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ORIGINAL PAPER

Psychometric analysis of the Register – Connectedness Scale for Older Adults in the context of older adults in Croatia

Jadranka Plužarić[1], Marija Barišić[1,2], Nikolina Farčić[1,3], Željko Mudri[1,4], Ivana Barać[1]

[1]*Department of Nursing and Palliative Medicine, Faculty of Dental Medicine and Health, Josip Juraj Strossmayer University of Osijek, Osijek, Croatia*
[2]*Faculty of Medicine, Josip Juraj Strossmayer University of Osijek, Osijek, Croatia*
[3]*Department of Neurosurgery, University Hospital Centre Osijek, Osijek, Croatia*
[4]*Department of Sociology, Croatian Catholic University, Zagreb, Croatia*

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Abstract

Aim: The aim of this study was to analyze the factor structure and psychometric properties of the Croatian version of the Register – Connectedness Scale for Older Adults (R-CSOA). *Design:* Cross-sectional study. *Methods:* The study included 698 older adults; the median age of respondents was 73 years (range 65–94). The Register – Connectedness Scale for older adults (R-CSOA) was used. *Results:* The results indicated satisfactory psychometric characteristics, high overall reliability of the scale ($\alpha > 0.959$), and high reliability across subscales (from $\alpha = 0.885$ to $\alpha = 0.935$) with a clear five-factor structure. Confirmatory factor analysis (CFA) was used and results of the final model of the R-CSOA show adequate (CFI and TLI) to good (RMSEA and SRMS) model fit. All subscales are significantly intercorrelated and have moderate to high statistically significant correlations with the overall scale. All subscales of the R-CSOA are statistically significantly correlated to external variables (self-esteem, loneliness, and successful aging). *Conclusion:* The Croatian version of the R-CSOA is a valid and reliable tool, suitable for measuring dimensions and level of connectedness in older adults in a Croatian context. Good reliability, construct validity, and sensitivity of the scale were confirmed.

Keywords: connectedness, factor analysis, older adults, R-CSOA, successful aging.

Introduction

The aging population poses a significant demographic challenge for countries worldwide. The proportion of people older than 65 in the EU member states was 20.3% in 2019, and an increase is predicted in the next 50 years. In Croatia, 22.3% of the population is over the age of 65, placing it among the countries with the oldest populations in Europe. A specific challenge is the progressive aging of the population over 80 years old. The elderly dependency rate is predicted to increase to 82.6% by the year 2100 (Eurostat, 2023).

The rising number of older adults places greater economic pressure on health and social systems while raising ethical concerns about the allocation of limited resources (Register et al., 2011). Promoting the concept of successful aging offers a way to mitigate the risks of health decline in older adults while reducing the financial and ethical challenges posed by demographic aging. Strategies aimed at achieving successful aging enhance health outcomes in older adults, thereby lowering social and healthcare costs (Lee et al., 2020).

The theory of successful aging (Rowe & Kahn, 1997) emphasizes active engagement in all aspects of life as a crucial factor in improving the quality of life for older adults. Similarly, the Register theory of Generative Quality of Life for the Elderly (Register & Herman, 2006; 2010) views quality of life as a dynamic, cumulative process shaped by meaningful connections formed through daily interactions with various life forces and experiences. According to this theory, older adults generate quality of life through six interconnected domains of connectedness: Biological connectedness – enhancing functional abilities and actively participating in health promotion and maintenance efforts; Metaphysical connectedness – an awareness of oneself within

Corresponding author: Nikolina Farčić, Department of Nursing and Palliative Medicine, Faculty of Dental Medicine and Health Osijek, Josip Juraj Strossmayer University of Osijek, Crkvena street 21, 31 000, Osijek, Croatia; email: nfarcic@fdmz.hr

the broader universe; Spiritual connectedness – a sense of connection to a higher power and a pursuit of purpose and meaning in life; Connection to others – maintaining interpersonal relationships that transcend spatial and temporal boundaries; Environmental connectedness – building a relationship with the physical and social environment of older adults; and Connection to society – engaging with personal and global social aspects (Register & Herman, 2006). Register's theory places connectedness at the core of successful aging, defining it as a state of harmonious, synchronous and interactive presence that transcends the limitations of time and space. A reduced level of connectedness can lead to compromised health and disability in older adults. If the level of connectedness is improved, it can increase the capacity of older adults to age successfully (Register & Herman, 2006).

While there are adequate measuring instruments for spiritual or social connectedness, there is a lack of instruments to measure connectedness from a multidimensional perspective.

The constructs of loneliness and self-esteem were most often measured, reflecting their strong association with quality of life and successful aging (Register & Herman, 2010). Measuring self-esteem equates to measuring an individual's belief in his own abilities. Older adults with high self-esteem are more resistant to environmental influences, face difficulties more successfully, and are more flexible and imaginative (Zhang et al., 2019). For older adults to develop a positive self-image and maintain high self-esteem, key factors include family, friends, the freedom to choose their own activities, the ability to regulate bodily functions, and control over other aspects of life. Self-esteem is closely related to the roles, relationships and status that an individual has in the family and society (Orth & Robins, 2014). Loneliness is another factor that negatively impacts quality of life in older adults, as they are particularly vulnerable to significant life changes, i.e., different degrees of social isolation or loneliness (Rokach et al., 2004). A decrease in friendships, the loss of life roles, and reduced engagement in various activities contribute to social isolation and loneliness among older adults (Wenger & Burholt, 2004).

Using a multidimensional measurement instrument allows researchers to more effectively evaluate strategies for enhancing connectedness in older adults (Register et al., 2011). An empirical investigation of the complexity of connectedness is not possible without psychometrically sound measuring instruments (da Silva-Sauer et al., 2020).

The Register – Connectedness Scale for Older Adults (R-CSOA) was developed and published in 2011 by Mary Elizabeth Register (Register et al., 2011). The R-CSOA was developed based on Register's Generative Quality of Life for the Elderly model, which equates connectedness with the quality of life (QOL) of older adults. The R-CSOA includes five domains (Facing Aging, Self-Regulating, Being Spiritual, Being Part of a Family, and Having Friends) and assesses connectedness in older adults from a multidimensional perspective (Register & Herman, 2010).

The Self-Regulating domain involves managing emotions and behaviors to foster optimism, independent decision-making, and personal fulfilment. The Facing Aging domain encompasses the thoughts and actions older adults experience as they come to terms with the natural aging process and increased awareness of mortality. It includes recognizing how much the world has changed and continues to change, alongside a desire to remain relevant despite shifts in one's role. Successful aging in this domain is characterized by staying informed about current events, engaging in discussions on societal issues, and expressing concern for the country's future. It also involves awareness of personal health and motivation to maintain or improve it.

The Being Part of a Family domain reflects the desire to interact with family members and to feel wanted, needed, and loved. The Having Friends domain captures the activities, thoughts, and feelings that help older adults feel connected to their friends – appreciating friendships, spending time together, and wishing for closer proximity to more friends.

Finally, the Being Spiritual domain refers to the recognition of a higher power or divine presence beyond individual control. Older adults may nurture this spirituality through prayer, worship, participation in faith communities, or personal reflection (Register & Herman, 2006; 2010).

This cross-sectional study was conducted in Croatia using the R-CSOA instrument. It explored the connectedness and self-perception of successful aging among older adults in Croatia (Plužarić et al., 2023).

The literature includes studies that examine specific dimensions of connectedness, such as social (Asante & Karikari, 2022; Shinokawa et al., 2023) or spiritual (McFadden, 2022) connectedness. However, older adults do not experience these aspects in isolation; instead, they perceive connectedness as a holistic and shared multidimensional experience.

A literature review revealed a lack of instruments suitable for examining multidimensional connectedness among diverse groups of older adults living in various cultural and ethnic contexts (Depp & Jeste, 2006; Suragarn et al., 2021). To address this gap, we aimed to provide a validated Croatian version of the R-CSOA as a psychometric tool for measuring connectedness.

Aim

The aim of this study was to analyze the factor structure and psychometric properties of the Croatian version of the Register – Connectedness Scale for older adults (R-CSOA).

Methods

Design

This descriptive cross-sectional study was conducted in 2022 to evaluate the validity and psychometric properties of the Croatian version of the R-CSOA among older adults in Croatia.

Sample

The study involved 698 older adults from Osijek-Baranja County, living either in their own homes or in nursing homes for the elderly and disabled. To be eligible for participation, individuals had to meet the following inclusion criteria: be 65 years of age or older, possess the ability to understand and speak Croatian, and provide voluntary informed consent. Exclusion criteria included individuals who could not be contacted, and those with a current neuropsychiatric disorder affecting cognition, diagnosed depression, or distressing physical symptoms that could impair their ability to participate in the study. Interviews were conducted in participants' homes, nursing homes, and community settings such as associations and clubs for older adults, with privacy ensured throughout the process.

A psychometric analysis was conducted to determine the required sample size, indicating that eight participants per questionnaire item were necessary (Kennedy, 2022). Based on this criterion, the minimum required sample size was 688 respondents. To account for potential non-responses and missing data, 766 individuals were initially included. After excluding cases with missing data (8.9% of items), the final sample comprised 698 respondents. There were more female respondents than male (443 [63.5%] vs. 255 [36.5%]). The median age was 73 years, ranging from 65 to 94. Most respondents (517 [74%]) lived in their own family house or apartment, while (181 [26%]) resided in a home for the elderly and disabled.

Instruments

A demographic and socioeconomic questionnaire (age, gender, subjective age, level of education, place of residence and housing choice, occupation, marital status, parenthood, social inclusion).

The R-CSOA (Register et al., 2011) consists of two sections, each containing 43 items organized into five subscales: Self-regulating (13 items), Facing Aging (10 items), Being Part of a Family (10 items), Having Friends (5 items), and Being Spiritual (5 items). In the first section, respondents rate their satisfaction with each item on a scale from 1 (not at all satisfied) to 4 (completely satisfied). In the second section, respondents assess the importance of the same items, using a scale from 1 (not at all important to me) to 4 (very important to me). To prevent missing values, the questionnaire's author recommends weighting the scores from the first section as follows: 1 is multiplied by -1.5, 2 by -0.5, 3 by +0.5, and 4 by +1.5. After weighting and multiplication, the possible score range is from -6 to +6. To eliminate negative values, 6 is added to each score, resulting in a final score range from 0 to 12.

The R-CSOA was translated following established guidelines to ensure clarity, use of common language, and cultural appropriateness. (Fenn et al., 2020; Råholm et al., 2010). Two lecturers, native Croatian speakers with proficient English skills, independently translated the R-CSOA into Croatian. The first author, also a native Croatian speaker, performed a back-translation and was excluded from further translation steps. Comparison of the back-translated version revealed no significant errors. Additionally, an independent English language expert reviewed the final translation. An assistant professor specializing in the Croatian language evaluated the clarity of the Croatian version. Two assistant professors – one methodologist and one psychologist – also reviewed the translated scale. The internal reliability of the scale was high, with a Cronbach's alpha of 0.959. The five domains of the scale demonstrated good internal consistency, with alpha values ranging from 0.885 to 0.935.

The Rosenberg Self-Esteem Scale (Rosenberg, 1965) is a ten-item instrument designed to assess global self-esteem by measuring both positive and negative feelings about oneself. It has been translated and validated in Croatian (Schmitt & Allik, 2005) and is considered unidimensional. Respondents rate each item on a 4-point Likert scale, ranging from 1 (strongly agree) to 4 (strongly disagree). This scale was chosen as an external criterion since it is

the most widely used measure of self-esteem for adult populations (Blascovich & Tomaka, 1993).

The self-esteem variable was derived from Rosenberg's Self-Esteem Scale, with higher scores indicating higher self-esteem. The scale demonstrated good internal reliability, with a Cronbach's alpha of 0.885.

The UCLA (University of California, Los Angeles) Loneliness Scale (Russell, 1996; Steptoe et al., 2013) is a 20-item instrument used to assess subjective feelings of social isolation and loneliness, measuring how often individuals feel disconnected from others. The scale was translated following established guidelines to ensure clarity, use of common language, and cultural appropriateness (Fenn et al., 2020; Råholm et al., 2010). Respondents rate each item on a 4-point scale ranging from 1 (never) to 4 (often). The loneliness variable was derived from the scale, with higher scores indicating greater self-reported loneliness. The scale demonstrated good internal reliability, with a Cronbach's alpha of 0.872.

The Successful Aging Self-Assessment Scale (Tucak Junaković et al., 2020) is a 20-item instrument designed to assess individuals' perceptions of their own aging. The scale has been translated and validated in Croatian (Tucak Junaković et al., 2020) and exhibits a one-factor structure. Respondents rate each item on a 5-point scale ranging from 1 (does not apply to me at all) to 5 (completely applies to me). The successful aging variable was derived from this scale, with higher scores indicating a greater level of self-reported successful aging. The scale demonstrated good internal reliability, with a Cronbach's alpha of 0.883.

Data collection

Before signing the informed consent, each respondent was thoroughly informed about the purpose of the study, ethical considerations, and details of how to complete the questionnaire. Respondents were free to withdraw from the study at any time. Their anonymity was guaranteed. Data were collected individually through face-to-face interactions. The investigator provided assistance to older adults who had difficulty reading or understanding certain items (due to impaired vision and / or hearing, but not impaired cognitive functioning), but did not suggest answers or influence their choices in any way. There was no time limit for completing the questionnaire.

Participation in the study was entirely voluntary and anonymous. Respondents received an introductory text along with the questionnaire, providing details about the study. They had the freedom to withdraw at any time without any consequences. Anonymity was strictly maintained, ensuring that respondents' identities could not be linked to their answers. Only the researchers had access to the collected data. Permission was obtained from the original author to translate and use the Register – Connectedness Scale for Older Adults (R-CSOA) as a research instrument. Additionally, consent was granted for the use of the Croatian versions of the Rosenberg Self-Esteem Scale, the Loneliness Scale, and the Successful Aging Self-Assessment Scale, developed by Croatian authors.

The study was conducted in accordance with the principles of the Declaration of Helsinki and received approval from the relevant Ethics Committee.

Data analysis

Statistical analyses were conducted using IBM SPSS 24, AMOS 24, and JASP 0.17.1 software. Descriptive statistics – including mean, standard deviation, range, variance, normality tests, skewness, and kurtosis – were used to characterize the subscales and examine their intercorrelations. Internal consistency of the scale and its subscales was assessed using Cronbach's alpha, McDonald's omega, and Guttman's lambda.

Construct validity was evaluated using Confirmatory Factor Analysis (CFA), with model fit assessed through the following indices: χ^2, CFI (Comparative Fit Index), TLI (Tucker Lewis Index), RMSEA (Root Mean Square Error of Approximation), SRMR (Standardized Root Mean Square Residual), and factor loadings. External validity was tested using Pearson correlation coefficients by examining the relationships between R-CSOA subscale scores and scores from the Rosenberg Self-Esteem Scale, the UCLA Loneliness Scale, and the Self-Assessed Successful Aging Scale.

Results

Descriptive statistics

To determine the suitability of the questionnaire for parametric statistical analysis, descriptive statistics were calculated for each of the five subscales (Table 1).

Although most normality tests were statistically significant, the data for all five subscales and thetotal scale were approximately normally distributed. This is supported by skewness values within ± 0.5 and kurtosis within ± 1.5, which, according to Field (2013), indicate approximate normality when values are below ± 2. Therefore, parametric statistics were used to assess the R-CSOA's construct and criterion validity, as well as its internal reliability.

Table 1 Descriptive statistics for all subscales and the total scale score of the R-CSOA (N = 698)

Subscales	Number of items	Mean	SD	K-S test	S-W test	C-W test	A-D test	Skewness	Kurtosis
Self-Regulating Subscale	13	8.72	2.05	0.065**	0.973***	0.611*	4.351**	-0.283	-0.661
Facing Aging Subscale	10	8.80	2.03	0.057*	0.974***	0.464*	3.679*	-0.244	-0.655
Being Part of a Family Subscale	10	9.06	2.16	0.087***	0.954***	0.998**	7.367***	-0.471	-0.369
Having Friends Subscale	5	8.46	2.47	0.099***	0.945***	1.585***	11.385***	-0.059	-0.920
Being Spiritual Subscale	5	9.08	2.74	0.172***	0.879***	0.449***	29.895***	-0.414	-1.128
Overall Connectedness	43	8.83	1.75	0.047	0.984***	0.322	2.285	-0.280	-0.490

*A-D test – Anderson-Darling test; C-W test – Cramér-von Mises test; K-S test – Kolmogorov-Smirnov test; S-W test – Shapiro-Wilk test; SD – standard deviation; *p < 0.05; **p < 0.01; ***p < 0.001*

Internal reliability and sensitivity

All subscales demonstrated moderate to excellent internal reliability, with Cronbach's alpha values ranging from 0.885 for the Facing Aging subscale to 0.935 for the Being Spiritual subscale. For the entire scale, reliability coefficients – including Cronbach's alpha, McDonald's omega, and Guttman's lambda – were all high, exceeding 0.959. Only the Being Spiritual subscale exhibited the full response range, indicating excellent sensitivity. Although the other subscales and the total scale did not cover the full response range, all reached the maximum possible score of 12.00 and showed slightly positive self-ratings (Table 2).

Additionally, item sensitivity analysis showed satisfactory results, with only two items (R-CSOA11 and R-CSOA29) lacking the full response range.

Table 2 Internal reliability and sensitivity for all subscales (N = 698)

Subscales	Number of Items	Cronbach's α	McDonald's ω	Guttman's λ_2	Min	Max
Self-Regulating Subscale	13	0.922	0.922	0.923	2.65	12.00
Facing Aging Subscale	10	0.885	0.886	0.888	1.55	12.00
Being Part of a Family Subscale	10	0.911	0.912	0.913	1.50	12.00
Having Friends Subscale	5	0.915	0.916	0.916	1.60	12.00
Being Spiritual Subscale	5	0.935	0.936	0.936	0.00	12.00
Overall Connectedness	43	0.959	0.958	0.960	2.98	12.00

Construct validity

Confirmatory factor analysis (CFA) was conducted using structural equation modeling (SEM) with the maximum likelihood (ML) method. The results for the initially proposed five-factor model showed poor fit based on CFI and TLI indices, but adequate fit according to χ^2, RMSEA, and SRMR. The final R-CSOA model demonstrated adequate fit on CFI and TLI and good fit on RMSEA and SRMR (Table 3).

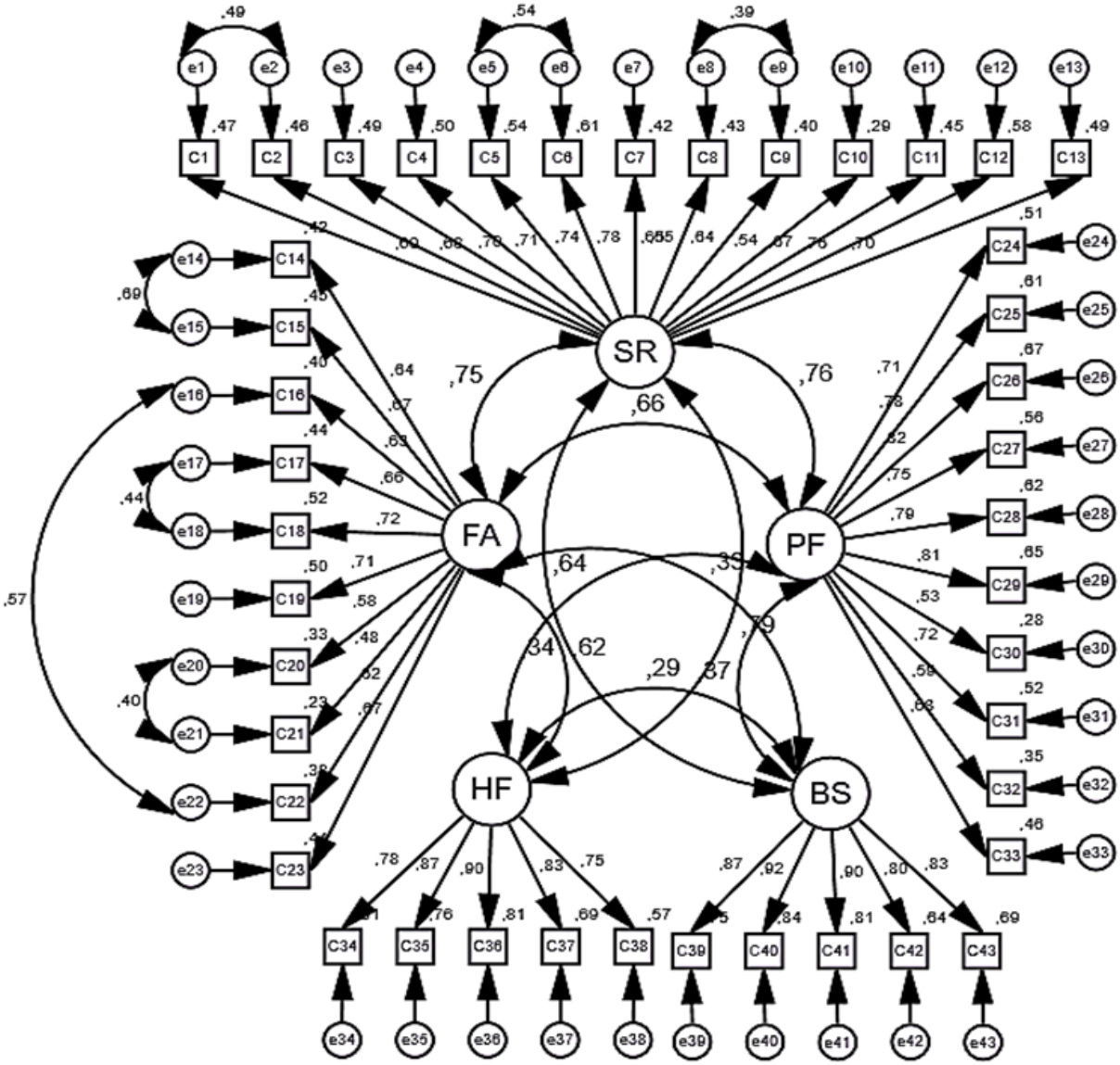
Table 3 CFA Model fit indices for the R-CSOA (N = 698)

Model fit indices	Proposed Model of R-CSOA (df = 850)	Final Model of R-CSOA (df = 843)	Reference values	
			Good fit	Adequate fit
χ^2	3980.96/850 = 4.19 (p < 0.01)	2581.84/843 = 3.06 (p < 0.01)	p > 0.01 (n.s.)	χ^2 / df ≤ 3 (for small sample size) χ^2 / df ≤ 5 (for large sample size)
CFI	0.85	0.92	≥ 0.95	≥ 0.90
TLI	0.84	0.91	≥ 0.95	≥ 0.90
RMSEA	0.07	0.05	≤ 0.06	≤ 0.08
SRMR	0.06	0.05	≤ 0.08	≤ 0.10

R-CSOA – Register – Connectedness Scale for Older Adults; CFI – Comparative Fit Index (compares the fit of a target model to the fit of an independent, or null, model); TLI – Tucker Lewis Index (a relative reduction in misfit per degree of freedom); RMSEA – Root Mean Square Error of Approximation (an absolute measure of model fit based on the non-centrality parameter); SRMR – Standardized Root Mean Square Residual (an absolute measure of model fit); χ^2 – chi-square; df – degrees of freedom

However, the factor loadings of the proposed model ranged from adequate (≥ 0.40) to good (≥ 0.70); notably, no items had loadings below 0.5, and more than half of the items had loadings above 0.7.

Additional analysis showed high covariances between the measurement errors of the R-CSOA14 and R-CSOA15 (M.I. = 383.45), R-CSOA16 and R-CSOA22 (M.I. = 236.01), R-CSOA17 and R-CSOA18 (M.I. = 139.62), R-CSOA20 and R-CSOA21 (M.I. = 118.38) of Facing Aging Subscale, and high covariances between the measurement errors of the R-CSOA5 and R-CSOA6 (M.I. = 211.49), R-CSOA1 and R-CSOA2 (M.I. = 171.51), R-CSOA8 and R-CSOA9 (M.I. = 110.32) of the Self-Regulating Subscale. In the final model covariance between errors were added, as these correlated items represent the same subscales (Figure 1).



Note: SF – Self-Regulating Subscale; FA – Facing Aging Subscale; PF – Being Part of a Family Subscale; HF – Having Friends Subscale; BS – Being Spiritual Subscale.

Figure 1 CFA Model fit indices for the R-CSOA (N = 698)

Furthermore, the Pearson correlation coefficient was employed to assess the relationships between the individual subscales of the questionnaire. All subscales are significantly intercorrelated. The strongest correlation was between the Self-Regulating and Having Friends Subscales ($r = 0.721$; $p < 0.01$), while the weakest correlation was between the Having Friends and Being Spiritual Subscales ($r = 0.285$; $p < 0.01$). All subscales showed moderate to high statistically significant

correlations with the total scale score, as expected for a measure of the entire questionnaire (Table 4).

External (criterion) validity

To assess external (criterion) validity, three variables were used: Rosenberg Self-Esteem, UCLA Loneliness, and the Successful Aging Scale. These are validated, widely used instruments with well-established psychometric properties in numerous previous studies. Pearson's correlation coefficient was employed to examine associations between the R-CSOA subscales and these external variables. All R-CSOA subscales showed statistically significant correlations with the external measures, all in the expected directions. Specifically, participants reporting higher levels of connectedness also demonstrated higher self-esteem, more successful aging, and lower levels of loneliness. The strongest correlation was observed between the Self-Regulating subscale and UCLA Loneliness ($r = -0.636$, $p < 0.01$), while the weakest was between the Being Spiritual subscale and Successful Aging ($r = 0.143$, $p < 0.01$) (Table 4).

Table 4 Correlation of individual subscales of the R-CSOA and correlation of individual subscales of the R-CSOA with external variables (Pearson correlation coefficient)

Subscales	Overall Connectedness	Self-Regulating	Facing Aging	Being Part of a Family	Having Friends	Being Spiritual
Rosenberg Self-Esteem	0.607**	0.632**	0.418**	0.529**	0.518**	0.189**
UCLA loneliness	-0.613**	-0.636**	-0.376**	-0.547**	-0.580**	-0.194**
Successful Aging	0.398**	0.357**	0.295**	0.377**	0.355**	0.143**
Overall Connectedness	1	0.899**	0.804**	0.846**	0.792**	0.514**
Self-Regulating		1	0.647**	0.686**	0.721**	0.309**
Facing Aging			1	0.574**	0.548**	0.286**
Being Part of a Family				1	0.605**	0.345**
Having Friends					1	0.285**
Being Spiritual						1

*UCLA – University of California, Los Angeles; *p < 0.05; **p < 0.01; ***p < 0.001*

Discussion

In the sample of 698 older adults, confirmatory factor analysis verified the assumed five-factor structure of the R-CSOA. The final model demonstrated good to excellent fit indices (CFI and TLI showed good fit; RMSEA and SRMR indicated excellent fit). Factor loadings ranged from adequate (≥ 0.40) to good (≥ 0.70), with no items loading below 0.5 and over half loading above 0.7. Although most items showed satisfactory loadings, slightly lower values appeared in the Self-Regulating and Facing Aging subscales. High covariances were observed between measurement errors of some items within these two subscales. These error covariances were included in the final model since the correlated items belong to the same subscales, improving model fit to a good-to-excellent level. The least saturated items with their respective factors were R-CSOA10 ("I listen to music and / or sing") from the Self-Regulating subscale and R-CSOA21 ("I wish I was in good health") from the Facing Aging subscale. Future applications of the scale might consider removing these items, as older adults in our socio-cultural context may not perceive these behaviors or attitudes as important aspects of connectedness, personal regulation, or coping with aging. These items thus may not form a homogeneous group within their subscales.

The results showed that all subscales were significantly intercorrelated with each other as well as with the total scale score, indicating that each subscale reflects a component of connectedness. The strongest correlation was found between the Self-Regulation and Having Friends subscales, differing from the original scale where the strongest association was between Self-Regulation and Being Part of a Family (Register et al., 2011). The weakest correlation was between Having Friends and Being Spiritual subscales, consistent with findings from the original scale (Register et al., 2011).

The Self-Regulating Subscale showed a highly significant correlation with the total connectedness scale score as well as with the other subscales. Items R-CSOA1 ("Feeling that I am part of the world") and R-CSOA2 ("Knowing that my life has a purpose") had the highest loadings. Recent studies highlight the importance of purpose and meaning in life for improving quality of life among older adults (Irving et al., 2017). Similarly, the Facing Aging Subscale demonstrated significant positive correlations with all other subscales, with item R-CSOA18 ("Talking about current events with

someone") showing the highest loading. The Being Part of a Family Subscale also showed a strong correlation with overall connectedness, with item R-CSOA26 ("Feeling loved by my family") having the highest loading. Close family relationships positively contribute to successfully coping with the changes of aging. Moreover, intergenerational relationships play a crucial role in the mental health of older adults (Fu & Ji, 2020). Perceived emotional connection with family members, along with a physically active lifestyle, are among the most significant protective factors that increase the likelihood of high self-reported life satisfaction in late adulthood (Fastame, 2021). In the Having Friends Subscale, item R-CSOA36 ("Feeling good about my friendships") showed the highest loading. These findings are consistent with studies emphasizing the importance of maintaining friendships for preserving mental health in older adults (Peng et al., 2022). The results also highlight the importance of attachment orientation in friendship relationships within health-related contexts. Research frequently shows that anxiety – stemming from life's uncertainties and fear of death – is reduced when older adults receive greater support from friends, especially those they have spent many years socializing with daily (Gur-Yaish et al., 2021). The Being Spiritual Subscale demonstrated the lowest level of correlation with both the other subscales and overall connectedness. Items R-CSOA42 ("Believing that there is a higher power") and R-CSOA40 ("Praying for something important") had the highest loadings, consistent with findings from the original scale's psychometric analysis (Register et al., 2011). This may be explained by the fact that over 90% of Croatia's population identifies as religious (Croatian Bureau of Statistics, 2022). Recent research has increasingly emphasized the importance of spiritual support in helping older adults cope better with stress (Can Oz et al., 2022). Numerous studies indicate that spirituality and religion play a positive role in reducing depression among older adults (Veras et al., 2019). Religion is a significant yet often overlooked dimension of social capital. While the importance of community and social support for older adults is frequently highlighted – often through activities like age-appropriate physical exercise, health education, and socializing within local communities – spiritual support tends to be neglected, partly because religion is a sensitive topic. However, spiritual support should not be underestimated, as many older adults face feelings of uselessness, inferiority, and social exclusion (Coleman et al., 2011), resulting in a lack of belonging.

The scale's validity is further supported by significant correlations with several theoretically related constructs, such as self-esteem, loneliness, and successful aging. These variables are well-established indicators of quality of life in older adults (Alaphilippe, 2008; Misha'l, 2017; Pinquart & Sörensen, 2001). The author of the connectedness theory herself asserts that connectedness is synonymous with quality of life. For example, measuring self-esteem helps to interpret which social conditions and subjective experiences contribute to higher or lower self-esteem. In this study, self-esteem showed a strong and significant correlation with the total score on the R-CSOA. An individual's self-esteem is shaped not only by a sense of competence, strength, and ability but also by a sense of personal and moral worth. Loneliness, recognized as one of the most significant challenges of aging, was included as an external variable. It plays a crucial role in shaping older adults' subjective life satisfaction (Wenger & Burholt, 2004). Notably, the results revealed a strong, highly negative correlation between loneliness and two key subscales: Being Part of a Family and Having Friends. Social isolation often arises due to illness or death of a spouse, children or grandchildren moving away, and a shrinking social network of friends and neighbors. A lower, yet still significant, correlation was found between connectedness and the external variable successful aging. According to Erikson's theory, the primary psychosocial task of the eighth and final stage of development is achieving ego integrity – a sense of life's meaning attained through a positive evaluation of one's lived experiences. Nevertheless, it should be noted that the significant associations between connectedness and related constructs may be somewhat inflated because the R-SCOA includes items partially overlapping with these constructs, and due to the common use of self-report measures (Perry et al., 2014). However, it is important to emphasize that a major challenge in researching successful aging is the inconsistent use of key variables – such as life satisfaction and good social relationships – which are treated as predictors in some studies, components in others, and outcomes or criteria in yet others (Cosco, 2015). This inconsistency complicates reaching a consensus on whether connectedness is truly the appropriate measure to explain and capture successful aging. Since the questionnaire's author is primarily a nurse, the insights gained from these results can support

nurses in designing effective nursing interventions. By adopting a patient-centered approach, nursing interventions can improve outcomes and offer a more constructive alternative to the current problem-focused, deficit-based model of quality of life in older adults (Mohamed et al., 2020).

Some differences in factor loadings between the Croatian version and the original questionnaire may be due to differences in respondents' lifestyles. While the original scale's validation sample included only community-dwelling older adults, the Croatian validation also involved participants living in nursing homes. Older adults in nursing homes tend to be more aware of their declining health and face greater challenges related to aging. The results of the R-CSOA analysis demonstrate that the Croatian version maintains and replicates the original theoretical structure. It is a straightforward tool suitable for use in both elderly healthcare settings and community social services (Herrera et al., 2022). Given the good psychometric properties of the original R-CSOA, the scale is appropriate for assessing connectedness in older adults in Croatia.

Based on these findings, recommendations for research and clinical practice highlight the importance of understanding the relevance and frequency of different dimensions of connectedness. Such insights can guide researchers in developing a new generation of nursing interventions tailored to the types of connections individuals value most, ensuring they align with each person's unique perspective and self-assessment.

Limitation of study

One limitation of this study is the disproportionate number of female respondents compared to males. Additionally, participants' responses may have been affected by difficulties in understanding certain questions, possibly due to impaired vision and / or hearing, especially since the researcher assisted some participants in completing the questionnaire. Furthermore, the use of a convenience sample may limit the generalizability of the findings, as it may not fully represent the broader population.

Conclusion

The Croatian version of the Register – Connectedness Scale for Older Adults (R-CSOA) is a valid and reliable instrument for assessing connectedness in older adults. Psychometric analysis showed no significant differences between the Croatian and original versions, which have the same number of items. The Croatian version demonstrated satisfactory internal consistency across all subscales, good sensitivity, and solid construct validity, evidenced by significant correlations between subscales and the total R-CSOA score. External validity was also significant and in the expected direction. Overall, the scale's reliability, construct validity, and sensitivity were confirmed.

Ethical aspects and conflict of interest

The study was conducted in accordance with the principles of the Declaration of Helsinki and received approval from the relevant Ethics Committee (reg. number: 2158-61-46-22-81). The authors declare no conflict of interest.

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Author contributions

Conception and design (JP, MB, NF, ŽM, IB), data analysis and interpretation (IB, ŽM), manuscript draft (JP, MB, IB), critical revision of the manuscript (NF, IB), final approval of the manuscript (JP, MB, NF, ŽM, IB).

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