



## Psychometric validation of the Malay version of the Ryff Psychological Well-Being Scale for caregivers of patients with dementia

Mohammed Rasheedan Ellin\*<sup>1</sup>, Vimala Ramoo<sup>2</sup>, Nor Aziyan Yahaya<sup>2</sup>, Tan Maw Pin<sup>2</sup>  
& Dayang Zuraina Abang Haji Kashim<sup>1</sup>

<sup>1</sup>Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak,  
94300 Kota Samarahan, Sarawak, Malaysia.

<sup>2</sup>Faculty of Medicine, Universiti Malaya, 50603 Kuala Lumpur, Malaysia.

### ABSTRACT

Despite its widespread international use, the Ryff Psychological Well-Being Scale lacks a culturally validated Malay version, highlighting the need for a reliable tool to assess psychological well-being in Malaysia. Psychological well-being is a multifaceted construct that requires culturally appropriate instruments. The Malay version was developed using rigorous forward-backwards translation to ensure linguistic accuracy and cultural relevance, followed by review from eight experts in psychology, medicine, and gerontology who assessed item clarity, relevance, and cultural suitability. Minor modifications were applied to improve readability without altering underlying constructs. Content validity evaluation showed high item-level and scale-level Content Validity Index (CVI) values, indicating strong agreement among experts. Reliability testing yielded a Cronbach's alpha of 0.865, confirming the robustness of the translated scale, though further evaluation may enhance its psychometric properties. These findings provide a reliable, culturally validated instrument for assessing psychological well-being among Malay-speaking populations, supporting both research applications and evidence-based practice, and facilitating cross-cultural mental health studies.

**Keywords:** psychological well-being, cross-cultural comparison, content validity index, dementia, caregivers

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Email address: [emrasheedan@unimas.my](mailto:emrasheedan@unimas.my) (Mohammed Rasheedan Ellin)

\*Corresponding author

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## 1 INTRODUCTION

The Ryff Psychological Well-Being Scale is a comprehensive tool that evaluates six distinct dimensions of psychological well-being, namely: autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance (Gao & McLellan, 2018). These dimensions provide valuable insights into an individual's emotional, psychological, and social functioning, enabling researchers, clinicians, and individuals to gain a deeper understanding of their mental health and overall well-being. While the original English version of the Ryff scale has proven invaluable across various research and clinical settings, the need for a Malay version is undeniable. Translating and validating the Ryff Psychological Well-Being Scale into Malay is essential, as Malaysia's multicultural and multilingual context creates a significant gap in psychological assessment and research without a culturally and linguistically validated version. Translation alone is insufficient because psychometric properties such as validity, reliability, and factor structure must be re-evaluated to ensure conceptual equivalence and measurement accuracy within the local sociocultural context.

Psychological well-being is a multidimensional construct that has been conceptualised and operationalised in diverse ways across disciplines, leading to variations in its definition and measurement. Some researchers adopt a relatively narrow and pragmatic definition, focusing on general life satisfaction and emotional states. For example, Raivio et al. (2015) operationalised psychological well-being using a brief six-item measure assessing life satisfaction, feeling needed, future orientation, zest for life, depressive feelings, and loneliness. Responses were dichotomous ("yes" or "no"), and the instrument demonstrated acceptable test-retest reliability and prognostic validity. While such approaches offer simplicity and feasibility in large-scale or longitudinal studies, they may inadequately capture the complexity of psychological well-being as a holistic construct.

Other conceptualisations are rooted in subjective well-being, emphasising affective experiences and happiness. Instruments such as the World Health Organisation Five Well-Being Index (WHO-5) align with this perspective by assessing positive mood, vitality, and general interest in life. Although psychological well-being is often discussed interchangeably with quality of life or mental health, these constructs differ conceptually in terms of depth, dimensionality, and theoretical grounding.

A variety of measurement tools have been developed to assess psychological well-being, differing in length, theoretical orientation, and dimensional coverage. The WHO-5 Well-Being Index is a widely used and validated instrument consisting solely of positively worded items, making it efficient and user-friendly in both clinical and community settings. Quinn et al. (2021), for instance, employed the WHO-5 to assess caregiver well-being. Despite its strengths, the WHO-5 primarily captures hedonic aspects of well-being, such as positive affect and subjective vitality, and does not explicitly assess broader psychological functioning or personal development.

In contrast, brief measures like the six-item instrument used by Raivio et al. (2015) emphasise feasibility but rely on limited indicators and binary response options, which may restrict sensitivity and conceptual richness. Consequently, while these instruments are useful for screening or large

population studies, they may be insufficient for research grounded in more comprehensive theoretical models of psychological well-being.

Ryff's model of psychological well-being offers a theoretically robust and multidimensional framework that integrates both hedonic and eudaimonic perspectives. According to Huta and Waterman (2014), hedonic well-being focuses on subjective experiences such as happiness, life satisfaction, and positive affect. In contrast, eudaimonic well-being emphasises optimal functioning, personal growth, and meaning in life. Ryff's conceptualisation is firmly grounded in the eudaimonic tradition, defining psychological well-being as the realisation of one's potential and the ability to function effectively despite life's challenges.

Based on this framework, Ryff developed the Psychological Well-Being Scale, which comprises six dimensions: self-acceptance, positive relations with others, autonomy, environmental mastery, purpose in life, and personal growth (Henn et al., 2016). The 18-item version of the scale has demonstrated strong empirical support and has been widely applied in diverse cultural and research contexts. Compared to simpler instruments such as the WHO-5, Ryff's scale provides a more nuanced and comprehensive assessment that aligns closely with the conceptual definition of psychological well-being adopted in this study.

Despite its extensive use internationally, a validated Malay version of the Ryff Psychological Well-Being Scale remains unavailable. Given that Malay is the national language of Malaysia. The majority of the population speaks it, but the absence of a culturally adapted, psychometrically validated Malay version limits its applicability in local research and clinical practice. Therefore, translating and validating Ryff's scale into Malay is both timely and necessary. This effort will enhance the accessibility of a theoretically sound and rigorously developed instrument, enabling more accurate assessment of psychological well-being among Malay-speaking populations and supporting high-quality mental health research in Malaysia.

Dementia caregiving represents a distinct and particularly demanding form of geriatric caregiving that warrants focused investigation. Unlike general psychological well-being studies conducted in broader populations, caregivers of older adults face chronic, cumulative, and multidimensional stressors embedded within long-term care responsibilities. Geriatric caregiving often involves managing functional decline, multimorbidity, and increasing dependency, which differ substantially from acute or short-term caregiving contexts.

Among geriatric conditions, dementia is uniquely characterised by progressive cognitive deterioration, behavioural disturbances, personality changes, and loss of autonomy. These features require continuous supervision, complex decision-making, and emotional adjustment as caregivers witness gradual psychological and relational loss. The trajectory of dementia caregiving is typically prolonged and unpredictable, intensifying emotional burden and altering family roles over time. As a result, the caregiving experience in dementia extends beyond situational stress and has profound implications for meaning-making, identity, social engagement, and long-term psychological adaptation.

Therefore, assessing psychological well-being in dementia caregivers necessitates an instrument that captures not only transient affective states (e.g., distress or mood) but also broader domains such as purpose in life, autonomy, environmental mastery, personal growth, and relational functioning. A general measure of psychological well-being may not sufficiently reflect the unique, enduring, and relationally embedded challenges inherent in dementia caregiving. This conceptual distinction justifies a focused examination of psychological well-being within the context of dementia caregiving rather than in general populations.

The Scale of Psychological Well-being (SPW) is an 18-item, validated instrument that measures six domains: purpose in life, self-acceptance, autonomy, personal growth, positive relations with others, and environmental mastery (Gao & McLellan, 2018). Each of these dimensions consists of three items. The subscale was measured by rating on a 6-point Likert scale, ranging from "1-disagree a lot" to "6-agree a lot". Overall, the total score ranges from 18 to 108.

Higher scores mean higher levels of psychological well-being (Ruggeri et al., 2020). Garcia et al. (2023) reported that the Scale of Psychological Well-being has high internal consistency, with a Cronbach's alpha of 0.91. Items Q1, Q2, Q3, Q8, Q9, Q11, Q12, Q13, Q17, and Q18 should undergo reverse-scoring. Reverse-scoring involves rephrasing these items in a manner that reflects the opposite direction of the intended scale measurement (Checa & Espejo, 2018).

The present study aims to translate, culturally adapt, and psychometrically validate the Malay version of the Ryff Psychological Well-Being Scale, thereby providing a reliable and valid instrument for assessing psychological well-being among Malay-speaking populations in Malaysia. This work is expected to facilitate more inclusive mental health research and support evidence-based psychological assessment and intervention in both clinical and community settings.

## **2 METHODS**

This section outlines the procedures used to translate, culturally adapt, and validate the Ryff Psychological Well-Being Scale into Malay, including forward-backwards translation, expert panel evaluation, content validation, and reliability assessment.

### **2.1 Forward and Backward Translation**

The translation process in this study followed a rigorous forward and backward translation methodology to ensure the linguistic accuracy and cultural relevance of the instrument. For the forward translation, a native Malay speaker with a degree in English Education and more than five years of experience in English-Malay translation was appointed. This process focused on preserving the conceptual meaning of the original items while ensuring linguistic clarity and cultural appropriateness for Malay-speaking respondents. Minor wording modifications were made to enhance readability and contextual suitability, without altering the underlying constructs of the original scale. The backward translation was conducted by a native English speaker with a degree in Teaching English as a Second Language (TESL) and over ten years of teaching experience. Comparison between the back-translated version and the original English instrument

revealed high semantic and conceptual equivalence. No major discrepancies in meaning were identified, indicating that the translated items accurately reflected the original scale's intent. Any minor differences detected were discussed and resolved through consensus, resulting in a final Malay version that maintained fidelity to the original instrument while being culturally comprehensible.

## **2.2 Expert Panel Evaluation of Instrument Validity and Reliability**

Eight experts with backgrounds in psychology, medicine, nursing, and public health reviewed the translated items. Each expert received an evaluation sheet showing the original English items side-by-side with the Malay translations, along with written instructions for scoring. The panel was given two weeks to complete the review. The expert group included geriatric specialists, a social gerontologist, a psychiatrist, nursing academics, a public health specialist, and a nurse manager of a geriatric ward.

## **2.3 Validity of the Instruments**

Content validation serves as a crucial step in ensuring that an instrument accurately measures its intended constructs, confirming the alignment of items with the content domain and the proposed dimensions. This process involves evaluating the appropriateness, clarity, and comprehensiveness of items by a panel of experts within the relevant field. In the current study, the Scale of Psychological Well-being underwent a robust content validation.

However, recognising that the instrument was originally developed in a Western sociocultural context and subsequently adapted for use in Malaysia through translation into Malay, the need for cross-cultural validation was acknowledged. Cultural differences in values, social norms, caregiving roles, and expressions of psychological well-being may influence how Malaysian caregivers interpret and respond to items. Therefore, cross-cultural validation was essential to ensure conceptual equivalence, cultural relevance, and content appropriateness of the translated instrument, as well as to confirm that each item accurately reflected the intended constructs of psychological well-being within the local caregiving context.

To achieve this, a panel of experts was appointed based on the following criteria: a professional background in nursing, medicine, psychology, or related fields, and more than five years of experience in the care, treatment, or management of patients with dementia. The expert panel was tasked with evaluating the clarity, relevance, and cultural suitability of each item in the Malay-translated instrument. The involvement of the expert panel was voluntary—the validation process employed expert evaluation using the Content Validity Index (CVI) as the primary method. The experts utilised a rating scale ranging from "1 – not accurate" to "4 – very clear" for each item, along with providing recommendations for improvement.

## 2.4 Method of Validation

Content Validity Index (CVI) was used to assess the instrument's validity in this study. According to Zamanzadeh et al. (2015), there are two categories of CVI: item-level CVI (I-CVI) and scale-level CVI (S-CVI). I-CVI represents the content validity of individual items and can guide researchers in revising, eliminating, or replacing items.

Mat Said et al. (2022) stated that to calculate I-CVI, firstly, the items rated as either "1" or "2" were dichotomised as "0" and the items rated as either "3" or "4" were dichotomised as "1" or "X" (Refer to Table 1). Then, to obtain the I-CVI value, the number of experts who rated the item as "X" is divided by the total number of experts. To obtain the scale level CVI (S-CVI/Average), the sum of I-CVI is divided by the number of items in the scale. The item was considered valid and accepted if the I-CVI value was above 0.79. The item needs revision if it ranged from 0.70–0.79 and is considered for elimination if the I-CVI value is less than 0.70 (Zamanzadeh et al., 2015). After validation by eight experts, the I-CVI for each item ranged from 0.625 to 1.0. Meanwhile, at the scale level, the instruments S-CVI/Average ranged from 0.875 to 0.99. The I-CVI for the Scale of Psychological Well-being ranged from 0.875 to 1, with an S-CVI/Average of 0.99. Therefore, all items were included in the questionnaire. However, there was a minor modification to the sentence structure of the Malay-translated items, as recommended by experts.

## 3 RESULTS

Table 1 demonstrates the Content Validity Index (CVI) for the Scale of Psychological Well-being, evaluated by eight experts. The majority of the items (Q1–Q13 and Q15–Q18) received unanimous agreement from all experts, achieving an I-CVI of 1.00. However, Q14 was rated as relevant by 7 of 8 experts, resulting in a slightly lower I-CVI of 0.875. The proportion of relevant items, as summarised at the bottom of the table, reflects high agreement across all questions, with a total I-CVI score of 17.87. These findings indicate strong content validity for the scale, with only minor disagreement on a single item (Q14), which still falls within an acceptable range.

Table 2 compares the initial Malay translation recommended by experts for four specific items (Q6, Q10, Q14, and Q18). The expert recommendations reflect linguistic refinements to improve clarity, accuracy, and cultural appropriateness. The expert revisions enhanced the semantic accuracy, readability, and cultural alignment of the Malay translations by refining word choices, sentence structure, and phrasing to reflect commonly better-used expressions and culturally appropriate meanings in the Malaysian context. Ambiguous terms and literal translations that could potentially lead to misinterpretation were modified to ensure conceptual equivalence with the original items. In addition, adjustments were made to improve linguistic clarity and respondent comprehension, particularly for items requiring abstract or reflective judgment, thereby strengthening the instrument's overall content validity.

**Table 1.** Content Validity Index (CVI) for the Scale of Psychological Well-Being.

Q	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Number of agreements	I-CVI
Q1	X	X	X	X	X	X	X	X	8	1
Q2	X	X	X	X	X	X	X	X	8	1
Q3	X	X	X	X	X	X	X	X	8	1
Q4	X	X	X	X	X	X	X	X	8	1
Q5	X	X	X	X	X	X	X	X	8	1
Q6	X	X	X	X	X	X	X	X	8	1
Q7	X	X	X	X	X	X	X	X	8	1
Q8	X	X	X	X	X	X	X	X	8	1
Q9	X	X	X	X	X	X	X	X	8	1
Q10	X	X	X	X	X	X	X	X	8	1
Q11	X	X	X	X	X	X	X	X	8	1
Q12	X	X	X	X	X	X	X	X	8	1
Q13	X	X	X	X	X	X	X	X	8	1
Q14	X	X	X	X	0	X	X	X	7	0.875
Q15	X	X	X	X	X	X	X	X	8	1
Q16	X	X	X	X	X	X	X	X	8	1
Q17	X	X	X	X	X	X	X	X	8	1
Q18	X	X	X	X	X	X	X	X	8	1
Proportion relevant	1	1	1	1	0.94	1	1	1	Total	17.875
									S-CVI/Ave	0.99
									S-CVI/UA	1

**Table 2.** English-Malay translation of the Scale of Psychological Well-Being and I-CVI value.

Item	Statement	Translation validity (I-CVI value)
Q1	“I like most parts of my personality.” “ <i>Saya suka hampir kebanyakan personaliti diri saya.</i> ”	1
Q2	“When I look at the story of my life, I am pleased with how things have turned out so far.” “ <i>Apabila saya melihat kisah kehidupan saya, saya berasa gembira dengan keadaan yang telah terjadi.</i> ”	1
Q3	“Some people wander aimlessly through life, but I am not one of them.” “ <i>Sesetengah orang tidak mempunyai tujuan yang jelas dalam kehidupan, tetapi saya bukan salah seorang daripadanya.</i> ”	1
Q4	“The demands of everyday life often get me down.” “ <i>Tuntutan kehidupan seharian saya sering menjejaskan diri saya.</i> ”	1
Q5	“In many ways, I feel disappointed about my achievements in life.” “ <i>Saya berasa kecewa melihat pencapaian dalam kebanyakan perkara dalam kehidupan saya.</i> ”	1
Q6	“Maintaining close relationships has been difficult and frustrating for me.” “ <i>Mengekalkan hubungan yang rapat sangat sukar dan membuat saya rasa kecewa.</i> ”	1
Q7	“I live life one day at a time and do not really think about the future.” “ <i>Saya hidup untuk hari ini dan tidak terlalu memikirkan tentang masa depan.</i> ”	1

Q8	“In general, I feel I am in charge of the situation in which I live.” “ <i>Secara umumnya, saya berasa saya bertanggungjawab dalam situasi di mana saya hidup.</i> ”	1
Q9	“I am good at managing the responsibilities of daily life.” “ <i>Saya bagus dalam menguruskan tanggungjawab dalam kehidupan seharian.</i> ”	1
Q10	“I sometimes feel as if I have done all there is to do in life.” “ <i>Kadang-kadang saya merasa seolah-olah saya telah melakukan semua perkara yang perlu dilakukan dalam hidup.</i> ”	1
Q11	“For me, life has been a continuous process of learning, changing, and growth.” “ <i>Bagi saya, kehidupan adalah suatu proses pembelajaran berpanjangan, berubah, dan berkembang.</i> ”	1
Q12	“I think it is important to have new experiences that challenge how I think about myself and the world.” “ <i>Saya merasakan penting untuk mempunyai pengalaman yang baru yang mencabar bagaimana saya memikirkan tentang diri saya dan dunia.</i> ”	1
Q13	“People would describe me as a giving person, willing to share my time with others.” “ <i>Orang akan menggambarkan diri saya sebagai seorang yang memberi dan sanggup berkongsi masa saya dengan orang lain.</i> ”	1
Q14	“I gave up trying to make big improvements or changes in my life a long time ago.” “ <i>Saya telah berputus asa untuk melakukan penambahbaikan atau perubahan besar dalam kehidupan saya pada masa yang lalu.</i> ”	0.875
Q15	“I tend to be influenced by people with strong opinions.” “ <i>Saya cenderung untuk dipengaruhi orang yang mempunyai pendapat yang kuat.</i> ”	1
Q16	“I have not experienced many warm and trusting relationships with others.” “ <i>Saya tidak merasai banyak hubungan yang mesra dan dipercayai dengan orang lain.</i> ”	1
Q17	“I have confidence in my own opinions, even if they are different from the way most other people think.” “ <i>Saya mempunyai keyakinan terhadap pendapat saya sendiri, walaupun ianya berbeza dengan cara berfikir kebanyakan orang lain.</i> ”	1
Q18	“I judge myself by what I think is important, not by the values of what others think is important.” “ <i>Saya menilai diri saya dengan apa yang saya anggap penting, bukan dengan nilai-nilai yang dianggap penting oleh orang lain.</i> ”	1

### 3.1 Reliability of the Instruments

To assess the reliability of the instruments intended for use in the main study, Cronbach's Alpha was calculated from a pilot study involving 30 participants. Although relatively small, In (2017) stated that a sample size of 30 participants is sufficient for conducting a pilot study. Notably, the 30 participants from the initial phase of data collection in the same sampling setting were excluded from the final samples. Cronbach's Alpha coefficient is considered the most appropriate measure of reliability for Likert scales (Robinson-Lane et al., 2021). Cronbach's alpha estimates the correlation among all variables in all possible combinations; a high-reliability estimate should be as close to 1 as possible (Sullivan, 2011). Even though there are no absolute rules for internal consistency, most agree that an acceptable internal consistency coefficient is 0.70 (Taber, 2018).

Reliability analysis was conducted on the 18-item Psychological Well-being Scale. Cronbach's alpha indicated that the questionnaire had good internal reliability ( $\alpha = 0.865$ ).

#### 4 DISCUSSION

In this research, the Content Validity Index (CVI) and Cronbach's alpha were used to evaluate the psychological well-being measure. The CVI was used to assess its validity, while Cronbach's alpha was used to evaluate the newly translated Malay version of the psychological well-being instrument.

The content validity assessment of the Malay-translated version showed that all items achieved an item-level content validity index (I-CVI) of 1.00, except Item 14, which had an I-CVI of 0.875. The sentence "I gave up trying to make big improvements or changes in my life a long time ago" is clear and grammatically correct. However, if you seek a critique of its structure, one aspect to consider is the length, a concern that also extends to the Malay version. While the sentence effectively conveys the respondent's perspective, it could be simplified for improved readability. Ultimately, the structure of a sentence can vary based on stylistic preferences and the desired emphasis.

A few items showed higher Cronbach's alpha values when deleted. Malay translated of Item 10 "*I sometimes feel as if I have done all there is to do in life*", Item 17 "*I have confidence in my own opinions, even if they are different from the way most other people think*", and Item 18 "*I judge myself by what I think is important, not by the values of what others think is important*" reported to increase Cronbach's alpha value if those items were deleted. However, all items were retained because the scale's Cronbach's alpha remained highly reliable.

Beyond linguistic clarity, it is important to consider what these items conceptually measure and their relevance within the Malaysian cultural context of dementia caregiving. The psychological well-being scale captures multidimensional constructs, including purpose in life, autonomy, environmental mastery, self-acceptance, and personal growth. In the context of dementia caregiving, these domains are particularly salient, as caregivers often experience shifts in life priorities, identity restructuring, and prolonged role adaptation. For example, Item 10 ("I sometimes feel as if I have done all there is to do in life") reflects existential fulfilment and purpose, which may fluctuate among caregivers facing long-term caregiving responsibilities. Similarly, Items 17 and 18 relate to autonomy and self-determination, constructs that may be influenced by collectivist cultural norms in Malaysia, where family expectations, filial responsibility, and community values can shape decision-making and self-evaluation. The increase in Cronbach's alpha if these items were deleted may indicate subtle conceptual variability in how autonomy and life accomplishment are interpreted within this caregiver population, rather than true measurement inconsistency. From a theoretical perspective, psychological well-being is not merely the absence of distress but involves positive functioning and meaning making; thus, retaining these components preserves the construct's multidimensional integrity. Practically, understanding how caregivers interpret autonomy, self-judgment, and life satisfaction is essential for designing culturally sensitive psychosocial interventions. These findings also highlight the need for future

comparative studies across broader caregiver populations to explore further how cultural values interact with psychological well-being domains.

A final review of the questionnaire (both English and Malay versions) was conducted by a bilingual language and psychometrics expert with experience in instrument development and validation. This specialist was chosen to ensure that the items were not only free of spelling and formatting errors but also maintained conceptual equivalence, clarity, and cultural appropriateness. Their expertise allowed for a comprehensive assessment of linguistic nuances, readability, and consistency across both language versions, thereby enhancing the overall quality and validity of the instrument prior to data collection.

Despite several limitations, the present study relied on self-reported questionnaires, which may have introduced response bias. Participants may have overreported positive psychological well-being or underreported distress due to social desirability, recall inaccuracies, or perceived expectations, potentially inflating well-being scores and affecting the accuracy of the findings. Additionally, no comparisons were made with other instruments assessing psychological well-being among caregivers, limiting the evaluation of convergent validity. Furthermore, the scale was administered only once, which precluded the assessment of other important psychometric properties, such as test-retest reliability and temporal stability. Future research should expand to include caregivers of patients with dementia across different hospitals in other Malaysian states to confirm the generalisability of the Scale of Psychological Well-being. An interviewer-rated tool may be more suitable, as it could reduce response bias. Test-retest reliability should be a focus in future research, especially in prospective studies examining caregivers' affiliate stigma levels at different points in time. Although the evaluation was successfully conducted, this study has several limitations. One key limitation is the small sample size used in the reliability analysis, which limits the generalisability of the findings. Additionally, potential bias may have arisen due to the use of purposive sampling in selecting the panel of experts.

In conclusion, the Malay translation of the psychological well-being scale demonstrated strong content validity and high internal consistency, supporting its reliability for assessing caregivers of dementia patients in Malaysia. Although a few items showed potential to increase Cronbach's alpha if deleted, retaining them preserved the multidimensional construct of psychological well-being, including purpose in life, autonomy, self-acceptance, and personal growth. Expert bilingual review ensured linguistic clarity, conceptual equivalence, and cultural appropriateness. Despite limitations such as self-report bias, lack of convergent validity assessment, and absence of test-retest evaluation, this instrument provides a robust foundation for culturally sensitive caregiver research, with future studies encouraged to expand its generalisability and psychometric evaluation.

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## **AUTHOR CONTRIBUTIONS**

The first author designed the study, collected the data, and conducted the data analysis. The second and third authors provided research consultation and assisted with the manuscript review. The fourth and fifth authors reviewed the manuscript.

## **CONFLICT OF INTEREST**

The authors declare that there is no conflict of interest.

## **DATA AVAILABILITY STATEMENT**

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## **ETHICAL STATEMENT**

Ethical approval for this study was obtained from the Universiti Malaya Medical Centre Medical Research Ethics Committee (UMMREC). The application was approved on 18 December 2020 (MREC ID: 2020113-9183).

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