, anxiety, and stress (Lovibond & Lovibond, 1995). The Chinese version of DASS-21 validated by Moussa et al. (2001) was used in this study. With seven items in each aspect, all items are rated on a 4-point Likert scale, ranging from 0 (*did not apply to me at all)* to 3 (*applied to me very much or most of the time*). Sum scores were computed to identify respondents' severity levels in each aspect (*normal, mild, moderate, severe, and extremely severe*) (Lovibond & Lovibond, 1995). Higher scores indicate a greater level of depression, anxiety or stress corresponding to each subscale.

Item Deduction Analysis of the Scale Validation Study

The IBM SPSS Statistics 28 was used to summarize the basic characteristics of participating carers and develop the scale in three steps. First, redundant and irrelevant items were identified with inter-item and item-total correlation analyses. Second, item-level Area Under Curve (AUC) values from the receiver operating characteristic (ROC) analysis were used to assess each item's ability to differentiate between low and high

levels of depression, anxiety, and stress. Adopting the outcome prediction method (Koczkodaj et al., 2017), the optimal number of items was determined by evaluating the individual and cumulative AUC values of each item with the ROC analysis, considering the specific purpose of a screening tool for identifying carers in need of support. This method evaluates the ability of each item to discriminate between two groups of a binary outcome, providing an outcome-oriented strategy to select items with the greatest predictive power. Finally, all items were reviewed by the researchers of the current study, who have expertise in psychology, public health, social work, and sociology, to evaluate their content validity and clinical relevance to finalize the CNST-11.

Results of the Item Deduction Analysis

Participants' Characteristics. A total of 803 carers of older adults aged 60 or above were included in the current study. The age of the carers ranged from 18 to 92, with a mean age of 54.5 (*SD* = 15.9). Most of the respondents were female (*n* = 578, 72.0%). One-third of the respondents were single (*n* = 273, 34.0%) and over half of them were married or had a partner (*n* = 471, 58.7%). A majority reported having a secondary school education or above (*n* = 705, 87.8%). Nearly half were economically active, either working full-time, part-time, or self-employed (*n* = 398, 49.6%), and one-third were retired (*n* = 266, 33.1%). As reported by the respondents, the care recipients aged from 60 to 101, with a mean age of 78.4 (*SD* = 10.3). Over half of the care recipients were female (*n* = 432, 53.8%).

On average, the respondents have been providing care for the care recipients for 8.4 years (*SD* = 8.3), and most of them were co-residing with the care recipients (*n* = 562, 70.0%). Over half of them were taking care of their parents (*n* = 492, 61.3%), followed by spouses (*n* = 214, 26.7%). Nearly half spent 30 hours or above in caretaking (*n* = 360, 44.8%) and about one-fifth spent less than 10 hours (*n* = 150, 18.7%). Nearly 60% of respondents received support from family, friends, or domestic helpers in taking care of the care recipients (*n* = 475, 59.2%).

Step 1: Inter-Item and Item-Total Correlations.

Inter-item and item-total correlations were performed to evaluate the relevancy and redundancy of items regarding carer's mental health conditions and need for support. Items with high inter-item correlations were candidates for deletion, while moderately correlated items were candidates for combination, factoring in content validity for the final decision. After reviewing highly correlated items, three items on mental health (*r* = 0.59 to 0.70) and one item on caregiving load (*r* = 0.70) were removed. A pair of moderately correlated items on carer's physical health was combined into a single item (*r* = 0.52). Item-total correlation was examined with the 32 remaining items, and two items with low correlation coefficients with the total score were further removed (*r* = 0.09 to 0.18).

Step 2: ROC Item Reduction Analysis.

The 30 items in the item pool were included in the ROC analysis to select items with the highest discriminatory power in identifying carers in need of support. Items were ranked based on AUC value of each individual item, and cumulative AUC was calculated to examine the additional discriminatory power of each added item. The optimal number of items was 10, reaching a cumulative AUC of 0.917. Further investigation of 10 items suggested that the item on the impact of carer's mental health exhibited a significantly lower prevalence (18.2%) than the other selected items (30.3% to 78.8%). It was dropped to improve the representativeness and discriminatory power

of the overall scale. The cumulative AUC remained strong at 0.914 with the 9 items, and the reliability alpha (*r*) reduced slightly from 0.821 and remained robust at 0.809.

Step 3: Content Validity Evaluation.

The content validity of the 30 items was examined by the expert panel, and two items capturing care recipient's aggressive behaviour and carer's ideation of self-harm or harming others were retained due to the potential clinical severity and danger of exhibiting these thoughts or behaviours in caregiving. The cumulative AUC remained strong at 0.910 with the two additional items (see Figure 1). A total of 11 items was selected for validation in the next phase of the study.

Phase III – Psychometric Properties and Need Stratification

Study Design and Process of the Validation Study for Psychometric Properties Testing and Need Stratification Analysis

The 803 carers with valid responses in Phase II were included to validate the 11-item Carer Need Screening Tool (CNST-11), with scales to assess its concurrent and divergent validity presented in the following.

Measurements for Psychometric Properties Testing and Need Stratification Analysis

Carer Burden Inventory (CBI). The CBI is a 24-item multidimensional inventory measuring carers' caregiving burden regarding the demands and challenges of their role as a carer (Chou et al., 2002; Novak & Guest, 1989). The inventory captures carers' well-being and quality of life in five dimensions. They are (1) time-dependence, (2) developmental, (3) physical, (4) social, and (5) emotional burden. Each item is rated on a 5-point Likert scale, ranging from 0 (*never*) to 4 (*nearly always*). Higher scores indicate a greater level of caregiving burden. The internal reliability (α) of CBI was 0.94.

Patient Health Questionnaire-9 (PHQ-9). The PHQ-9, originated from the Patient Health Questionnaire developed by Spitzer (1999), is a 9-item instrument used to assess one's severity of depression symptoms. The scale is on a 4-point Likert scale ranging from 0 (*not at all*) to 3 (*nearly every day*). Higher scores indicate a more severe level of depression. The internal reliability (α) of PHQ-9 was 0.87.

Generalized Anxiety Disorder 7-item scale (GAD-7). The GAD-7 is a 7-item instrument used to assess one's severity of generalized anxiety disorder symptoms over the past two weeks in clinical and research settings (Spitzer et al., 2006). The scale is on a 4-point Likert scale ranging from 0 (*not at all*) to 3 (*nearly every day*). Higher scores indicate a greater level of anxiety. The internal reliability (α) of GAD-7 was 0.92.

Perceived Stress Scale (PSS-10). The PSS-10 is a 10-item instrument designed to measure one's subjective perception of stress over the past month (Cohen et al., 1983). The scale is on a 5-point Likert scale, ranging from 0 (*never*) to 4 (*very often*). Higher scores indicate a greater level of perceived stress. The internal reliability (α) of the PSS-10 was 0.84.

5-Level EQ-5D version (EQ-5D-5L). The EQ-5D-5L is a 5-dimension scale measuring one's health status in terms of mobility, self-care, usual activities, pain/ discomfort, and anxiety/ depression (Herdman et al., 2011). Respondents were asked to select the level that best describes their current health state on the five dimensions using a five-level scale, ranging from 1 (*no problems*) to 5 (*extreme problems*). A normative

profile for the Hong Kong population was used to calculate the normative scores (Wong et al., 2019). Higher normative scores indicate a better health status.

Preparedness for Caregiving Scale (PCS). The PCS is an 8-item scale measuring carers' perceived preparedness in taking up the caregiving role (Archbold et al., 1990). Respondents rated their level of confidence in different aspects, like providing physical care, providing emotional support, setting up in-home support services, and dealing with the stress of caregiving, on a 5-point Likert scale, ranging from 0 (*not at all prepared*) to 4 (*very well prepared*). Higher scores indicate a better preparedness for the caregiving role. The internal reliability (α) of the PCS was 0.91.

Positive Aspects of Caregiving (PAC). The PAC was developed to measure carers' perceptions towards positive aspects of caregiving across two dimensions: self-affirmation and outlook of life (Tarlow et al., 2004). The Chinese version used in this study consists of 11 items (Lou et al., 2015). Each item is rated on a 5-point Likert scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Higher scores indicate more positive appraisals of caregiving. The internal reliability (α) of the PAC was 0.94.

Data Analysis of Psychometric Properties Testing and Need Stratification

The CNST-11 was validated through five steps using the IBM SPSS Statistics 28, AMOS 28, and R. First, the sample was randomly split into two equivalent samples using the SOLOMON method developed specifically for factor analysis (Lorenzo-Seva, 2022). Second, exploratory factor analysis (EFA) with maximum likelihood estimation and oblimin rotation was performed on the first subsample to examine the factor structure and construct validity of the screening tool. Third, confirmatory factor analysis (CFA) with the maximum likelihood method was performed on the second subsample to confirm the factor structure and evaluate the model fit. Goodness-of-fit indices including comparative fit index (CFI), Incremental Fit Index (IFI), Tucker-Lewis Index (TLI), Root Mean Square Error Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR) were examined. A value of CFI, IFI, or TLI larger than .90 and .95 is considered a good fit and an excellent fit, respectively. An RMSEA or SRMR below .08 and .05 is considered an adequate fit and a good fit, respectively.

Fourth, scale-level ROC analysis was performed on the whole sample to determine the optimal cut-offs for classifying carers into different need levels. Finally, the psychometric properties of the screening tool were evaluated using Cronbach's α for reliability and various validity tests.

Results of Psychometric Properties Testing and Need Stratification Analysis

Step 1: Split-Half Sample.

The sample of 803 respondents was divided into two equivalent subsamples based on the 11 items using the SOLOMON method developed by Lorenzo-Seva (2022). The first half of the sample comprised 402 carers for the EFA and the second half consisted of 401 carers for the CFA.

Step 2 – 3: EFA and CFA.

Exploratory factor analysis (EFA) was performed using Maximum Likelihood with oblimin rotation on the subsample of 402 respondents. The data was well-suited for factor analysis (KMO = 0.849, Bartlett's Test of Sphericity: χ^2 (55) = 1133.7; $p <$ 0.001). All 11 items had a significant factor loading larger than 0.3 (Hair, 2019).

Two factors were identified, explaining a cumulative variance of 39.6%, with eigenvalues greater than 1. The first factor contained nine items depicting multifaceted

challenges/ caregiving stressors and the second factor contained two items on dysfunctional stressors in the caregiving dyad. The expert panel's review of the content validity suggested that an item related to conflicts between the carers and the care recipients in the first factor was more closely associated with the dysfunctionality of the items in the second factor. The model was respecified to enhance interpretability and practicability based on the clinical relevance of the items. Both the initial model and the respecified model with 8 items in the first factor and 3 items in the second factor were tested in the confirmatory factor analysis (CFA).

The model fit of the initial two-factor model was good in the CFA using the second subsample of 401 carers (CMIN/df=1.695, CFI=0.971, IFI=0.971, TLI=0.963, RMSEA=0.042, SRMR=0.038). The respecified model also yielded a good fit (CMIN/df=2.083, CFI=0.955, IFI=0.955, TLI=0.942, RMSEA=0.052, SRMR=0.047). The respecified model was adapted considering both the model fit and clinical implications.

Step 4: ROC Analysis and Need Stratification.

The need stratification of CNST-11 employed a hybrid analytical approach for determining the cut-offs for the four carer need levels. This approach integrated clinical evaluations of three items from the second factor to define a high need level and ROC analysis of eight items from the first factor, using PHQ-9, GAD-7, or PSS-10 as state variables to identify low, mild and moderate need levels.

Before performing the ROC analysis, carers were classified as clinically at-risk for depression with the criterion score at 10 or above on PHQ-9, anxiety at 10 or above on GAD-7, and stress at 20 or above on PSS-10. Two ROC analyses were performed on the first factor to identify carers at risk on at least one mental health scale (n = 266) and carers at risk on all three mental health scales (n = 66), and the AUC was 0.851 (95% confidence interval [CI] = 0.823-0.879) and 0.922 (95% CI = 0.897-0.947), respectively. Both results indicated good discriminatory accuracy (Pintea & Moldovan, 2009).

The Youden Index (J) suggested a cut-off of 6/7 with a sensitivity of 0.756 and a specificity of 0.790 for identifying carers at risk on at least one mental health scale (Youden, 1950). This cut-off was used to differentiate carers between the low and the mild need-level groups. The positive predictive value (PPV) was 75.6% and the negative predictive value (NPV) was 79.0%. For carers at risk on all three mental health scales, the Youden Index (J) suggested two potential cut-offs, 7/8 and 9/10; the latter was selected to obtain a balanced sensitivity at 0.848 and specificity at 0.852. This cut-off was used to differentiate carers between the mild and the moderate need-level groups. The positive predictive value (PPV) was 84.8% and the negative predictive value (NPV) was 85.2%.

Step 5: Evaluation of Psychometric Properties.

The Cronbach's alpha of the CNST-11 was 0.818, suggesting good internal reliability. Concurrent validity of the screening tool was assessed by examining its Pearson correlation coefficients with well-established scales on caregiving burden and mental health conditions, namely CBI, PHQ-9, GAD-7, PSS-10, and EQ-5D-5L (see Table 1). The CNST-11 exhibited a strong positive correlation with the overall CBI score (r = 0.712, p < .001), and moderate correlations with all five subscales of the CBI including time-dependence (r = 0.387, p < .001), developmental (r = 0.643, p < .001), physical (r = 0.659, p < .001), social (r = 0.611, p < .001), and emotional burden (r = 0.487, p < .001). The CNST-11 also had a strong positive correlation with PHQ-9 (r = 0.719, p < .001) and moderate positive correlations with GAD-7 (r = 0.688, p < .001), PSS-10 (r = 0.615, p < .001), and EQ-5D-5L (r = -0.575, p < .001). Divergent validity

was assessed with PCS and PAC. The correlation of CNST-11 with PCS was relatively low (r = -0.317, p < .001) and weak with PAC (r = -0.121, p < .001).

Discussion

This study developed and validated an 11-item Carer Need Screening Tool (CNST-11) that could be used to identify the need level of carers for older adults to inform services matching. To the best of our knowledge, this is the first carer-centric tool that followed a meticulous process and covered three dimensions (i.e., carer, care recipient, and caregiving dyad) related to caregiving ecology. By expanding Pearlin's stress process model (1990) to a parallel model, the understanding of carers' needs expands beyond the experience of carers, it improves the comprehension of their journey with the conditions of care recipients and interactive dynamics of the caregiving dyad considered.

Considering the increasing demand amid resource constraints for support among older adults' carers and the constantly changing situations of the caregiving dyad, routine and regular assessment is essential for delivering timely and need-appropriate services. This brief screening tool was designed to be self-administered by carers. It reduces the administration time and the burden of identifying in-need carers, encouraging practical adaptation in clinical practices. Not only can the CNST-11 be used to identify carers who have a greater potential to benefit from interventions, but it can also assist the continuous assessment of their changes over time or throughout interventions with a quick overview of their conditions.

As a single score measurement, it exhibited good psychometric properties among a representative sample of the carer population. The CNST-11 can be used to facilitate service triage and resource allocation in carer support services, providing helping professionals with clear and useful initial guidance with simple administration to cater for the continuously growing demand of support for carers of older adults. The excellent cumulative AUC value of the 11-item CNST suggested that there was over 90% probability that in-need carers could be identified by having higher scores than non-vulnerable carers. The CNST-11 had high internal consistency and good validity supported by its moderate to high correlations with well-established mental health scales including PHQ-9, GAD-7, PSS-10, and EQ-5D-5L. As a screening tool targeted on measuring carer needs, its high correlation with CBI and low correlations with PCS and PAC also provided strong evidence of its pertinence to carers' conditions. These results suggested that the CNST-11 is a reliable and valid screening tool.

Methodologically, the present study demonstrated the merits of identifying items with the highest discriminatory power using ROC item reduction analysis. The direct assessment of each item's performance with an intended outcome (e.g., DASS-21), instead of solely investigating the underlying construct with EFA for item selection, ensured an outcome-based selection process embedding the screening tool with solid empirical validity. Moreover, the factor structure of the 2-factor model identified by EFA was modified to account for the clinical relevance of conflicts between caregiving dyads in relation to carers' ideation of self-harm or harming others and care recipients' regression. Integrating clinical judgement, the modification provided a valid and more practical solution for helping professionals to understand carers' needs and conditions. The modification also enabled easy identification of caregiving dyads potentially at risk of any type of harm, which was recognized as an important issue among carers that helping professionals must address (Czeisler et al., 2021; Murawski et al., 2023). This

approach integrated both theoretical reasoning and statistical analysis of empirical data, facilitating the establishment of a brief and practical tool to assess the needs of older adults' carers.

Limitations

The validation of the CNST-11 was based on a cross-sectional study, and the results only provided point-in-time associations of the CNST-11 with constructs related to caregiving and mental health. The predictive validity of the CNST-11 needs to be further investigated longitudinally to examine its forecasting properties for a better understanding of their dynamic caregiving journey. As a 2-dimensional single score screening tool, it may overlook specific aspects considering the multifaceted nature of caregiving. To address that, a stepwise approach in screening is suggested by using the CNST-11 as an initial assessment of carers' need for intervention followed by an in-depth assessment to inform strategic service matching. Lastly, recruiting carers via NGOs may be vulnerable to selection bias since they are likely to share similar characteristics. Hidden carers who do not associate with any NGOs may be left out due to hesitation in identifying themselves as carers and refrain from accessing support (Knowles et al., 2016). Hence, further studies to develop a multidimensional screening tool adapting an outcome-based item selection approach among a more representative sample are needed for further assessing the specific needs of carers.

Conclusion

Despite the limitations described above, the current study has developed a brief and efficient screening tool for older adults' carers with good reliability and validity for practical service allocation. The CNST-11 is the first screening tool for carers of older adults that comprehensively utilized stakeholders' opinions and empirical data in its development with an outcome-oriented approach for item selection. Helping professionals in the field are encouraged to employ the tool in their routine operations and practices.

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Conflicts of Interest

The authors have no conflicts of interest to declare.

Data Availability

This study is not pre-registered. Survey data are not publicly available due to confidentiality concerns regarding social service users.

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Tables

Table 1. Concurrent and Divergent Validity of CNST-11: Correlation Coefficients

	Correlation with CNST-11 (N = 803)
Concurrent Validity	
CBI	0.712***
Time-dependence	0.387***
Developmental	0.643***
Physical	0.659***
Social	0.611***
Emotional	0.487***
PHQ-9	0.719***
GAD-7	0.688***
PSS10	0.615***
EQ-5D-5L	-0.575***
Divergent Validity	
PCS	-0.121***
PAC	-0.317***

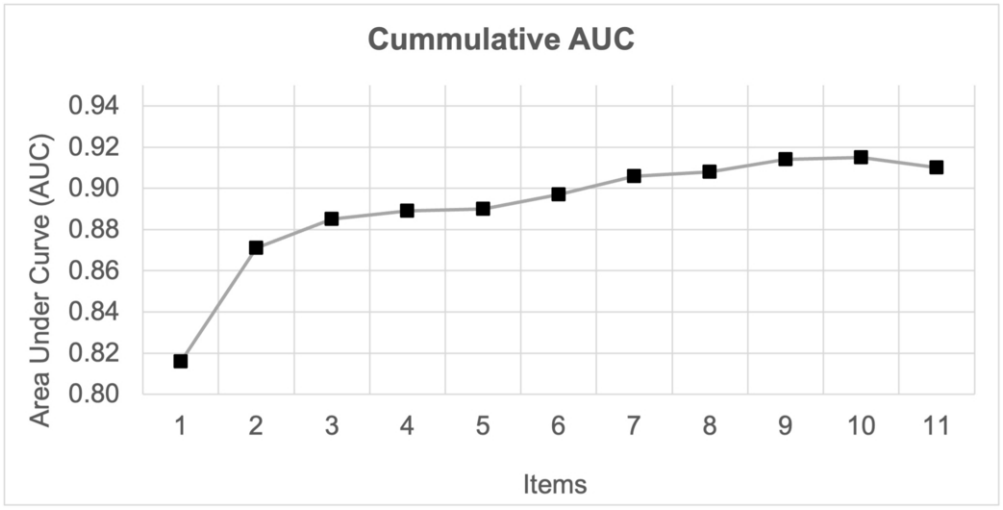
Note: CNST-11 = 11-item Carer Need Screening Tool; CBI = Caregiver Burden Inventory; PHQ-9 = nine-item Patient Health Questionnaire; GAD-7 = seven-item Generalized Anxiety Disorder Scale; PSS10 = ten-item Perceived Stress Scale; EQ-5D-5L = five-level EQ-5D; PCS = Preparedness for Caregiving Scale; PAC = Positive Aspects of Caregiving.

*** $p < .001$.

Figures

Figure 1. Cumulative Area Under Curve (AUC) of the 11 Selected Items.

Alt Text: A line graph showing the cumulative values of Area Under Curve (AUC) for each added item, increasing from 0.82 for the first item to 0.91 for the 11th item.



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