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RESEARCH ARTICLE (ORIGINAL)

Psychometric properties of a questionnaire for assessing informal caregivers' skills

Propriedades psicométricas de um questionário de avaliação das competências do cuidador informal

Propiedades psicométricas de un cuestionario de evaluación de las competencias del cuidador informal

Fernanda Gatez Trevisan dos Santos [1]
https://orcid.org/0000-0001-7082-6949

Rafaely de Cassia Nogueira Sanches [1]
https://orcid.org/0000-0002-1686-7595

Elizabeth Bernardino [2]
https://orcid.org/0000-0003-1321-8562

Eraldo Schunk Silva [1]
https://orcid.org/0000-0002-6253-5962

Maria do Carmo Fernandez Lourenço Haddad [1]
https://orcid.org/0000-0001-7564-8563

Amanda de Souza Gonçalves [1]
https://orcid.org/0000-0001-5363-315X

Cremilde Aparecida Trindade Radovanovic [1]
https://orcid.org/0000-0001-9825-3062

[1] State University of Maringá, Maringá, Paraná, Brazil

[2] Federal University of Paraná, Curitiba, Paraná, Brazil

Corresponding author
Fernanda Gatez Trevisan dos Santos
E-mail: fer.gatez@gmail.com

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Abstract
Background: Health professionals are responsible for training informal caregivers to provide home care and therefore it is important to assess caregivers' skills.
Objective: To explore the psychometric properties of a questionnaire for assessing informal caregivers' skills.
Methodology: Methodological study involving 216 informal caregivers from a city in the southern region of Brazil. Structural construct validity was examined through exploratory and confirmatory factor analysis. Reliability was assessed by evaluating internal consistency.
Results: The exploratory factor analysis revealed four factors corresponding to the following skills: Psychomotor (Factor 1), Cognitive (Factor 2), Emotional (Factor 3), and Relational (Factor 4). The confirmatory factor analysis revealed satisfactory results for all fit indices and internal consistency of $\alpha = 0.82$.
Conclusion: The questionnaire shows evidence of reliability and validity and can be used to assess informal caregivers' skills in home settings.

Keywords: caregivers; psychometrics; surveys and questionnaires; validation study; family; home nursing

Resumo
Enquadramento: Cabe aos profissionais de saúde realizar a capacitação do cuidador informal para executar a assistência domiciliária, e, nesse contexto, é importante avaliar as competências do cuidador.
Objetivo: Avaliar as propriedades psicométricas de um questionário de avaliação das competências do cuidador informal.
Metodologia: Estudo metodológico, com a participação de 216 cuidadores informais de um município da região sul do Brasil. Estimou-se a validade estrutural de construto por meio de análise fatorial exploratória e confirmatória, para a confiabilidade verificou-se a consistência interna do questionário.
Resultados: A análise fatorial exploratória apresentou quatro fatores nesse estudo, que correspondem às competências psicomotora (Fator 1), cognitiva (Fator 2), emocional (Fator 3) e Relacional (fator 4). A análise fatorial confirmatória revelou resultados satisfatórios para todos os índices de ajustamento, e a consistência interna apresentou valor de $\alpha = 0,82$.
Conclusão: O questionário apresenta evidências de confiabilidade e validade e pode ser utilizado para avaliar as competências do cuidador informal no contexto dominciliário.

Palavras-chave: cuidadores; psicometria; inquéritos e questionários; estudos de validação; família; assistência domiciliar

Resumen
Marco contextual: Corresponde a los profesionales de la salud capacitar a los cuidadores informales para que presten atención domiciliaria y, en este contexto, es importante evaluar las competencias del cuidador.
Objetivo: Evaluar las propiedades psicométricas de un cuestionario para evaluar las competencias del cuidador informal.
Metodología: Estudio metodológico, con la participación de 216 cuidadores informales de una ciudad de la región sur de Brasil. La validez estructural del constructo se estimó mediante un análisis factorial exploratorio y confirmatorio, y se verificó la consistencia interna del cuestionario para comprobar su fiabilidad.
Resultados: El análisis factorial exploratorio mostró cuatro factores en este estudio, correspondientes a la competencia psicomotora (factor 1), cognitiva (factor 2), emocional (factor 3) y relacional (factor 4). El análisis factorial confirmatorio reveló resultados satisfactorios para todos los índices de ajuste y la consistencia interna mostró un valor de $\alpha = 0,82$.
Conclusión: El cuestionario muestra fiabilidad y validez, y puede utilizarse para evaluar las competencias del cuidador informal en el ámbito doméstico.

Palabras clave: cuidadores; psicometría; encuestas y cuestionarios; estudio de validación; familia; atención domiciliaria de salud

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Introduction

Care dependency affects the basic activities of daily living and the tasks necessary to maintain health and well-being, impairing individual autonomy and self-control and leading to the need for a caregiver (Budib et al., 2020; Lopes et al., 2020). Caregivers are referred to as either formal or informal. This study will focus on informal caregivers who are defined as people who provide unpaid care without a formal contractual agreement or the technical skills to provide care at home. This role is usually played by children, spouses, parents, neighbors, friends, or volunteers from non-governmental and religious organizations (Pereira et al., 2017; Silva & Silva, 2020; Uribe et al., 2017).

Informal caregivers require training to provide home care safely and effectively. The process of educating and training the caregiver is a fundamental aspect that needs to be enhanced by the health team at all levels of care, offering support and proposing strategies to overcome difficulties (Ariza-Vega et al., 2019; Holm et al., 2015; Ministério da Saúde, Secretaria de Atenção à Saúde, Departamento de Atenção Hospitalar e de Urgência, 2016).

One of the challenges of caregiver empowerment and training is the difficulty in identifying informal caregivers' skills. It should be noted that the Brazilian Ministry of Health (2016) has highlighted the importance of health professionals' monitoring and supervision of caregivers' activities in home settings.

A tool capable of providing valid information is essential to produce scientifically robust data to inform interventions for improving the health conditions of the population (Sanches, 2019; Souza et al., 2017). Thus, this study aimed to explore the psychometric properties of a questionnaire for assessing informal caregivers' skills.

Background

The skills needed to provide home care involve the ability to provide care and combine knowledge, skills, and attitudes to solve problems and prevent harm, making use of the available resources (Holm et al., 2015; Pereira et al., 2017; Silva & Silva, 2020). Home care skills are theoretically defined as the family caregiver's ability to provide care at home (Sanches, 2019).

To date, there are no instruments available in the literature for assessing informal caregivers' skills from a multidimensional perspective. Thus, a questionnaire was developed in Brazil for this purpose: the *COPER 14 - Competências Cognitivas (CO), Psicomotoras (P), Emocionais (E) e Relacionais (R)* (COPER 14 - Cognitive (CO), Psychomotor (P), Emotional (E), and Relational (R) Skills). This instrument is easily applicable in clinical practice and has 14 items initially distributed across three factors identified in the pre-test (cognitive-emotional, psychomotor, and relational skills) and rated on a five-point Likert-type scale (Sanches, 2019).

The assessment of the psychometric properties of the COPER 14 is crucial. After its validation, the questionnaire may help professionals assess informal caregivers' skills, improving them and reinforcing the guidelines on aspects in which they showed more difficulty, given that this type of care is complex for the family (Sanches, 2019).

Psychomotor skills involve the performance of activities related to the practical aspects of caregiving such as knowing how to handle support technologies, having manual dexterity and skills, and combining knowledge and practice (Holm et al., 2015; Sanches, 2019). Cognitive skills are related to the ability to know why and how to perform care, as well as the ability to plan, organize, and assess the care provided (Jansen et al., 2015; Sanches, 2019; Silva & Silva, 2020). Emotional skills refer to the caregiver's ability to adapt, the psychological conditions to assume caregiving, and the ability to manage stress and overload and have quality of life (Nascimento & Figueiredo, 2019; Sanches, 2019; Silva & Silva, 2020). Relational skills are related to the respect for the moral and ethical singularities of the dependent person, as well as to establishing effective verbal and non-verbal communication and building a bonding and respectful relationship (Holm et al., 2015; Jansen et al., 2015; Uribe et al., 2017).

Research question

What are the psychometric properties of the final version of the informal caregivers' skills assessment questionnaire (COPER 14) in a sample of Brazilian caregivers in home care settings?

Methodology

This methodological study with a quantitative approach was conducted in a city in the interior region of Paraná, Brazil. The model suggested by Pasquali (2010) was adopted as a methodological framework, using psychometrics to assess the questionnaire's validity and reliability. Data were collected between May and July 2019.

The study participants were informal caregivers of people dependent on others to perform activities of daily living. The following inclusion criteria were applied: being over 18 years of age, being appointed as the main caregiver of care-dependent people, and living in the urban region of the city under study. The exclusion criteria were the death of the care-dependent person and two unsuccessful attempts to contact the caregiver.

A minimum of 10 participants per questionnaire item was established to define sample size. A survey was conducted with the managers of the 39 basic health units (BHUs) in the city, which indicated the existence of 1,017 care-dependent individuals and their caregivers. A stratified random sampling technique was used, considering an estimation error of 5% and a 95% confidence level. A 15% rate was added for possible losses or errors, constituting an initial sample of 227 caregivers, 11 of whom were excluded. The final sample consisted of 216 people.

For data collection, participants received home visits by community health agents (CHAs). The research team

consisted of the main researcher and three nurses who were previously trained to apply the COPER 14 questionnaire. The main researcher accompanied the nurses the first time they went to the field to avoid possible difficulties. The questionnaire is divided into two parts: the first contains 13 questions about the caregiver's characteristics, such as age, gender, education level, among others, and the second part was called specific and includes 14 items distributed across four factors: Cognitive, Emotional, Psychomotor, and Relational skills. The total score ranges from 1 to 70 and is calculated by dividing the total score of all the sums of the maximum answers into quartiles, with the highest scores indicating greater competence, as follows: 1-17 points, *low skills*; 18-35, *little skills*; 36-52, *good skills*, and 53-70, *great skills* (Sanches, 2019).

Prior to the exploratory factor analysis (EFA), the Kaiser-Meyer-Olkin (KMO) test for sampling adequacy was performed to identify the proportion of item variance that can be explained by a latent variable. This test indicates the degree of adequacy of the application of the EFA to the data set. It can range from 0 to 1, with values equal or close to zero indicating that the sum of the partial correlations of the assessed items is quite high in relation to the sum of the total correlations. In these cases, factor analysis may be inappropriate. The following rule was adopted for interpreting KMO values: values less than 0.5 are *unacceptable*, values between 0.5 and 0.7 are *mediocre*; values between 0.7 and 0.8 are *good*, values between 0.8 and 0.9 are *great*, and values above 0.9 are *superb* (Damásio, 2012).

Structural validity was assessed through an EFA and a confirmatory factor analysis (CFA). There are several procedures and criteria for factor retention, but the most widely used is the Kaiser-Guttman criterion, better known as eigenvalue > 1. This criterion was used in this study for factor retention, and only factors with eigenvalues greater than 1 were retained. Finally, the communalities were determined (h^2; Damásio, 2012). Communalities can range from 0 to 1, and a good fit for the analysis model should have high values, that is, the closer to 1 (100%), the better the model fit (Silva et al., 2020).

The CFA used the maximum likelihood method. The Goodness-of-Fit Index (GFI) and the Comparative Fit Index (CFI) were used (values higher than 0.90 indicate an *adequate fit* and higher than 0.95 indicate an *excellent fit*). The Root Mean Square Error of Approximation (RMSEA; values higher than 0.08 indicate a *poor fit*) and the ratio between Chi-square and degrees of freedom ($\alpha 2/df$) were used. Although there is no consensus on the appropriate value of this index, it is suggested to be between 2 and 5 (Bravo-Andrade et al., 2019).

Cronbach's alpha coefficient (α) was used to assess the reliability of the COPER 14 questionnaire. With values ranging from 0 to 1, the closer to 1, the more consistent the instrument will be. For this study, alpha values greater than 0.70 were considered acceptable (Rodrigues & Henriques, 2018). Standard deviation (*SD*; Souza et al., 2017) was determined to identify possible measurement errors. The Fleiss Kappa (k) was used to identify possible redundant items. The items with a correlation above 0.30 were considered adequate.

Data were entered into spreadsheets using Microsoft Excel 2013 and analyzed using the Statistical Analysis System software (SAS, version 9.4).

This study followed Resolution No. 466/2012 and was approved by the Standing Committee on Ethics in Research with Human Beings, under opinion number 2584897/2018. All participants signed two copies of the informed consent form (ICF).

Results

Of the 216 caregivers, the majority (181) were women (83.80%), 101 (46.76%) were over 60 years of age, 119 (55.09%) lived with a partner, 129 (59.72%) had up to 8 years of schooling, and 101 (46.76%) were unemployed. As for the degree of kinship, 96 (44.44%) were children, 49 (22.69%) were spouses, and 24 (11.11%) were parents. A total of 134 caregivers (62.04%) reported having a health condition.

Concerning the questions about caregiving, 202 (93.52%) had never taken a caregiving course, 130 (60.19%) had never cared for someone before, and 182 (84.26%) were currently caring for only one person. The number of caregiving hours per day ranged from 2 to 24, with 161 (74.54%) caregivers reporting that they spend more than 12 hours per day caring for their ill family member. The duration of caregiving ranged from 3 months to 46 years, with 127 (58.80%) caregivers reporting that they had been providing care for more than five years.

EFA

Sample size was adequate for the EFA, and the adequacy of model fit was considered acceptable, with a KMO value of 0.7951. Based on Kaiser's criterion, four factors were retained with eigenvalues greater than 1, with the following explained variances in descending order: Factor 1 eigenvalue = 4.25 (40.36%), Factor 2 eigenvalue = 1.40 (10.05%), Factor 3 eigenvalue = 1.23 (8.79%), and Factor 4 eigenvalue = 1.05 (7.52%; Table 1).

Table 1 shows the eigenvalue and explained variance for the four factors. It should be noted that the factors retained in the EFA explained 56.71% of total variance (Table 1).

Table 1

Eigenvalue and explained variance for the four factors in COPER 14

Factors	Skills	Eigenvalue	Explained variance (%)
Factor 1	Psychomotor	4.25	40.36
Factor 2	Cognitive	1.40	10.05
Factor 3	Emotional	1.23	8.79
Factor 4	Relational	1.05	7.52
Total	-	-	56.71

The first factor - Psychomotor skills - was assessed by items Q2, Q3, Q4, Q7, and Q11 and is the most important factor to explain informal caregivers' skills (Table 2). The second factor - Cognitive Skills - was assessed by items Q1, Q5, Q10, and Q12 (Table 2). The third factor - Emotional Skills - was assessed by items Q8 and Q9 (Table 2). The fourth factor - Relational Skills - was assessed by items Q6, Q13, and Q14 (Table 2).
Table 2 shows the factor loadings for the COPER 14 items in the EFA.

Table 2

Factor loadings for the COPER 14 items in the Exploratory Factor Analysis

Item	Factor 1	Factor 2	Factor 3	Factor 4
Psychomotor				
Q2 How would you rate your level of knowledge: To identify signs and symptoms of worsening health in the person you are caring for.	**0.67**	0.17	0.21	0.00
Q3 How would you rate your level of knowledge: To identify the nutritional needs of the person you are caring for.	**0.65**	0.21	0.03	0.25
Q4 How would you rate your level of knowledge: To identify signs and symptoms of dehydration in the person you are caring for.	**0.76**	0.05	0.01	0.03
Q7 How would you rate your level of knowledge: To recognize signs of changes in the elimination processes of the person you are caring for.	**0.55**	0.27	0.25	0.05
Q11 How would you rate your level of preparedness: To assess the body temperature of the person you are caring for.	**0.55**	0.25	0.27	0.26
Cognitive				
Q1 How would you rate your level of knowledge: To identify the physical limitations of the person you are caring for.	0.05	**0.56**	0.16	0.26
Q5 How would you rate your level of knowledge: To identify the medications of the person you are caring for (e.g., schedules, side effects, indications, contraindications, allergies).	0.28	**0.81**	-0.01	0.06
Q10 How would you rate your level of preparedness: To administer/ provide the medications.	0.18	**0.84**	0.07	-0.05
Q12 How would you rate your level of preparedness: To dress and undress the person you are caring for	0.06	**0.41**	0.37	0.15
Emotional				
Q8 How adapted do you feel: To the daily care routine.	0.20	0.04	**0.84**	-0.01
Q9 How adapted do you feel: To exercise the caregiver's role.	0.17	0.15	**0.83**	0.17
Relational				
Q6 How would you rate your level of knowledge: To identify facial expressions in the person you are caring for.	0.27	0.25	0.18	**0.34**
Q13 How would you rate your level of preparedness: To communicate with the person you are caring for.	-0.07	0.06	0.38	**0.71**
Q14 How would you rate your level of preparedness: To promote the autonomy of the person you are caring for.	0.30	0.08	-0.16	**0.75**

Factor loadings ranged from 0.55 (items 7 and 11) to 0.76 (item 4) in Factor 1 (Psychomotor Skills); from 0.41 (item 12) to 0.81 (item 5) in Factor 2 (Cognitive Skills); from 0.83 (item 9) to 0.84 (item 8) in Factor 3 (Emotional Skills); and from 0.34 (item 6) to 0.75 (item 14) in Factor 4 (Relational Skills). Table 3 shows the communalities (h^2) estimated for the COPER 14 items in the EFA.

Table 3

Communalities estimated for the COPER 14 items in the Exploratory Factor Analysis

Q1	Q2	Q3	Q4	Q5	Q6	Q7
0.4111	0.5175	0.5329	0.5858	0.7314	0.2776	0.4440
Q8	**Q9**	**Q10**	**Q11**	**Q12**	**Q13**	**Q14**
0.7465	0.7630	0.7488	0.5023	0.3376	0.6628	0.6777

The communalities ranged from 0.2776 (item 6) to 0.7488 (item 10). The communality found in item 6 indicates a possible deletion of the item, but a final diagnosis was made after the CFA.

CFA

The goodness-of-fit indices obtained for the model using the CFA revealed satisfactory results, as shown in Table 4 below.

Table 4

Goodness-of-fit indices obtained for the COPER 14 adjusted model

Index	X^2/df	CFI	GFI	RMSEA	Pclose
Value	1.653	0.934	0.929	0.055	0.929
Reference	< 3	> 0.9	> 0.9	< 0.08	> 0.05

The adjusted and validated structural model shows a higher correlation between Psychomotor and Relational skills (r = 0.72), followed by the correlation between Psychomotor and Cognitive skills (r = 0.59). The items remained the same in the questionnaire. All items showed a correlation higher than 0.30, even item Q6, which was kept in the Relational skills.

Reliability

All items showed satisfactory correlations (> 0.30), ranging from 0.32 in item Q13 to 0.58 in item Q11.It was concluded that deleting any of the items, including item 6, would not change Cronbach's alpha (α). Thus, in its final version, the questionnaire kept the 14 items, with a α value = 0.82. The following α values were obtained for each factor: Psychomotor (α = 0.74), Cognitive (α = 0.68), Emotional (α = 80), and Relational (α = 0.46; Table 5).

Table 5

Mean and standard deviation of the items, inter-item correlation (r), and Cronbach's alpha (α) if item deleted considering the 14 items of the COPER questionnaire

Item	Mean	Standard deviation	*r*	*α*
Q 1	4.03	0.91	0.40	0.81
Q 2	3.13	1.16	0.49	0.80
Q 3	3.68	1.14	0.51	0.80
Q 4	2.42	1.43	0.35	0.81
Q 5	3.76	1.22	0.52	0.80
Q 6	4.22	1.01	0.40	0.81
Q 7	2.85	1.37	0.51	0.80
Q 8	3.74	1.18	0.41	0.81
Q 9	3.76	1.18	0.52	0.80
Q 10	4.21	1.13	0.47	0.80
Q 11	3.41	1.38	0.58	0.80
Q 12	3.93	1.27	0.38	0.81
Q 13	4.07	1.06	0.32	0.81
Q 14	3.44	1.41	0.33	0.81

To verify the sums of the total scores for the final version, the value of all the sums of the maximum answers was divided into quartiles, with lower scores indicating a lower level of caregiving skills. For better visualization and further analysis by the interviewer, a column was inserted after the number of each item, indicating the construct to which that item belonged. In this way, it is possible to identify the dimension in which the caregiver had more difficulties.

Discussion

This study assessed the structural and confirmatory validity and reliability of the COPER 14 questionnaire and found that it has adequate psychometric properties to be applied in this sample of caregivers, making it a useful tool for national studies on caregiving skills.

The original version of the instrument was pre-tested with 30 participants, revealing three dimensions. Cognitive-emotional skills (α = 0.76) were assessed in questions 1, 4, 5, 12, 13, and 14; Psychomotor skills (α = 0.66) in questions 2, 3, 6, 10, and 11; and Relational skills in questions 7 to 9 (α = 0.79; Sanches, 2019). In this study, four factors were obtained in the EFA and the Cognitive-emotional factor was divided. Although no item was deleted, some of them were reallocated: 4 and 7 moved to the Psychomotor skills, item 6 to the Relational skills, and item 10 to the Cognitive skills. The score remained the same as in the original version, as well as the questions for informal caregivers' characterization in the first part of the COPER 14. Cronbach's α coefficient also increased from 0.79 (pre-test version) to 0.82.

Psychometric tests are essential to produce an accurate instrument and ensure the quality of its results (Souza et al., 2017). The concept of validity is applied to verify whether the instrument measures exactly the phenomenon it proposes to measure, for example, informal caregivers' skills (Silva et al., 2020; Souza et al., 2017). A high KMO (0.7951) was found in this sample, confirming that the items of the proposed scale measure the same construct and are interrelated and the data matrix can be subject to factoring (Holanda et al., 2019).

According to Pasquali (2017), a factor analysis assesses how many common constructs are needed to explain item covariance. Considering all eigenvalues greater than 1 (eigenvalues > 1), the following four factors were retained (F1, F2, F3, and F4) in the EFA: Psychomotor, Cognitive, Emotional, and Relational skills.

Questions Q2, Q3, Q4, Q7, and Q11 refer to Psychomotor skills, which involve knowing how to provide care and having the skills to do it (Ariza-Vega et al., 2019; Holm et al., 2015; Sanches, 2019). The percentage of total variance explained by the factors was 56.71%, with the Psychomotor skills (F1) being the most important factor in determining the construct under study.

Cognitive skills (F2) are assessed in questions Q1, Q5, Q10, and Q12. They refer to the ability to know why and how to perform each caregiving activity with planning and organization (Jansen et al., 2015; Sanches, 2019; Silva & Silva, 2020). Emotional skills (F3) are assessed in Q8 and Q9 and refer to the ability to adapt and the psychological conditions to take on caregiving responsibilities (Nascimento & Figueiredo, 2019; Sanches, 2019; Silva & Silva, 2020). Finally, Q6, Q13, and Q14 belong to the dimension of Relational skills (F4) and refer to

the bond between caregivers and patients (Holm et al., 2015; Jansen et al., 2015; Uribe et al., 2017).

Communalities represent the proportion of the variance for each variable included in the analysis that is explained by the extracted components. It is generally agreed in the literature that low communalities indicate that the variables are not linearly correlated. Therefore, if the researcher finds a communality below acceptable values, it is recommended that the item be excluded and the factor analysis be repeated (Holanda et al, 2019; Silva et al., 2020).

In this study, the communality in Q6 was slightly below the critical value. From a more conservative perspective, it would be advisable to exclude it, but the item was kept to promote the retention of three items in Factor 4 (Relational skills; Santos, 2017). Additionally, the reliability analysis found that item Q6 had a good inter-item correlation (0.40) and that its deletion would not change the questionnaire's Cronbach's alpha. All inter-item correlations were satisfactory and higher than 0.30, thus it can be concluded that the factors in the questionnaire assess the same construct (Santos, 2017).

The CFA aimed to confirm and adjust the theoretical model proposed for the questionnaire (Souza et al., 2017), and the analysis revealed satisfactory results for all indices. The total Cronbach's alpha coefficient obtained was α = 0.82, which indicates high reliability and confirms the internal consistency of the questionnaire. The deletion of an item did not significantly improve internal consistency, so the final version of the COPER questionnaire kept the 14 items.

A limitation of this study was that the potential research subjects were identified at the city's BHUs, so it was not possible to obtain a representative sample given that some families are followed-up in the private sector. It should be noted that this study complements the validation process of the COPER 14 questionnaire, given that the original version had only been pre-tested with a considerably small sample.

Conclusion

The statistical procedures performed in this study confirmed the reliability and validity of the proposed questionnaire based on internal consistency, the EFA, and the CFA. The questionnaire shows satisfactory results for use in Brazilian home settings.

The COPER 14 questionnaire can be used daily at all levels of care to help professionals assess informal caregivers' skills and contribute to guide or train these families, especially those experiencing care dependency for the first time, based on their needs.

Author contributions

Conceptualization: Santos, F. G., Sanches, R. C., Bernardino, E., Silva, E. S., Haddad, M. C., Radovanovic, C. A.

Data curation: Santos, F. G., Silva, E. S.

Formal analysis: Santos, F. G., Sanches, R. C., Silva, E. S., Gonçalves, A. S., Radovanovic, C. A.

Investigation: Santos, F. G., Sanches, R. C., Gonçalves, A. S.

Methodology: Santos, F. G., Sanches, R. C., Bernardino, E., Silva, E. S., Haddad, M. C., Radovanovic, C. A.

Project administration: Santos, F. G., Radovanovic, C. A.

Resources: Santos, F. G., Sanches, R. C., Gonçalves, A. S.

Software: Santos, F. G., Silva, E. S.

Supervision: Santos, F. G., Bernardino, E., Radovanovic, C. A.

Validation: Santos, F. G., Radovanovic, C. A.

Visualization: Santos, F. G., Sanches, R. C., Bernardino, E., Silva, E. S., Haddad, M. C., Gonçalves, A. S., Radovanovic, C. A.

Writing – original draft: Santos, F. G., Sanches, R. C., Radovanovic, C. A.

Writing – review & editing: Santos, F. G., Sanches, R. C., Bernardino, E., Silva, E. S., Haddad, M. C., Gonçalves, A. S., Radovanovic, C. A

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