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Measurement invariance of the CD-RISC-10 across gender, age, and education: A study with Slovenian adults

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Abstract
The study aimed to investigate measurement invariance of the 10-item Connor-Davidson Resilience Scale (CD-RISC-10) across gender, age, and education. Adults from a general population of Slovenia ($N = 431$; 58% female; age 18 to 59 years) filled in the CD-RISC-10, the short form of the Mental Health Continuum and the Depression, Anxiety and Stress Scale. Measurement invariance of the proposed one-factor model of CD-RISC-10 by gender, age, and level of education was examined using multiple-group confirmatory factor analysis. The results showed configural, metric, and scalar invariance of the CD-RISC-10 across gender, age, and educational groups. The measure showed satisfactory reliability, positive associations with emotional, psychological, and social well-being, and negative links with negative emotional states. Group differences in latent means suggested higher resilience in men than women, early adults as compared to emerging adults, and people with higher as compared to those with lower level of education. The Slovenian version of the CD-RISC-10 is an acceptably reliable and valid measure of resilience, suitable to detect possible differences between gender, age, and educational groups. Resilience shows favorable associations with enhanced positive mental health and diminished symptoms of mental problems.

Keywords Resilience · CD-RISC-10 · Measurement invariance · Gender · Age · Education

Introduction

In recent mental health and quality of life research, the concept of resilience has received increased attention (Luthar et al., 2014; O'Donohue et al., 2019). Although several definitions of resilience were proposed (Connor & Davidson, 2003; Masten, 2001; Rutter, 1985), two distinct features emerged from these definitions: significant *adversity* and *positive adaptation.* Namely, resilience can be described as an individual's capacity to uphold relatively stable, healthy levels of functioning, or positive adaptations in stressful situations or potentially traumatic events (Connor & Davidson, 2003; Fletcher & Sarkar, 2013; Luthar, 2006). Resilience does not mean to avoid stress and adversity but to have the ability to persist despite difficulties and to cope effectively in various stressful circumstances (Fletcher & Sarkar, 2013; Southwick et al., 2014).

Evidence provided by studies relying on diverse measures of resilience suggests that this personal characteristic is instrumental in advantageous psychological outcomes. A recent meta-analysis (Hu et al., 2015) showed that resilience plays an important role in preserving mental health and preventing the onset of mental health problems, including depression and anxiety. Higher resilience is associated with more frequent use of engagement coping strategies (aimed at actively dealing with the stressor or related emotions), which are crucial for improving psychological well-being (Arrogante et al., 2015). Furthermore, resilience has been found to be positively related to life satisfaction, positive emotions (Hu et al., 2015; Miranda & Cruz, 2020; Shi et al., 2015), and achievement motivation (Magnano et al., 2016), as well as negatively related to emotional and behavioral problems (Ziaian et al., 2012). Some studies have shown that greater resilience can protect against substance use (Wingo et al., 2014) and burnout in adults (Hao et al., 2015) and support the maintenance of cognitive and physical functioning in the elderly (Fontes & Neri, 2015). A recent study examining psychological functioning of adults during the COVID-19 pandemic revealed that individuals

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with higher self-perceived resilience reported less stress and higher well-being levels compared to individuals with lower self-perceived resilience, regardless of their demographic and health characteristics (Kavčič et al., 2020).

Given the importance of resilience for health and positive functioning, valid instruments should be provided to assess this concept. Among several resilience measurement tools, the original Connor-Davidson Resilience Scale (CD-RISC) received very good psychometric ratings with adequate internal consistency, test-retest reliability, and construct validity (Connor & Davidson, 2003; Windle et al., 2011). Factor analysis of the 25-item scale yielded five dimensions that refer to personal qualities, which enable successful adaptation to adversity: personal competence, high standards, and tenacity; trust in one's instincts, tolerance of negative affect, and strengthening effects of stress; positive acceptance of change and secure relationships; control; and spirituality (Connor & Davidson, 2003). The CD-RISC was translated in many languages and its measurement characteristics were examined in a variety of populations (Burns & Anstey, 2010; Gras et al., 2019; Jorgensen & Seedat, 2008; Sarubin et al., 2015; Tsigkaropoulou et al., 2018; Yu et al., 2011). Nevertheless, many of these validation studies failed to confirm the five-factor structure, and instead suggested a smaller number of factors (Crespo et al., 2014; Guihard et al., 2018; Manzano-García & Ayala-Calvo, 2013).

Due to inconclusive results regarding the factor structure of the CD-RISC, Campbell-Sills and Stein (2007) proposed an abbreviated, 10-item single-factor version of the scale (CD-RISC-10). In a sample of 1743 undergraduate American students, exploratory and confirmatory analyses supported the unidimensional model of the CD-RISC-10 with good internal consistency (alpha coefficient .85), suitable test-retest reliability, and a correlation of $r = .92$ with the 25-item CD-RISC (Campbell-Sills & Stein, 2007). The measurement characteristics of CD-RISC-10 were investigated in different countries and settings including Australian (Ehrich et al., 2017) and Canadian (Hébert et al., 2018) university students, German adults (Sarubin et al., 2015), Finnish older adults (Tourunen et al., 2019), and more specific groups such as Spanish women with breast cancer (Alarcón et al., 2020), Korean toxic chemical-exposed workers (Shin et al., 2018), Chinese undergraduates and depressive patients (Cheng et al., 2020), Nepali individuals with chronic pain (Sharma et al., 2018), and Colombian vulnerable adolescents (Guarnizo Guzmán et al., 2019). All the above-mentioned studies replicated the unidimensional factor structure and supported adequate internal consistency of the CD-RISC-10. Thus, even though the 25-item CD-RISC measures resilience more comprehensively and taps aspects of resilience not included in the CD-RISC-10, the reviewed evidence suggests the latter is not only more economic but also psychometrically sounder. In addition to suitable reliability and construct validity, the CD-RISC-10 also shows associations with a variety of favorable outcomes in diverse samples of participants, including higher positive affect and lower negative affect and performance anxiety in competitive athletes (Gonzales et al. 2016), higher quality of life and sleep in young adults (Notario-Pacheco et al., 2011), higher self-esteem and lower emotional distress in Spanish non-professional caregivers (Blanco et al., 2019), higher quality of life and lower perceived stress and depression in community living elderly (Serrano-Parra et al., 2013), higher levels of hardiness and lower levels of burnout in Australian cricketers (Gucciardi et al., 2011), and lower psychological distress and higher perceived social support among parents of children with cancer (Ye et al., 2017).

Previous research also addressed associations between resilience and demographic variables as the later could represent risk or protective factors of resilience. The examination of differences in resilience levels between demographic groups is worthy for several reasons: normative data may need to be determined separately for each group, groups of individuals at risk for diminished resilience and consequently reduced mental health can be identified etc. Most commonly, the effects of age and gender on resilience as assessed with the CD-RISC-10 have been examined. Most of the studies identified higher resilience scores in males in comparison with females (Cheng et al., 2020; Notario-Pacheco et al., 2011; Shin et al., 2018). More inconsistent results were found in determining age differences; a study conducted with university students revealed that those under the age of 25 had higher resilience scores compared to those over the age of 25 (Notario-Pacheco et al., 2011). A study in the working population aged between 20 and 59 years revealed that resilience scores of 20 to 29-year-olds were lower than those of 40 to 49-year-old participants (Shin et al., 2018), while a study with Spanish general population showed no associations between age and resilience (Pulido-Martos et al., 2020). Associations between resilience (as measured by the CD-RISC-10) and education are rarely reported; in addition, studies were conducted on specific participant groups. A significant positive correlation was found between educational qualification and resilience level among nurses (Ang et al., 2018), however no association between resilience and education was observed in a sample of adult women exposed to traumatic experiences (Scali et al., 2012).

The existence of measurement invariance is required for accurate group comparisons. Measurement invariance assesses the psychometric equivalence of a measure across groups, while measurement non-invariance suggests that a construct has a different structure or meaning to different groups, and so it cannot be meaningfully compared across groups (Putnick & Bornstein, 2016). Several studies, relying on rather specific samples of participants, provided information about measurement invariance of the CD-RISC-10. For instance, the measurement invariance across genders was demonstrated in competitive distance runners in Australia

(Gonzalez et al., 2016), US public accountants (Smith et al., 2018), Chinese undergraduate students (Cheng et al., 2020) and older adults (Meng et al., 2019), and Colombian vulnerable adolescents (Guarnizo Guzmán et al., 2019). In addition, (partial) measurement invariance across age was revealed in Australian adolescent and adult cricketers (Gucciardi et al., 2011) and US accountants (Smith et al., 2018). Recently, measurement invariance of the CD-RISC-10 was supported across gender with Spanish adults from a general population (Pulido-Martos et al., 2020). In addition, using MIMIC modelling authors supported measurement invariance of the CD-RISC-10 by age. We found no reports on measurement invariance across education.

Since the CD-RISC-10 has not been yet validated in Slovenia, the first objective of the study was to determine the psychometric properties of the Slovenian version of the CD-RISC-10 and examine its factor structure on a heterogeneous sample of adults from a general population. The second objective was to test the measurement invariance of the instrument across gender, age, and education, which could further improve the psychometric robustness of the Slovenian version of the CD-RISC-10. As recommended (Milfont & Fischer, 2015; Millsap, 2011), different levels of measurement invariance were considered: configural invariance (equal factor structure across groups), metric invariance (also weak invariance; equal factor loadings across groups), and scalar invariance (also strong invariance; equal thresholds or intercepts across groups). If measurement invariance was determined, differences in resilience levels between the above sociodemographic categories could also be examined. Finally, the relationship between resilience and measures of psychological functioning was investigated to obtain evidence of the convergent validity of the CD-RISC-10. More precisely, we expected that resilience would be associated with higher levels of emotional, psychological, and social well-being, and lower levels of negative emotional states (i.e., depression, anxiety, and stress).

Method

Participants

The study included 431 adults (58% female), aged from 18 to 59 years ($M = 32.9$; $SD = 13.0$) and living in various regions of Slovenia. Participants were divided into three age groups representing three developmental periods of adulthood: emerging adulthood group included 196 individuals (60% female), aged from 18 to 25 years ($M = 20.5$; $SD = 1.8$), early adulthood group comprised 127 people (60% female), aged from 26 to 45 years ($M = 37.1$; $SD = 6.2$), and middle adulthood group involved 108 participants (51% female), aged from 46 to 59 years ($M = 50.5$; $SD = 3.1$). Regarding educational level, 67.1% had a high school or lower education and 32.9% attained college, university, Masters or PhD degree.

Measures

The 10-item version of the Connor-Davidson Resilience Scale – CD-RISC-10 (Campbell-Sills & Stein, 2007) was used as a self-report measure of trait resilience. The participants rated the degree to which each item was characteristic of themselves in the last month on a 5-point scale ranging from 0 (not true at all) to 4 (true nearly all the time). The item scores are summed to produce a score ranging from 0 to 40, with higher scores indicating greater resilience. As reviewed above, the CD-RISC-10 has a one-dimensional structure and has shown satisfactory internal consistency and validity (e.g., Campbell-Sills & Stein, 2007). With the present sample, the alpha coefficient of internal consistency was .83.

The short form of the Mental Health Continuum – MHC-SF (Keyes, 2009) was applied as a self-report measure of emotional, psychological, and social subjective well-being. It includes 14 items, rated on a 6-point scale (0 – never, 5 – every day during the past week). Previous studies provided evidence on good internal consistency, satisfactory test-retest reliability, and sound validity of the scale (e.g., Lamers et al., 2011). In the present study, the alpha coefficients were .90, .88, and .83 for emotional, psychological, and social well-being scales, respectively.

The short version of the Depression Anxiety Stress Scales – DASS-21 (Lovibond & Lovibond, 1995) was employed as a self-report measure of negative emotional states. The 21 items are rated along a 4-point severity/frequency scale ranging from 0 – did not apply to me at all to 3 – applied to me very much or most of the time. The scales showed good internal consistency, and construct, convergent and divergent validity (Antony et al., 1998; Osman et al., 2012). In this study, the alpha coefficients of internal consistency were .89, .78, and .87 for the depression, anxiety, and stress scales, respectively.

Procedure

Undergraduate students of one of the Slovenian public universities participated as a part of their psychology course assignment. They were also asked to invite other male and female adults to take part in the study. The participants filled in the questionnaire via an on-line survey site. All the questions in the survey were obligatory, so there were no missing values. The following ethical issues were addressed: the respondents had the freedom to decline participation or withdraw from the study at any time without any consequences, no personal data that could enable identification of an individual was collected, the participants were informed about the aims of the study before beginning the survey and they provided informed consent. They were also asked to give their consent to the survey site's privacy policy. As the study included only self-report questionnaires, no risks were anticipated. Should the items

make the participants uncomfortable, they could discontinue their participation at any time.

Data Analyses

Preliminary analyses were performed using IBM SPSS Statistics version 22.0 (IBM Corp, 2013) and included a review of the descriptive statistics of the CD-RISC-10 items and the total score across gender, age, and educational groups, including means, standard deviations, skewness, and kurtosis coefficients, item discrimination indices (i.e. corrected item-total correlations), and Cronbach's alpha reliability coefficients.

We used M*plus* version 8.4 (Muthén & Muthén, 1998-2019) to perform the confirmatory factor analysis (CFA) of the CD-RISC-10 separately in each gender, age, and educational group, and to test the measurement invariance across these groups using multiple-group confirmatory factor analysis (MG-CFA). The variances of the factors were set to 1 for identification purposes and the robust Maximum Likelihood (MLR) method was used for model estimation with ordinal observed variables.

The model fit was evaluated using the Satorra-Bentler scaled chi-square ($SB\chi^2$), the root-mean-square error of approximation (RMSEA) with 90% confidence interval (CI), the comparative fit index (CFI), and the standardized root mean square residual (SRMR). RMSEA values below .08 and .05 (Browne & Cudeck, 1992), SRMR values below .10 and .05, and CFI values above .90 and .95 (Hu & Bentler, 1999) were considered to indicate acceptable and good model fit, respectively. The values of the chi-square test statistics were interpreted with caution, as they are known to be dependent on sample size and are oversensitive to even minor misspecifications of the model (Cheung & Rensvold, 2002). In tests of measurement invariance, the nested models were compared based on the relative changes of the sample-size-independent fit indices. Specifically, we used $\Delta CFI \geq -.010$, $\Delta RMSEA \leq .015$, and $\Delta SRMR \leq .030$ as an indication of invariance (Chen, 2007). If metric or scalar invariances were not achieved, modification indices would be examined to establish partial measurement invariance by relaxing constraints on non-invariant items (Byrne et al., 1989).

To estimate latent mean differences between gender, age, and educational groups, respectively, the latent mean was set to zero in one group (i.e. males, emerging adults, and less educated participants) and freely estimated in other groups. The freely estimated latent means reflect the difference from the reference group in units of standard deviation. The significance of the latent mean differences to the reference group was evaluated using Wald *z*-tests. The early and middle adult groups were compared with the MODEL CONSTRAINT command in M*plus*.

Finally, to investigate convergent validity of the CD-RISC-10 across gender, are, and educational groups, Pearson correlation coefficients were computed with outcome variables reflecting subjective well-being and negative emotional states.

Results

Descriptive Statistics for the CD-RISC-10 Items and the Total Score

Descriptive statistics for all CD-RISC-10 items and the total score by gender, age, and educational group are summarized in Table 1. Across all groups, the distributions of items and the total score were slightly skewed to the left, but both skewness and kurtosis coefficients were relatively low. Table 3 shows item discrimination indices and alpha reliability coefficients for the groups of interest. The item discrimination indices were highest for item 9 and lowest for item 3. The alpha reliability coefficients were above .76 in all groups.

Measurement Invariance across Gender, Age, and Educational Groups

First, baseline models were established separately for each gender, age, and educational group (see Table 2). For the male group, a unidimensional model yielded a marginally acceptable model fit (model G1). The modification indices were examined, showing a large residual covariance between items 1 and 8, both of which reflect high adaptability to change or failure. After this covariance was freely estimated (model G1b), the fit of the model was significantly improved ($\Delta SB\chi^2_{(1)} = 30.832$, $p < .001$, $\Delta RMSEA = -.018$, $\Delta CFI = .041$, $\Delta SRMR = -.006$). In the female group, the unidimensional model demonstrated good levels of fit to the data (model G2). We further investigated the fit of the unidimensional model for the three age groups. In the youngest age group composed of emerging adults, the model showed acceptable fit to the data (model A1), and the fit was good in the early and emerging adult groups (models A2 and A3). Finally, the unidimensional model also showed good fit to the data in both educational groups (models E1 and E2).

For all ten items, the standardized factor loadings yielded values above .30 in all gender, age, and educational groups, with the highest loadings being observed for item 9 and the lowest loadings for item 3. The McDonald's omega reliability coefficients were above .77 in all groups (see Table 3).

The well-fitting baseline models were combined into multiple-group models to investigate the measurement invariance of the CD-RISC-10 across gender, age, and educational groups (see Table 4). Tests of configural, metric, and scalar invariance models for gender groups (models MIG1, MIG2, and MIG3) all yielded acceptable levels of fit, with

Table 1 Descriptive statistics for the CD-RISC-10 items and the total score

	Gender				Age						Education			
	Male		Female		18–25 yrs.		26–45 yrs.		46–60 yrs.		Lower		Higher	
	M (*SD*)	Skew/ Kurt	*M* (*SD*)	Skew/ Kurt	*M* (*SD*)	Skew/ Kurt	*M* (*SD*)	Skew/ Kurt	*M* (SD)	Skew/ Kurt	*M* (*SD*)	Skew/ Kurt	*M*(*SD*)	Skew/ Kurt
Item 1	3.70 (.86)	−.47/ .17	3.74 (.88)	−.49/ .26	3.64 (.94)	−.42/−.05	3.89 (.77)	−.34/−.16	3.67 (.84)	−.54/ .73	3.69 (.92)	−.45/ .03	3.80 (.78)	−.46/ .54
Item 2	3.90 (.81)	−.77/ .81	3.68 (.78)	−.30/ .06	3.71 (.82)	−.25/−.42	3.89 (.72)	−.50/ .47	3.75 (.83)	−.78/ 1.21	3.70 (.79)	−.38/ .04	3.92 (.79)	−.73/ .99
Item 3	3.48 (1.11)	−.40/−.44	3.35 (1.05)	−.14/−.61	3.35 (1.15)	−.15/−.85	3.56 (1.03)	−.41/−.15	3.32 (.97)	−.26/−.23	3.42 (1.08)	−.19/−.73	3.38 (1.06)	−.38/−.20
Item 4	3.56 (.96)	−.12/−.43	3.47 (.98)	−.23/−.36	3.40 (1.05)	−.09/−.61	3.63 (.92)	−.36/−.13	3.56 (.86)	.01/−.17	3.42 (.97)	−.15/−.35	3.68 (.96)	−.26/−.41
Item 5	3.97 (.90)	−.49/−.58	3.88 (.91)	−.59/−.08	3.85 (.99)	−.56/−.38	3.97 (.84)	−.44/−.41	3.99 (.84)	−.47/−.39	3.89 (.93)	−.52/−.30	3.98 (.87)	−.61/−.21
Item 6	4.29 (.74)	−.84/ .42	4.11 (.82)	−.55/−.23	4.19 (.85)	−.89/ .43	4.17 (.74)	−.41/−.64	4.18 (.76)	−.44/−.72	4.16 (.83)	−.74/ .11	4.24 (.71)	−.39/−.97
Item 7	3.80 (.90)	−.73/ .50	3.39 (.94)	−.26/−.16	3.46 (.96)	−.44/ .01	3.67 (.87)	−.39/−.11	3.62 (.98)	−.43/−.32	3.44 (.96)	−.31/−.23	3.81 (.87)	−.68/ .62
Item 8	3.79 (.98)	−.58/ .02	3.53 (.92)	−.30/ .02	3.66 (.96)	−.37/−.31	3.71 (.94)	−.45/ .18	3.54 (.97)	−.39/ .17	3.64 (.94)	−.31/−.31	3.64 (.99)	−.55/ .33
Item 9	3.78 (.84)	−.29/−.48	3.61 (.94)	−.51/ .23	3.64 (.94)	−.52/ .16	3.79 (.89)	−.40/−.17	3.63 (.84)	−.37/ .12	3.62 (.92)	−.44/ .03	3.81 (.84)	−.42/ .07
Item 10	3.63 (1.02)	−.30/−.64	3.44 (.91)	−.12/−.42	3.49 (.98)	−.36/−.35	3.66 (.95)	.00/−1.01	3.40 (.93)	−.02/−.55	3.47 (.96)	−.26/−.36	3.61 (.97)	−.02/−1.00
Total score	3.79 (.56)	−.20/ .45	3.62 (.58)	−.24/ .24	3.64 (.61)	−.34/ .06	3.79 (.50)	.31/−.41	3.66 (.58)	−.19/ .72	3.64 (.60)	−.22/ .31	3.79 (.52)	.09/.00

Skew = skewness; *Kurt* = kurtosis

Table 2 Confirmatory factor analysis fit statistics for the single-factor CD-RISC-10 model by gender, age, and education

	$SB\chi^2_{(df)}$	RMSEA	90% CI	CFI	SRMR
Gender					
G1: Male	$71.355_{(35)}$	.076	[.050, .101]	.906	.056
G1b: Male	$54.609_{(34)}$	.058	[.026, .085]	.947	.050
G2: Female	$55.948_{(35)}$	.049	[.022, .072]	.960	.040
Age					
A1: 18–25 yrs.	$67.805_{(35)}$	.069	[.044, .094]	.932	.051
A2: 26–45 yrs.	$3.929_{(35)}$	.000	[.000, .053]	1.000	.047
A3: 46–60 yrs.	$4.911_{(35)}$	.040	[.000, .083]	.977	.053
Education					
E1: Lower	$53.706_{(35)}$	.043	[.017, .065]	.972	.038
E2: Higher	$41.597_{(35)}$	.036	[.000, .074]	.969	.052

deterioration in model fit for the successively more constrained models being within the recommended cut-off values (Chen, 2007).

For the three age groups, the configural invariance model provided a good fit to the data (model MIA1). The metric invariance model also fitted the data well (model MIA2), but a significant decrease in model fit was observed compared to the configural model, as indicated by $\Delta CFI < -.010$ and $\Delta SRMR > .030$ (Chen, 2007). A review of the modification indices showed that freely estimating the loading of item 8 could improve the model fit (Byrne et al., 1989). The partial metric invariance model with one item loading freely estimated (model MIA2b) yielded a good fit to the data, and the decrease in model fit compared to the configural model was within the acceptable range, according to $\Delta RMSEA$ and ΔCFI values (and it was marginally acceptable according to $\Delta SRMR$ value). The fit of the scalar invariance model was good (model MIA3), and the changes in goodness-of-fit indices were small enough to support scalar invariance across age groups.

Finally, the measurement invariance was tested across two educational groups. The tests of the configural, metric, and scalar invariance (models MIE1, MIE2, and MIE3) showed a good fit of the models to the data. The gradual inclusion of invariance constraints led to an acceptably small decrease in model fits compared to the less restrictive models.

The achievement of scalar invariance with at least two invariant items is a prerequisite for valid estimation and comparison of latent means across groups (Steenkamp & Baumgartner, 1998). Group comparisons of latent means can be considered more reliable than comparisons of observed means because latent means are corrected for measurement error.

Latent Mean Differences between Gender, Age, and Educational Groups

Comparisons of the latent means showed that women reported significantly lower resilience than men (−.350 *SD*, $p = .002$). Significant differences were also found among educational groups, with participants who had reached college or higher education levels reporting higher resilience than participants who had completed primary or secondary education (.292 *SD*, $p = .004$). Compared with the emerging adults, early adults reported significantly higher resilience (.286 *SD*, $p = .012$),

Table 3 Factor loadings, corrected item-total correlations, and reliability coefficients for the CD-RISC-10

	Gender				Age						Education			
	Male		Female		18–25 yrs.		26–45 yrs.		46–60 yrs.		Lower		Higher	
	Factor loading	Item-total *r*	Factor loading	Item-total *r*	Factor loading	Item-total *r*	Factor loading	Item-total *r*	Factor loading	Item-total *r*	Factor loading	Item-total *r*	Factor loading	Item-total *r*
Item 1	.54	.42	.50	.48	.45	.43	.40	.36	.57	.53	.46	.44	.53	.46
Item 2	.66	.59	.66	.59	.64	.59	.58	.51	.76	.68	.66	.60	.68	.57
Item 3	.31	.30	.47	.42	.40	.38	.34	.30	.42	.42	.41	.38	.38	.37
Item 4	.50	.50	.58	.55	.57	.55	.59	.55	.47	.48	.58	.55	.46	.48
Item 5	.58	.53	.40	.38	.45	.42	.50	.44	.54	.49	.48	.44	.49	.43
Item 6	.63	.57	.60	.53	.71	.61	.49	.43	.61	.57	.65	.57	.56	.49
Item 7	.68	.60	.62	.54	.64	.58	.57	.46	.75	.66	.67	.61	.58	.47
Item 8	.52	.40	.65	.58	.74	.63	.42	.37	.51	.45	.71	.62	.36	.31
Item 9	.71	.62	.79	.68	.76	.66	.74	.63	.79	.70	.75	.66	.78	.65
Item 10	.55	.52	.49	.45	.46	.46	.50	.41	.66	.62	.54	.52	.46	.41
Reliability	$\omega = .82$	$\alpha = .81$	$\omega = .83$	$\alpha = .83$	$\omega = .83$	$\alpha = .83$	$\omega = .78$	$\alpha = .77$	$\omega = .86$	$\alpha = .85$	$\omega = .84$	$\alpha = .84$	$\omega = .78$	$\alpha = .78$

Factor loading = standardized factor loading; item-total *r* = corrected item-total correlation; ω = McDonald's omega reliability coefficient; α = Cronbach's alpha reliability coefficient

Table 4 The comparison of configural, metric, and scalar invariance models of the CD-RISC-10 by gender, age, and education

	Goodness-of-fit					Model comparison					
	$SB\chi^2_{(df)}$	RMSEA	90% CI	CFI	SRMR	Ref. model	$\Delta SB\chi^2_{(df)}$	*p*	ΔRMSEA	ΔCFI	ΔSRMR
Gender											
MIG1: Configural	$110.559_{(69)}$	.053	[.034, .071]	.955	.044						
MIG2: Metric	$124.781_{(78)}$	.053	[.035, .070]	.949	.065	MIG1	$14.190_{(9)}$	.116	.000	−.006	.021
MIG3: Scalar	$143.296_{(87)}$	.055	[.038, .070]	.939	.068	MIG2	$18.896_{(9)}$	.026	.002	−.010	.003
Age											
MIA1: Configural	$138.414_{(105)}$	.047	[.021, .067]	.963	.050						
MIA2: Metric	$166.862_{(123)}$	.050	[.028, .068]	.952	.085	MIA1	$29.385_{(18)}$	.044	.003	−.011	.035
MIA2b: Partial metric	$161.364_{(121)}$	.048	[.026, .067]	.955	.081	MIA1	$23.330_{(16)}$	.105	.001	−.008	.031
MIA3: Scalar	$183.842_{(139)}$	.047	[.026, .065]	.951	.084	MIA2b	$22.299_{(18)}$	.219	−.001	−.004	.003
Education											
MIE1: Configural	$94.967_{(70)}$	.041	[.015, .060]	.972	.043						
MIE2: Metric	$105.653_{(79)}$	.040	[.015, .058]	.970	.062	MIE1	$10.461_{(9)}$	.314	−.001	−.002	.019
MIE3: Scalar	$123.046_{(88)}$	.043	[.023, .060]	.960	.064	MIE2	$18.302_{(9)}$	.032	.003	−.010	.002

Ref. model = reference model; $\Delta SB\chi^2$, ΔRMSEA, and ΔCFI = change in model fit in relation to the reference model

while middle adults reported a similar resilience level (.068 *SD*, $p = .612$). Although the resilience level of middle adults was lower compared to early adults, the difference was not significant (−.219 *SD*, $p = .101$).

Convergent Validity of the CD-RISC-10

Convergent validity of the CD-RISC-10 was tested by examining its correlations with outcome variables reflecting subjective well-being and negative emotional states (see Table 5). Higher self-reported resilience was moderately associated with higher emotional, psychological, and social well-being, but lower levels of depression, anxiety, and stress. This pattern of associations was consistent across genders, age groups, and educational groups.

Discussion

Individuals' resilience reflects their ability to positively adapt and bounce back in face of various life adversities (Connor & Davidson, 2003; Gucciardi et al., 2011). It plays an important role in sustaining mental health and protecting from mental health problems (Hu et al., 2015), which was demonstrated also during the present COVID-19 pandemic (e.g., Liu et al., 2020; Zager Kocjan et al., 2021). Resilience is frequently measured by CD-RISC-10, thus the evidence of the

Table 5 Correlations of the CD-RISC-10 scores with measures of well-being and negative emotional states

	Emotional well-being	Psychological well-being	Social well-being	Depression	Anxiety	Stress
Total sample	$.46^{***}$	$.58^{***}$	$.45^{***}$	$-.48^{***}$	$-.38^{***}$	$-.49^{***}$
Gender						
Female	$.49^{***}$	$.64^{***}$	$.52^{***}$	$-.51^{***}$	$-.37^{***}$	$-.47^{***}$
Male	$.38^{***}$	$.50^{***}$	$.34^{***}$	$-.43^{***}$	-39^{***}	$-.45^{***}$
Age						
18–25 yrs.	$.41^{***}$	$.61^{***}$	$.51^{***}$	$-.49^{***}$	$-.43^{***}$	$-.45^{***}$
26–45 yrs.	$.49^{***}$	$.54^{***}$	$.42^{***}$	$-.42^{***}$	$-.24^{**}$	$-.46^{***}$
46–60 yrs.	$.49^{***}$	$.54^{***}$	$.40^{***}$	$-.51^{***}$	$-.38^{***}$	$-.53^{***}$
Education						
Lower	$.40^{***}$	$.55^{***}$	$.46^{***}$	$-.46^{***}$	$-.39^{***}$	$-.45^{***}$
Higher	$.58^{***}$	$.63^{***}$	$.43^{***}$	$-.49^{***}$	$-.31^{***}$	$-.49^{***}$

** $p < .01$; *** $p < .001$

questionnaire's measurement invariance across different groups is necessary for appropriate interpretation of mean differences. The findings of the present study support scalar measurement invariance of CD-RISC-10 across gender, age, and education.

With regard to gender, the results of this study uphold configural, metric, and scalar invariance. Evidence of strong measurement invariance across gender is consistent with previous findings with rather specific samples of participants (Cheng et al., 2020; Guarnizo Guzmán et al., 2019; Gonzalez et al., 2016; Meng et al., 2019; Smith et al., 2018) and a comparable Spanish general population sample (Pulido-Martos et al., 2020). This evidence allows for the examination of gender differences in latent mean scores. In the present study, women reported significantly lower resilience levels than men, which is in line with previous studies (Cheng et al., 2020; Lee et al., 2013; Notario-Pacheco et al., 2011; Pulido-Martos et al., 2020; Shin et al., 2018). One possible factor contributing to the observed gender differences could be that the CD-RISC-10 taps resilient qualities less salient in women than men (Cheng et al., 2020; Pulido-Martos et al., 2020). For example, women tend to rely on social resources during stressful circumstances more frequently than men (Taylor et al., 2000), but the CD-RISC-10 does not address this capacity. In addition, the CD-RISC-10 denotes qualities related to internal control and personal competence, which are typically more pronounced in men than women, while items reflecting spirituality and external control, which are self-reportedly higher in women than men, are not included (Pulido-Martos et al., 2020).

Further, the results support the configural, partial metric, and scalar invariance across three age groups of adults. It should be noted that the factor loading of item 8 was higher in the youngest group then the two older groups, suggesting that the persistence in face of failure could be a more prominent aspect of resilience in emerging adulthood than in early and middle adulthood. Overall, our results support previous evidence on measurement invariance of CD-RISC-10 by age (Gucciardi et al., 2011; Pulido-Martos et al., 2020; Smith et al., 2018). These results suggest that the CD-RISC-10 has a similar structure and meaning in emerging, early and middle adulthood and thus justify the investigation of age differences. Comparisons of the latent means revealed similar levels of resilience in emerging and middle adults but somewhat higher levels in early adults. Studies investigating associations between age and resilience showed rather inconsistent results (Notario-Pacheco et al., 2011; Pulido-Martos et al., 2020; Smith et al., 2018), though they also categorized participants in quite diverse age groups, constraining the comparability of findings. A meta-analysis revealed a small positive effect of age (Lee et al., 2013), but the authors noted that most studies included were quite homogenous in terms of participants' background characteristics. The role of age in resilience thus remains to be investigated in detail in future studies. A possible mechanism explaining positive (though admittedly small) associations between age and resilience could be exposure to various personal, social and professional experiences. As people age, they have more and more various experiences potentially leading to increasingly better skills to deal with complex situations. Somewhat surprisingly, a moderate amount of adverse life events could provide a path to higher resilience as such events may promote the development of toughness and mastery (Seery et al., 2010).

To the best of our knowledge, the present study is the first to offer evidence for configural, metric, and scalar invariance of CD-RISC-10 across educational groups, thus supporting the psychometric equivalence of the measure with participants with lower and higher levels of education. The analyses of group differences revealed higher levels of resilience in adults with at least finished college than in adults with completed primary or secondary education. Positive associations between resilience and higher education were also reported in scarce previous studies (Ang et al., 2018; Rodríguez-Rey et al., 2016). Higher education may be beneficial for personal resilience by fostering diverse skills, knowledge and resources useful for resilient functioning. For example, higher education is associated with better physical health and higher life satisfaction (e.g., Savage & Norton, 2012), increased perceived control (Mirowsky & Ross, 2007), higher sense of mastery and higher social support (Dalgard et al., 2007). Our results further suggest that lower education could represent a risk factor for decreased resilience, thus educational policies that promote continuing education beyond secondary school could be beneficial (Frankenberg et al., 2013). On the other hand, the association may run in the other direction as more resilient people may be more likely to tackle and successfully surmount challenges (Yılmaz, 2017), such as tertiary education.

Furthermore, the Slovenian version of CD-RISC-10 showed satisfactory reliability and convergent validity. More precisely, across gender, age, and educational groups, resilience was moderately associated with higher emotional, psychological, and social well-being, and lower levels of depression, anxiety, and stress. Keeping in mind that correlations do not imply causation, the associations revealed are in line with previous studies suggesting a protective role of resilience in mental health (Hu et al., 2015). A favorable role of resilience was documented also during the COVID-19 pandemic as it predicted better well-being and lower stress even after accounting for effects of individuals' background characteristics (Kavčič et al., 2020), suggesting it may be one of the crucial personal resources that should be measured and fostered in people in adverse situations such as the current pandemic. The beneficial effect of resilience may come about in several ways – the resilience may promote positive mental health, diminish the possibility of increased mental health problems (Fletcher & Sarkar, 2013; Lee et al., 2013) as well as buffer

against detrimental effects of other risk factors on poor mental health (e.g., Kavčič et al., 2020). Group differences obtained in the present study suggest that in adverse situations, women as compared to men, emerging and middle adults as compared to early adults, and adults with lower as compared to those with higher education may be less protected by resilience and thus more at risk for diminished well-being and increased symptoms of mental health problems. The CD-RISC-10 as a psychometrically sound measure could be valuable in identifying individuals or groups of individuals at risk for poor mental health due to unfavorable levels of resilience. These individuals could then be included in various programs, proven to effectively enhance resilience (e.g., Chmitorz et al., 2018).

The present study is not without its limitations. Above all, the sample of participants was not very large and not representative of the population of Slovenia. However, the sample was heterogeneous and sampled from a general population, thus the results expand previous findings on measurement invariance of CD-RISC-10 across age and gender revealed in rather specific samples (e.g., Cheng et al., 2020; Gucciardi et al., 2011). Next, older adults were not included in this study. Studies including large samples of participants, ranging in age across entire adulthood, are needed, in order to examine measurement invariance of CD-RISC-10 across all developmental periods of adulthood and to fully investigate the association between age and resilience. Nevertheless, the present study provides evidence that CD-RISC-10 is a psychometrically sound measure of resilience without measurement bias towards gender, age, or education. Thus, the instrument can justifiably be used to compare resilience by these background variables.

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Data Availability Data is available from authors upon request.

Declarations All procedures performed in the study were in accordance with the ethical standards of the institutional and/or national research committee, with the Declaration of Helsinki and its later amendments, and the American Psychological Association. A consent to translate and use the CD-RISC-10 for research purposes was obtained from its authors. Prior to participation in the study, the participants were presented with the purpose of the study, its expected benefits, as well as ethical aspects. They were informed that the participation in the study was voluntary and completely anonymous; they also had the right to withdraw from the study at any time without penalty. The study posed no foreseeable risks for the participants. All the participants provided informed consent by clicking on the link with the online questionnaire.

Conflict of Interest The authors declare that they have no conflict of interest.

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