

ORIGINAL ARTICLE

Refining Caregiver Reaction Assessment (CRA) Instrument Using Rasch Measurement Model Validation

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ABSTRACT

Introduction: Stroke is known to cause various degrees of dependency, leading to sensory, and motor deficits. In most cases, family members take on the responsibility of home care, without the assistance of medical professionals. This can lead to emotional challenges such as financial crises, role pressure, physical health issues, social life stress, and spiritual strain. In this context, an instrument called Caregiver Reaction Assessment (CRA) has been designed to gauge the workload of family caregiver on the aspects of item difficulty, reliability, as well as validity of person and item. The instrument must be subjected to repeated validity and reliability testing for accurate measurement of the intended construct. Therefore, this study aimed to assess the psychometric properties of CRA instrument using Rasch analysis, with a focus on aspects of item difficulty, reliability, as well as validity of person and item. **Materials and methods:** A cross-sectional design was used in the investigation with a total of 65 family caregivers as samples. CRA instrument was then used to gauge family caregiver burden, while data was processed with Winstep 5.2.4.0 software. **Results:** The results showed that based on Rasch model analysis, the item reliability index was 0.94, and the participant reliability index was 0.85 with a 0.87 Cronbach's alpha value. MNSQ and ZSTD's outfits had infit and outfit values for items Q3, Q9, and Q20. The hardest item to approve was Q9, with a logit of 1.48. **Conclusion:** CRA instrument could help gauge family caregiver burden, particularly those who care for stroke patients.

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INTRODUCTION

Sensory and motor disabilities are the main complications of stroke, causing varying degrees of dependence in patients. These complications restrict stroke patients from carrying out daily activities (1), underscoring the role of caregiver who provides physical, emotional, and instrumental support or assistance to family members with life-limiting diseases (2).

Family caregiver providing care experience disturbances in emotions, physical health, social life, impaired social relations, spiritual pressure, role tension, and financial crises, collectively referred to as burden (1),(3),(4). This burden can cause severe damage to mental and physical health, such as hypertension, cardiovascular disorders, and immune deficiency (5),(6). Most family caregivers in

Asia consider the role as part of the culture (7) required to improve the quality of life post-stroke incidence (8).

Assessing the response of family caregiver in caring for stroke patients should be considered necessary (9), specifically among those newly diagnosed with the disease (10). Several instruments can be used to assess family caregiver burden, such as Family Burden Interview Schedule (FBIS), which evaluates the objective burden but ignores aspects of subjective burden and has low sensitivity. This may provide a potential false negative impact where caregiver who truly needs help may not be indicated by FBIS cutoff score (11). Zarit Burden Interview (ZBI) instrument is aimed at an elderly target population, hence, difficulties in assessment and interpretation often occur when used for young individuals (12). In Caregiver Burden Inventory instrument (CBI) and Caregiver Burden Scale (CBS), domains regarding caregiver fears about the future and financial burden are yet to be studied, such as families with difficulties in paying for care and low levels of insurance coverage (13). Caregiver Reaction Assessment (CRA) instrument is comprehensive in

measuring the burden and reactions of family caregiver (8). This instrument considers negative and positive aspects, but there is a potential bias toward providing responses that do not accurately represent true feelings and experiences (7).

The validity and reliability of the Brazilian version of the Caregiver Reaction Assessment (CRA) has been tested on aged family members through exploratory factor analysis using further Principal Component Analysis (PCA) (14). Likewise, the Spanish version of the CRA has been validated using the same techniques to assess the internal structure of the instrument (7). In Singapore, the validity and reliability of the CRA were tested among informal caregivers of the elderly using Confirmatory Factor Analysis (CFA) (15). CRA has been developed in Indonesia with the CRA-Indonesia Version (CRA-ID), which has gone through a validation process through cross-cultural translation and Confirmatory Factor Analysis (CFA) psychometric testing aimed at family caregivers of cancer patients in Indonesia (8). These studies use the Classical Theory Approach (CTT), which shows that CRA has good internal consistency. However, it has had several significant weaknesses, including reliance on samples and tests, weakness in assessing item difficulty, and measurement similarity. In contrast, Rasch Analysis offers advantages in invariance, measurement precision, and the ability to assess item difficulty and individual ability separately (16). Therefore, this study was conducted to analyze the psychometric properties of CRA instrument with Rasch analysis on the aspects of item difficulty, reliability, as well as validity of person and item.

CRA is the most frequently used instrument and has good psychometric value in measuring family caregiver burden (17), (18) but the sensitivity to specific subscales may influence different responses (19). This instrument, which measures multidimensional loads both positively and negatively, is already available in 10 languages, including Dutch, Norwegian, Swedish, Japanese, Chinese, Tamil, Korean, German, English, and Indonesian (7). It has been applied to family caregiver with general physical disorders (20), dementia (17), and cancer (18), (21), (22), (16). However, the psychometric properties of the Indonesian version have not been analyzed using Rasch analysis on item difficulty, reliability, as well as validity of person and item. To ensure that the original meaning is maintained and adapted to the appropriate context, CRA must be tested for validity and reliability, specifically for family caregiver of stroke patients.

MATERIALS AND METHODS

Study Design and Sample Collection

A cross-sectional design was used and samples consisted of 65 individuals from Bantul region, Indonesia, selected

using the simple random sampling method. Although Rasch analysis typically does not demand a substantial number of participants, a total of 50-250 is recommended to assess the model's goodness of fit (22). Specific Rasch parameters may be significantly influenced by limited sample sizes, including response category functions and item fit (23). Investigations on the accuracy and bias of item estimates in Rasch rating scale model show that instrument items totaling 25 and samples between 50-100 produced Root Mean Squared Error (RMSE) values of 0.1974-0.2512 and Mean Absolute Error (MAE) of 0.1974-0.2512.

RMSE and MAE values are used to evaluate model performance by measuring the error rate or difference between predicted and actual values. The difference between both lies in the calculation method, where RMSE considers the square of the error, and MAE measures the size of the average error. Therefore, RMSE value shows the average square root error of the model prediction to the actual value in the data of 0.1974-0.2512, and MAE value suggests the model has an average error of 0.1659-0.2099 from the actual value (24). The data samples were obtained from the medical record data of the Public Health Centre, accompanied by a home visit. Inclusion criteria include family caregiver with stroke patients living in the same house. Exclusion criteria included stroke patients who received health services at home from professional health workers and family caregiver with a health education background.

Measurement and data collection

Data were collected using CRA tool established by Given et al. to measure caregiver burden from family members with physical or mental disorders (25). The instrument consists of 24 items with five domains, namely lack of family support, self-esteem, finances, schedule, and health (8).

Data analysis

Data analysis measured the instrument quality, and responses using the Winsteps application version 5.2.4.0. The data were transformed mathematically into a logit (odd logarithm unit). The logarithm function converts raw ordinal (Likert-type) data into the same interval scale (20). Before further analysis, Winsteps software version 5.2.4.0 was used to check the validity and reliability of the instrument. A two-sided assessment scale model (person and item) was built for 24 CRA items, and responses were collected from 65 participants using Rasch model.

Ethical considerations

Before filling out the questionnaire, participants were informed about the study purpose. Participation was voluntary, and participants could stop at any time. Approval was received from the Health Research Ethics

Committee of the Faculty of Health, Universitas Jenderal Achmad Yani Yogyakarta, with the number: SKep/280/KEPK/VIII/2022.

RESULTS

Burden refers to the opinion, perception, or attitude of family caregiver in caring for stroke patients while at home. This component is known as latent properties, which are hidden and cannot be observed directly. Measurement of properties was carried out using CRA instrument, while analysis was conducted with Rasch measurement model. This model assumes unidimensionality, indicating that one trait drives participant responses to the items. It requires those with greater ability to obtain higher ratings for an item than others with less ability (18).

Cronbach's alpha coefficient value of 0.87 suggested that CRA had excellent internal consistency and could be considered a very reliable instrument. In addition, the separation person and item index were 2.35 and 4.04, respectively. The separation index estimates how well the questionnaire can distinguish between "person abilities" in terms of latent traits, as well as easy and difficult items. The greater the separation index, the more likely the participant will respond correctly to the item. The Likert scale analysis used a five-frequency rating including strongly disagree, disagree, undecided, agree, and strongly agree.

The validity analysis used raw variance explained by measures to determine the efficiency of the instrument. Table I shows that the value of Raw variance explained by measures was 40%. This implies that the instrument meets the unidimensionality requirements in a suitable category, with the minimum requirement being 20% (22).

Table I: Reliability and validity of person and item

	Person	Item
Separation	2.35	4.04
Reliability	0.85	0.94
Cronbach's alpha	0.87	
Raw variance explained by measures		40%

Table I shows the reliability index in logit measures that determine the questionnaire's overall quality and psychometric properties. Person and item reliability index of 0.85 and 0.94 respectively indicated good responses.

DISCUSSION

Classical Test Theory frequently regards ordinal responses to items in questionnaires as intervals, potentially resulting in interpretational errors, particularly when assessing overall scores to determine individuals' trait levels (16). Due to these limitations, Rasch analysis method considers individuals with extraordinary

ability as more likely to complete each test item. The probability of completing an easier item is greater than a more difficult item. This probability, denoted as theta (subject ability) and beta (item difficulty) determines the likelihood of correct responses. The closer the proximity of data to the predicted results, the better the fitness with Rasch model (26). A review of item contents with different disease histories is recommended to mine qualitative data. This underscores the need for qualitative studies to obtain in-depth information about the items from the participants' perspective (27).

MNSQ infit and outfit are evaluated for each item to determine the function of the rating scale on CRA questionnaire. The analysis identifies whether an item falls into the fit or misfit category for Rasch model. Based on the results, Q3, Q9, and Q20 items have infit and outfit values on MNSQ outside the range of 0.5-1.5 while ZSTD outfit values ranged from -1.9-1.9. This implies that the question items have no meaning for measurement, and there are indications of issues with item construction due to low discrimination power (23,28). MNSQ value of infit and outfit on items Q3 (I have sufficient funds to pay for the things needed to take care of my family), Q9 (I want to take care of my family), and Q20 (caring for my family is important to me) showed that psychometric traits were inadequate in measuring the construct. This suggests that the item is not sensitive to participants with a tendency for high or low family caregiver burden. In addition, Figure 1 shows person map item in Q9 with a logit of 1.48 which is the most difficult to approve. This was in line with CRA validation study in Brazil where a tendency for low reliability in self-esteem domain was observed, specifically in Q9 item which had the lowest reliability (29). Family caregiver had difficulties in answering Q9, specifically those who experience fatigue due to numerous demands requiring attention (5), hence, Q3, Q9, and Q20 items need to be improved. In general, MNSQ infit and outfit statistics showed good consistency between the target item and the response pattern at a certain level of difficulty (30).

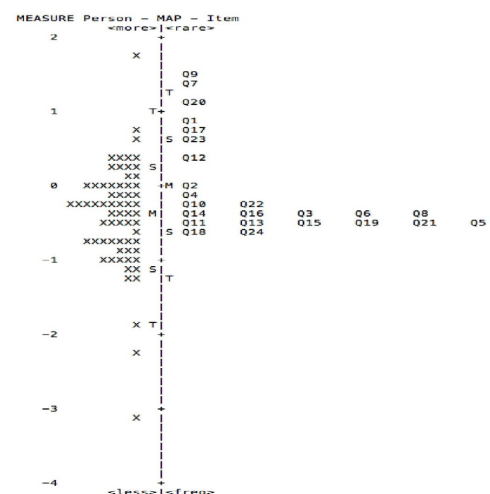


Figure 1: Item Person Map of Caregiver Reaction Assessment (CRA)

Table II: Summary of Item Statistics

Item	Infit MNSQ	Outfit		PT-Mea Corr	Measure (logit)	Model SE
		MNSQ	ZSTD			
Q1	0.99	0.89	-3.90	0.49	0.81	0.17
Q2	0.95	0.94	-0.29	0.55	-0.03	0.13
Q3	1.66	1.52	2.98	0.31	-0.37	0.13
Q4	0.75	0.70	-1.99	0.60	-0.13	0.13
Q5	0.85	0.78	-1.48	0.61	-0.46	0.12
Q6	0.96	0.94	-0.37	0.64	-0.41	0.12
Q7	1.38	1.43	1.66	0.22	1.39	0.20
Q8	0.78	0.76	-1.64	0.61	-0.34	0.13
Q9	1.61	1.59	2.22	0.28	1.48	0.21
Q10	0.71	0.70	-2.09	0.61	-0.26	0.13
Q11	0.66	0.62	-2.80	0.70	-0.52	0.12
Q12	1.38	2.16	4.31	0.11	0.32	0.14
Q13	0.74	0.72	-1.97	0.61	-0.51	0.12
Q14	0.74	0.71	-2.07	0.60	-0.34	0.13
Q15	0.94	0.86	-0.91	0.50	-0.48	0.12
Q16	0.67	0.63	-2.72	0.64	-0.32	0.13
Q17	0.90	0.86	-0.56	0.34	0.76	0.16
Q18	0.71	0.69	-2.23	0.65	-0.60	0.13
Q19	1.06	0.96	-0.18	0.47	-0.48	0.12
Q20	3.21	3.21	5.88	-0.08	1.16	0.19
Q21	1.38	1.29	1.77	0.44	-0.51	0.12
Q22	1.01	0.95	-0.25	0.52	-0.22	0.13
Q23	0.82	0.73	-1.24	0.46	0.60	0.16
Q24	1.15	1.06	0.45	0.43	-0.57	0.13

Table II shows the fit and outfit statistics of mean-square fit statistics (MNSQ) and Standardized Fit Statistics (ZSTD). Items Q3, Q9, and Q20 have infit and outfit values on MNSQ outside the range of 0.5-1.5 while ZSTD outfit values were outside the range of -1.9-1.9.

Table III shows five dimensions with different response patterns based on the level of item difficulty. However, the distribution of items across three categories appears uneven, with the majority tending to be at the easy level. Items with a higher difficulty are in the domain of Caregiver Esteem (CE). This domain had no distribution at the easy level, underscoring the need for necessary adjustment. Assessing caregiver esteem is essential, as it reflects self-evaluation in caring for patients (31). Self-esteem helps in coping with stressors such as burden of caring for family members, exposure to stress, and poorer psychological health (32), (33). Therefore, factors that reduce self-esteem will negatively impact mental health and vice versa (34), (35). The construct validity can be increased by adding a more even distribution of items starting from the easy to very difficult level. Despite the European origin, CRA instrument can be

comprehensively understood and accurately assessed by Indonesian participants regarding health complaints.

Table III: Item difficulty level

Construct of instrument	Difficulty Level		
	Very difficult	Difficult	Easy
Caregiver Esteem (CE)	Q1, Q7, Q9, Q17, Q20	Q12, Q23	
Lack Family Support (LFS)			Q2, Q6, Q13, Q16, Q22
Impact on finance (IF)			Q3, Q21, Q24
Impact on Schedule (IS)			Q4, Q8, Q11, Q14, Q18
Impact on health (IH)			Q5, Q10, Q19, Q15

Implications and Limitations

This study provides a validation instrument by evaluating the impact and early prevention of excessive family caregiver burden. The instrument can reflect valid results for measuring family caregiver with stroke patients. However, a limitation of this study lies in the method of data collection, which relied on face-to-face interviews. This approach may inadvertently influence participants to conceal true feelings, particularly when stroke patients assist in filling out the instrument. Further validation studies using Rasch method analysis with larger sample sizes are essential to improve the results.

CONCLUSION

In conclusion, based on the results of Rasch's analysis, CRA instrument generally has good psychometric performance. This instrument could measure family caregiver burden, specifically those caring for stroke patients. However, further development was needed for less-fit items.

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REFERENCES

1. Ashghali Farahani M, Najafi Ghezalje T, Haghani S, Alazmani-Noodeh F. The effect of a supportive home care program on caregiver burden with stroke patients in Iran: an experimental study. BMC Health Serv Res. 2021 Dec 1;21(1). doi: 10.1186/s12913-021-06340-4
2. van Driel AG, Becqué Y, Rietjens JAC, van der Heide A, Witkamp FE. Supportive nursing care for family caregivers – A retrospective nursing file study. Appl Nurs Res. 2021;59:151434. Available from: <https://www.sciencedirect.com/science/article/pii/S0897189721000409> DOI: <https://doi.org/10.1016/j.apnr.2021.151434>

3. Choi S, Seo J. Analysis of caregiver burden in palliative care: An integrated review. *Nurs Forum*. 2019 Apr 1;54(2):280–90. [accessed 9 Oct 2021] Available from: <https://onlinelibrary.wiley.com/doi/full/10.1111/nuf.12328> DOI: <https://doi.org/10.1111/nuf.12328>
4. Azizi A, Khatiban M, Mollai Z, Mohammadi Y. Effect of Informational Support on Anxiety in Family Caregivers of Patients with Hemiplegic Stroke. *J Stroke Cerebrovasc Dis*. 2020;29(9):105020. Available from: <https://www.sciencedirect.com/science/article/pii/S1052305720304389> DOI: <https://doi.org/10.1016/j.jstrokecerebrovasdis.2020.105020>
5. Hekmatpou D, Baghban EM, Dehkordi LM. The effect of patient care education on burden of care and the quality of life of caregivers of stroke patients. *J Multidiscip Healthc*. 2019;12:211–7. doi: 10.2147/JMDH.S196903
6. Bidwell JT, Hostinar CE, Higgins MK, Abshire MA, Cothran F, Butts B, et al. Caregiver subjective and physiological markers of stress and patient heart failure severity in family care dyads. *Psychoneuroendocrinology*. 2021;133:105399. Available from: <https://www.sciencedirect.com/science/article/pii/S0306453021002730> DOI: <https://doi.org/10.1016/j.psyneuen.2021.105399>
7. Alvira C, Cabrera E, Kostov B, Risco E, Farrñ M, Miguel S, et al. Validity and reliability of the Spanish caregiver reaction assessment scale for caregivers of people with dementia. *Int J Nurs Pract*. 2021;27(4). Available from: <https://www.scopus.com/inward/record.uri?eid=2-s2.0-85085602668&doi=10.1111%2Fijn.12848&partnerID=40&md5=fbf406ed264ec144da8b5fed38ba0687>
8. Kristanti MS, Vernooij-Dassen M, Utarini A, Effendy C, Engels Y. Measuring the burden on family caregivers of people with cancer: Cross-cultural translation and psychometric testing of the caregiver reaction assessment-Indonesian version. *Cancer Nurs*. 2021;44(1):37–44. doi: 10.1097/NCC.0000000000000733
9. Bahar Z, Elzigil A, Beser A, Къзкгъзль Ц, Ugur Ö, Suylemez BA. Reliability and Validity of the Turkish Version of the Caregiver Reaction Assessment Scale. *Stud Ethno-Medicine*. 2017 Oct 2;11(4):341–9. Available from: <https://doi.org/10.1080/09735070.2017.1387396>
10. Demiris G, Oliver DP, Washington K, Pike K. A Problem-Solving Intervention for Hospice Family Caregivers: A Randomized Clinical Trial. *J Am Geriatr Soc*. 2019; Available from: <https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063882651&doi=10.1111%2Fjgs.15894&partnerID=40&md5=3f6bfe67c3a3d6eb4e1c9ace471d87e2> DOI: <https://doi.org/10.1111/jgs.15894>
11. Yu Y, Liu Z-W, Zhou W, Zhao M, Tang B-W, Xiao S-Y. Determining a cutoff score for the family burden interview schedule using three statistical methods. *BMC Med Res Methodol*. 2019;19(1):93. Available from: <https://doi.org/10.1186/s12874-019-0734-8>
12. Pinyopornpanish K, Pinyopornpanish M, Wongpakaran N, Wongpakaran T, Soontornpun A, Kuntawong P. Investigating psychometric properties of the Thai version of the Zarit Burden Interview using rasch model and confirmatory factor analysis. *BMC Res Notes*. 2020 Dec 2;13(1):120. Available from: <https://bmresnotes.biomedcentral.com/articles/10.1186/s13104-020-04967-w> DOI: <https://doi.org/10.1186/s13104-020-04967-w>
13. Hejazi SS, Hosseini M, Ebadi A, Alavi Majd H. Development and psychometric properties evaluation of caregiver burden questionnaire in family caregivers of hemodialysis patients. *BMC Nurs*. 2022;21(1):246. Available from: <https://doi.org/10.1186/s12912-022-01025-7>
14. Mota FR do N, Victor JF, Silva MJ da, Soares ES, Ori6 MOB, Marques MB, et al. Validity and reliability of the Brazilian version of the Caregiver Reaction Assessment. *Rev Bras Enferm*. 2018;71 2(suppl 2):827–34. doi: 10.1590/0034-7167-2017-0153
15. Malhotra R, Chan A, Malhotra C, Штbye T. Validity and reliability of the Caregiver Reaction Assessment scale among primary informal caregivers for older persons in Singapore. *Aging Ment Health*. 2012 Nov 1;16(8):1004–15. Available from: <https://doi.org/10.1080/13607863.2012.702728>
16. Hadžibajramović E, Schaufeli W, De Witte H. A Rasch analysis of the Burnout Assessment Tool (BAT). *PLoS One*. 2020;15(11 November):1–19. doi: 10.1371/journal.pone.0242241
17. Kim KH, Shin YS. The effect of caregiver reaction on psychological well-being among family caregivers of cancer patients. *Korean J Adult Nurs*. 2017;29(6):647–56. doi: 10.7475/kjan.2017.29.6.647
18. Ozdemir S, Ng S, Malhotra C, Teo I, Finkelstein EA, Singh R, et al. Patient–Caregiver Treatment Preference Discordance and Its Association With Caregiving Burden and Esteem. *Innov Aging*. 2021;5(3):1–10. doi: 10.1093/geroni/igab020
19. Ng HY, Griva K, Lim HA, Tan JYS, Mahendran R. The burden of filial piety: A qualitative study on caregiving motivations amongst family caregivers of patients with cancer in Singapore. *Psychol Health*. 2016 Nov 1;31(11):1293–310. Available from: <https://doi.org/10.1080/08870446.2016.1204450>
20. Boone WJ, Townsend JS, Staver JR. Utilizing Multifaceted Rasch Measurement Through FACETS to Evaluate Science Education Data Sets Composed of Judges, Respondents, and Rating Scale Items: An Exemplar Utilizing the Elementary Science Teaching Analysis Matrix Instrument. *Sci Educ*. 2016;100(2):221–38. Available from: <https://www.scopus.com/inward/record.uri?eid=2-s2.0->

- 84958592607&doi=10.1002%2Fscs.21210&partnerID=40&md5=92567c0f83220ade3f1786f6c5ae4170 DOI: <https://doi.org/10.1002/sce.21210>
21. Bond TG, Yan Z, Heene M. Applying the rasch model: Fundamental measurement in the human sciences. *Applying the Rasch Model: Fundamental Measurement in the Human Sciences*. 2020. 1–348 p. Available from: <https://www.scopus.com/inward/record.uri?eid=2-s2.0-85131286686&doi=10.4324%2F9780429030499&partnerID=40&md5=ab413072a613e86117f03464e433e278>
22. Sumintono B, Widhiarso W. *Aplikasi Model RASCH Untuk Penelitian Ilmu-ilmu Sosial*. Cimahi: Tim Komunika Publishing House; 2014.
23. Linacre JM. Sample size and item calibration stability. *Rasch Meas Trans*. 1994;7:328. Available from: <https://cir.nii.ac.jp/crid/1370565164294452101>
24. Azizan NH, Mahmud Z, Rambli A, Hafizah Azizan N. Rasch Rating Scale Item Estimates using Maximum Likelihood Approach: Effects of Sample Size on the Accuracy and Bias of the Estimates. *Int J Adv Sci Technol*. 2020;29(4s):2526–31. Available from: <https://www.researchgate.net/publication/343152554>
25. Given CW, Given B, Stommel M, Collins C, King S, Franklin S. The caregiver reaction assessment (CRA) for caregivers to persons with chronic physical and mental impairments. *Res Nurs Health*. 1992 Aug 22;15(4):271–83. Available from: <https://onlinelibrary.wiley.com/doi/10.1002/nur.4770150406>
26. Mukherjee S, Tennant A, Beresford B. Measuring Burnout in Pediatric Oncology Staff: Should We Be Using the Maslach Burnout Inventory? *J Pediatr Oncol Nurs*. 2020;37(1):55–64. doi: 10.1177/1043454219873638
27. Chen WH, Lenderking W, Jin Y, Wyrwich KW, Gelhorn H, Revicki DA. Is Rasch model analysis applicable in small sample size pilot studies for assessing item characteristics? An example using PROMIS pain behavior item bank data. *Qual Life Res*. 2014;23(2):485–93. doi: 10.1007/s11136-013-0487-5
28. LaHuis DM, Clark P, O'Brien E. An Examination of Item Response Theory Item Fit Indices for the Graded Response Model. *Organ Res Methods*. 2009 Nov 30;14(1):10–23. Available from: <https://doi.org/10.1177/1094428109350930>
29. Monteiro EA, Mazin SC, Dantas RAS. Questionário de Avaliação da Sobrecarga do Cuidador Informal: validação para o Brasil. *Rev Bras Enferm*. 2015 Jun;68(3):421–8. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-71672015000300421&lng=pt&tlng=pt DOI: <https://doi.org/10.1590/0034-7167.2015680307i>
30. Mucoz CP, Nieto BB. Spanish Version of the Flourishing Scale (FS) on the parents of children with cancer: A validation through rasch analysis. *Front Psychol*. 2019;10(JAN):1–8. doi: 10.3389/fpsyg.2019.00035
31. Pozo Mucoz C, Bretones Nieto B. Spanish Version of the Flourishing Scale (FS) on the Parents of Children With Cancer: A Validation Through Rasch Analysis. *Front Psychol*. 2019 Jan 25;10:35. Available from: <https://www.frontiersin.org/article/10.3389/fpsyg.2019.00035/full> DOI: <https://doi.org/10.3389/fpsyg.2019.00035>
32. Loh KP, Watson E, Culakova E, Flannery M, Sohn M, Xu H, et al. Caregiver-oncologist prognostic concordance, caregiving esteem, and caregiver outcomes. *J Geriatr Oncol*. 2022;13(6):828–33. Available from: <https://doi.org/10.1016/j.jgo.2022.02.018>
33. Nipp RD, Greer JA, El-Jawahri A, Moran SM, Traeger L, Jacobs JM, et al. Coping and prognostic awareness in patients with advanced cancer. *J Clin Oncol*. 2017;35(22):2551. doi: <https://doi.org/10.1200/JCO.2016.71.3404>
34. Molero M del M, Pérez-Fuentes M del C, Gómez JJ. Analysis of the Mediating Role of Self-Efficacy and Self-Esteem on the Effect of Workload on Burnout's Influence on Nurses' Plans to Work Longer. *Front Psychol*. 2018 Dec 18;9:2605. Available from: <https://www.frontiersin.org/article/10.3389/fpsyg.2018.02605/full> DOI: <https://doi.org/10.3389/fpsyg.2018.02605>
35. Jütten LH, Mark RE, Sitskoorn MM. Predicting self-esteem in informal caregivers of people with dementia: Modifiable and non-modifiable factors. *Aging Ment Health*. 2020 Feb 1;24(2):221–6. Available from: <https://www.tandfonline.com/doi/full/10.1080/13607863.2018.1531374>