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Connor-Davidson Resilience Scale: Validation study in a Portuguese sample

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6 Title: Connor-Davidson Resilience Scale: Validation study in a Portuguese sample
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47 factorial analysis; convergent validity.
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53 **Word count:** 5057 words
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Abstract

Objective: The objective of this paper is to evaluate the psychometric properties and convergent validity of first Portuguese version of the Connor- Davidson Resilience Scale (CD-RISC, 2003). **Participants:** Data sets came from two studies in Portugal, respectively, 476 participants from the Resilience Effect in Coping with Trauma (RECT) project and 405 participants from the Health Impact Assessment of Employment Strategies (HIAES) project. **Method and Results:** The original CD-RISC items were translated to Portuguese and used in a survey along with additional psychosocial and biomedical measures. An Exploratory Factorial Analysis (EFA) with each of the two samples revealed that the best solution in both samples had 3 factors - Self-Efficacy, Spirituality and Social Support. A Confirmatory Factor Analysis (CFA) using the two samples together and the 3 factors model specified on the EAF revealed, in absolute, a good overall fit and, comparatively, a better fit than the model with the original 5 factors. **Conclusions:** The bivariate correlations between the 3 factors and the variables used for the convergent validity are consistent with previous research and show significant correlations with physical activity, medication, mental health, subjective happiness and stress. There may be a protective and beneficial role of positive mental health and resilience on health outcomes.

Article Summary

- Uses a Large sample of Portuguese participants studied with rigorous data collection protocols provide the right context to test the CD-RISC psychometric properties in the context of the Portuguese population.
- Applies sound validated data analysis methodologies (following Green and colleagues) for testing the psychometric properties.
- Makes available a tested (and validated by the original CD-RISC authors) translated version to the Portuguese speaking community.
- Has two different samples, resulting in using least convectional psychometric analysis.
- The two different samples also resulted in differences in test power for the convergent validity analysis.

Funding statement

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Competing interests

There are no competing interests.

Introduction

Resilience can be described as a dynamic process of adaptively overcoming stress and adversity while maintaining normal psychological and physical functioning, and not merely the absence of psychopathology (e.g. Rutten et al., 2013). As an individual characteristic, resilience is likely influenced by external variables, such as adequate social support, that reduce risk for stress-related mental disorders by buffering the impact of stress (e.g. McCrory, De Brito, & Viding, 2010).

In a quantitative methodological review for searching, screening and appraising resilience scales quality, the Connor-Davidson Resilience Scale, the Resilience Scale for Adults and the Brief Resilience Scale received the best psychometric ratings (Windle, Bennett, & Noyes, 2011).

According to the perspective that resilience is a personal quality that reflects the ability to cope with stress, Connor and Davidson (2003) developed a brief self-report scale to quantify resilience. The original version of Connor-Davidson Resilience Scale (CD-RISC) has 25 self-rated items, each of them rated a 5-point scale from 0 ('not true at all') to 4 ('true nearly all the time'). Despite the absence of a proposed cut-off value, higher scores represent higher resilience. The CD-RISC has been developed with participants from different settings, including the general population, primary care outpatients, psychiatric inpatients, and clinical trial patients (Connor & Davidson, 2003). Due to this specificity of the scale studies, CD-RISC can be applied to different populations since it was not developed for a specific group (Karairmak, 2010). The original study demonstrates solid psychometric properties, with good internal consistency and test-retest reliability, with validity being demonstrated with other measures of stress and hardiness (Connor & Davidson, 2003). It suggests that resilience is modifiable and can improve with treatment. Further research on violent trauma shows

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2
3 that survivors who exhibit better health or less distress from the trauma are more
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5 resilient (Connor, Davidson, & Lee, 2003).
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7
8 The CD-RISC has been translated into over fifty languages and has been tested in
9
10 several different contexts and specific populations (Davidson & Connor, 2017).
11

12 Preliminary studies of the scale revealed that the CD-RISC has a multifactorial
13
14 structure. Connor and Davidson (2003) performed exploratory factor analysis, using the
15
16 adults sample from general population. The factor analyses yielded 5 factors, named as
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18 *personal competence, high standards, and tenacity; trust in one's instinct, tolerance of*
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20 *negative affect and strengthening effects of stress; positive acceptance of change and*
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22 *secure relationships with others; control; spiritual influences.* Nevertheless, the CD-
23
24 RISC factor structure still needs to be clarified since subsequent studies found different
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26 factor structures.
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30 Prince-Embury (2013) suggests that the instability of factor structure might have been
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32 related to insufficient numbers of items covering various aspects of the original
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34 construct and that factor structure differences would be expected in studies of groups
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36 that varied culturally and demographically.
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39 Therefore, the objective of this study was to evaluate the psychometric properties of the
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41 CD-RISC Portuguese version with the aim of determining whether it can be used as a
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43 reliable and valid tool to assess Portuguese population resilience.
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46 47 48 **Method**

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51 The study of CD-RISC psychometric properties and convergent validity was conducted
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53 with data sets coming from two studies.
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3 The first data set comes from a research project on Resilience Effect in Coping with
4 Trauma (RECT) in Portugal, conducted at the Faculty of Psychology of the University
5 of Lisbon. This research project has been analyzed by the Ethical Committee of the
6 University of Lisbon – Faculty of Psychology and obtained authorization to perform
7 these studies. The second data set comes from a project on Health Impact Assessment of
8 Employment Strategies (HIAES) in Portugal, within a collaboration protocol between
9 the Institute of Preventive Medicine & Public Health (IMP&SP) of the Faculty of
10 Medicine, University of Lisbon (FMUL), the National Institute of Health Doutor
11 Ricardo Jorge, Public Institute (INSA, IP) and the former High Commissioner for
12 Health (ACS), as a financial sponsor. Subsequently, this has also been supported by the
13 Directorate-General of Health (DGS), still under the same protocol. The project Health
14 Impact Assessment (HIA) of Employment Strategies was approved by two institutional
15 ethical committees, the Ethics Committee for Health of the INSA, IP and the Ethics
16 Committee for Health of the Lisbon / North Hospital Center of Faculty of Medicine of
17 the University of Lisbon (CHLN/FMUL). It was also approved by the National
18 Commission of Data Protection (CNPD). This research was conducted under the
19 Helsinki declaration code of ethics.

40 **Patients and public involvement**

41 All the participants, from both research projects, were inform of the investigation
42 details, accept to participate, and gave their signed informed consent.
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Sample

The RECT project has a convenience sample of 476 participants (44% female participants) comprised by master students, technical course of medical emergency students, and general population. Participants from the HIAES project consist of 405 workers (51% female participants) at a private mutualistic financial institution - Associação Mutualista Caixa Económica Montepio Geral (CEMG) – and is also a convenience non-probabilistic sample. Descriptive data from the two samples for general sociodemographic variables show noteworthy differences in age and education. Regarding the age of the participants, the mean for the RECT sample was 26 (SD=6.24), while the HIAES project's mean was 41 (SD=8.3). Concerning the education variable, the RECT project's sample was composed mostly of participants with a high school degree (58%), followed by middle school (27%) and graduate or higher (15%) degrees. The HIAES project's sample, however, had a higher percentage of participants with a graduate or higher degree (69%), followed by high school (30%) and middle school (1%) degrees.

Instruments

Besides the CD-RISC Scale, we also collected a set of other measures relevant for each project objectives. In this section we only describe the CD-RISC and the measures relevant to test for convergent validity. It is important to note that different measures were collected in each of the samples and, also, for different groups within each sample.

Connor-Davidson Resilience Scale (CD-RISC)

The CD-RISC (Connor & Davidson, 2003) is a scale developed to quantify psychological resilience and the clinical effects of the treatment of anxiety and depression. It is composed by 25 items measured in a 5 points scale (0 - not true to 4 - almost always true) and the original study describes five factors: the notion of 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 finally, spiritual influences. Despite the Connor & Davidson's original study corroborating these five factors, latter studies have reported support for only one factor (e.g. Kararmak, 2010).

Additional measures

A set of additional 8 measures were collected in these two studies. More specifically, in the RECT project the following measures were collected.

- Social Provisions Scale (SPS), an instrument that measures perceived social support (Cutrona & Russell, 1987). Here we used the Portuguese version developed by Moreira and Canaipa (2007).
- Satisfaction With Life Scale (SWLS), an instrument that measures life satisfaction based on the subjective judgement done by each person, accordingly to his own pattern of life satisfaction (Diener, Emmons, Larsen, & Griffin, 1985). We used the Portuguese adaptation of the scale conducted by Simões (1992).

- Perceived Stress Scale (PSS-10), a reduced version of PSS (Cohen, Kamarck, & Mermelstein, 1983; Cohen & Williamson, 1988), an instrument used to measure the perception of stress. We used the Portuguese adaptation of the PSS-10 described by Rocha (2009).
- Stress Vulnerability Questionnaire (23QVS), a measure of the individual's vulnerability to stress (Vaz-Serra, 2000).

In the HIAES project 4 additional measures were collected:

- Health and life styles (H&LS) information regarding perceived health (measured using a single item - "How would you classify your general health state during the last three months?" - and a three points Likert), the practice of physical exercise (measured using both a practice frequency and a practice quality scales) and medication consumption (measured using a dichotomous scale – yes versus no - for a set of fourteen clinical conditions).
- Biomedical indexes (BI) measured by means of blood samples, anthropometric parameters and blood pressure.
- Mental Health Inventory (MHI-5), the reduced version of the MHI Ribeiro 2001 (Veit & Ware, 1983) that measures psychological stress and well-being using 5 items and a frequency scale of 1, always, to 6, never. Here, we used a Portuguese adaptation of the MIH-5 described by Ribeiro (2001).
- Subjective Happiness Scale (SHS), a measure of subjective happiness originally developed by Lyubomirsky and Lepper (1999), composed by four items responded on a Likert 7 points scale. Again, we used a Portuguese version described by Pais-Ribeiro (2012).

Procedure

Translation and adaptation to the Portuguese Language

The CD-RISC items were translated a process of translation and back-translation from the original American scale (CD-RISC; 2003) by specialists in psychology and fluent in both Portuguese and English, and finally approved by the original CD-RISC authors.

Survey procedure

For the RECT data a survey was conducted between April 2009 and May 2010.

Questionnaire application was in paper and pencil format and either face to face or administered in a classroom context. Part of the sample (421 participants) only answered to the CD-RISC scale. Another part of the sample (the remaining 55 participants) responded to all of the additional convergent validity measures.

For the HIAES data a survey was conducted between November 2012 and June 2013.

All participants answered the survey electronically, and to the Connor-Davidson Resilience Scale (CD-RISC) participants responded in paper and pencil format.

Additionally, for a subsample of 260, anthropometric measures and blood samples were also collected.

Psychometric properties

The main objective of this paper was to study the psychometric characteristics of the Portuguese version of the CD-RISC. In this sense, we followed Green and colleagues' (2014) procedure where an Exploratory Factorial Analysis (EFA) was used to test the factorial structure of the original 25-item 5-factor solution version of the CD-RISC and

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3 afterwards a Confirmatory Factor Analysis (CFA) was used to compare a proposed
4 solution based on the EFA results with Connor and Davidson's original one. We note
5 that this methodology used by Green and colleagues is particularly suited for our type of
6 data because it allows to run a confirmatory test of the factorial structure of the scale
7 with the complete sample but first taking in consideration the specific behavior of the
8 items in each of the two samples.
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11 More specifically, two independent EFAs were conducted in each one of the two data
12 sets. In this analysis, the following criteria were taken into account. First, to determine
13 the number of factors we considered the criteria an eigenvalue higher than 0.7. Second,
14 for the interpretation of the items in each factor there were considered the oblimin
15 rotated solutions once it is expected that the factors correlate among themselves.
16 Additionally, for an item to be held for a particular factor communalities should be
17 higher than 0.09, and loadings equal or higher to 0.32 and also cross-loadings lower to
18 0.32 (Tabachnick & Fidell, 2007). Finally, the resulting items in a factor were tested for
19 internal consistency using Cronbach alpha.
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23 Following the EFA, two CFAs were conducted using the complete sample to test and
24 compare both the proposed solution as specified by EFA and the original 25-item 5-
25 factor solution. The statistical quality of the models was assessed using two sets of
26 measures. First, measures of the overall goodness of fit measures considering the
27 following criteria: SRMR and RMSEA lower or equal to 0.08, Comparative Fit Index
28 (CFI) and Tucker-Lewis Index (TLI) higher our equal to 0.90. Additionally, measures
29 of the localized areas of strain with the following criteria: standardized residuals lower
30 or equal to 2.58 and general modification indexes analysis lower or equal to 4.
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Convergent validity

Another aim of the present paper is to provide data for the convergent validity of the CD-RISC. The convergent validity is a form of validation that tests for the association between a construct measured by a scale and other measures that theoretically relate to this construct (Campbell & Fiske, 1959). For the convergent validity of the CD-RISC, variables used in the survey of the HIAES and RECT project were selected and bivariate correlations were computed. First, due to the sample dimension and the characteristics of the variables studied, only correlations with a p-value equal or lower than 0.01 are considered statistically significant. Second, for the interpretation we considered correlation values inferior to 0.20 as weak correlations, between 0.20 and 0.60 as moderate correlations, and higher than 0.60 strong correlations.

Results

Psychometric validation

Exploratory Factorial Analysis

A first set of EFAs were conducted on each data sample forcing the 25-items to the original 5-factor solution and, following Karairmak (2010) and Burns and Anstey (2010), to 3-factor and 1-factor solutions. The results on both data set indicated that none of the solutions replicated corresponding results. In fact, the factor structure for the 5 and 3-factor solutions did not hold, and for the three solutions tested several items revealed low communalities, low loadings and cross loadings in both samples. In line with this, items 5, 11, 12, 14, 17, 20 and 23 were excluded because of systematic problems in the different solutions. A second set of EFAs were conducted with the 18-items for each data sample. Once the original 5-factor and 3-factor solutions could no

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3 longer be interpreted, we used the scree-plot to choose the best solution. The results on
4
5 both data sets showed that the best solution had 3 factors but items 22 and 25 still
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7 revealed problematic. A final set of EFAs was conducted with the 16-items. Results
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9 showed that the best solution in both samples had 3 factors with, respectively, 37% and
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11 31% of explained variance (
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14 Table 1

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16 Table 2
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22 and Table). Factor 1 was the most representative factor, composed by 11 items and
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24 explained, respectively, 20% and 16% of variance, and an alpha of 0.82 and 0.76. This
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26 factor, that we labeled **Self-Efficacy**, describes individuals' beliefs about not only their
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28 personal competence while dealing with challenging demands, but also their ability to
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30 exercise control over their own functioning. Factor 2 was composed by 3 items and
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32 explained, respectively, 9% and 8% of variance, and an alpha of 0.71 and 0.67. This
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34 factor was named **Spirituality** and evaluates specific aspects of spirituality, namely the
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36 belief that life has a purpose and that spiritual forces can influence earthly events.
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38 Finally, Factor 3 was composed by 2 items and explained, respectively, 8% and 7% of
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40 variance, and an alpha of 0.53 and 0.44. This factor refers to the perceived **Social**
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42 **Support**, and evaluates how people perceive they can rely on others for emotional and
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44 functional support. We note that the alphas for Self-Efficacy and Spirituality are above
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46 0.7. Also, for the Social Support, once there were only two items, we used bivariate
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48 correlations. Here the results show a moderate association between the two items.
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52 A descriptive analysis of the three subscales show that the average results for Self-
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54 Efficacy are above the mid-point of the scale and have small standard deviations (SD)
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on both RECT and HIAES samples, respectively, 2.92 (SD=0.54) and 3.03 (SD=0.40).

The same applies to the average results and standard deviations of the Spirituality subscale, respectively 2.64 (SD=0.91) and 2.47 (SD=0.84), and of the Social Support subscale, respectively 3.14 (SD=0.83) and 3.24 (SD=0.67).

Table 1

Table 2

Confirmatory Factorial Analysis

CFA was conducted to test the model specified by EFA and to compare this model with the one suggested by Connor and Davidson's original five-factor solution. Considering the meaning of both the proposed three factors solution and the original five-factors solution, in both cases the CFAs were computed allowing for factors to correlate among themselves.

A preliminary analysis of the frequency distributions and statistics for skewness and kurtosis of CD-RISC show severe negative asymmetry of the data in most of the 25 items. To reduce the impact of the data distributions on the model computations, we log transformed all the data (note that the data was previously transformed to eliminate zero values by adding a constant, and afterwards all the results were inverted). The asymmetry of the resulting log transformed frequency distributions for the 25 items were significantly reduced and consequently used in the CFA.

The results for the proposed 16-item 3-factors solution reveal a good overall fit, $\chi^2(101) = 368.64, p < .001$; SRMR = .05, RMSEA = .06 [.05, .06], CFI = .90, TLI = .89.

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3 The analysis also shows that few standardized residuals are higher than 2.58 and,
4 similarly, few modification indexes are above 4. Finally, all items were highly
5 correlated with their factors, with all correlations between .40 and .77 and all $ps < .001$.
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10 The results for the original 25-item 5-factor solution reveal a moderate overall fit, with
11 both CFI and TLI measures slightly below the criteria, $\chi^2(263) = 1219.08$, $p < .001$;
12 SRMR = .06, RMSEA = .07 [.06, .07], CFI = .82, TLI = .79. Additionally, the analysis
13 also shows several standardized residuals above the criteria and, similarly, several
14 modification indexes are above 4. All items were significantly correlated with their
15 factors (all $ps < .001$), but correlations ranged between a weak .20 and strong .70.
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22 Overall, the proposed 16-item 3-factors solution had better performance in the CFA.
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28 **Convergent validity**

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31 Six of the 8 measures used to test the convergent validity (i.e., SPS, SWLS, PSS-10,
32 23QVS, MHI5 and SHS) were tested for the psychometric properties on their
33 unidimensional versions (Table 3). Results all levels of explained variance are above
34 40% all Cronbach alphas' above 80. The sole exception to these results is the 23QVS
35 with a somewhat lower explained variance of 23% and alpha of 0.76. Additionally, for
36 the H&LS we consider a single item on physical health (Phea) and two indexes, one on
37 physical activity (Pact) using the average of the frequency of psychical activity and of
38 commitment to the physical activity, and an index on medication consumption (Mcons),
39 consisting in the sum of the answers for medication consumption regarding 14 clinical
40 conditions. Finally, for the BI we computed an index to identify the presence of
41 metabolic syndrome (Met) using the recommendations of the European Society of
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3 Cardiology (ESC, <http://www.escardio.org>) and an index for cardiovascular risk (Card)
4 based on the norms of the Portuguese Society of Cardiology (SPC, www.spc.pt).
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14 Bivariate correlations were computed between each one of the three subscales,
15 computed based on the 16-items in the CD-RISC, and each of the 8 measures described
16 above and used to test the convergent validity (Table). The results for the self-efficacy
17 factor show a significant negative association with the two measures of stress
18 considered - perceived stress ($r=-0.32$) and vulnerability to stress ($r=-0.34$). This result
19 is consistent with the idea that people with high efficacy beliefs are able to overcome
20 obstacles and focus on opportunities, and are more able to perceive stressful situations
21 as challenging rather than as problematic events (Luszczynska, Gutiérrez-Doña, &
22 Schwarzer, 2005). Also, the results show positive correlations between the self-efficacy
23 factor and two additional variables, namely, subjective happiness ($r=0.31$) and mental
24 health ($r=0.35$). Again, this is consistent with the literature where self-efficacy beliefs
25 are considered to regulate positive and negative emotions. In this sense, people with
26 higher self-efficacy beliefs are less distressed and feel more capable of dealing with the
27 problematic situations (Bandura, 1997). Recent studies have found that self-efficacy is
28 indeed positively correlated with happiness (e.g. Erozkán, Dogan, & Adiguzel, 2016)
29 and satisfaction with life e.g. (Luszczynska et al., 2005). Finally, another set of striking
30 correlations show, although moderately, the self-efficacy factor as a significant and
31 negative correlation with physical health ($r=-0.17$) and medication consumption ($r=-$
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3 0.13)¹. These last results constitute an extension of the findings where self-efficacy is
4 associated with increased health and life satisfaction.
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7 The results for the spirituality factor show only a marginal significant correlation with
8 the vulnerability to stress measure ($r=0.25$). This result is consistent with Connor et al.
9 (2003) study with survivors of violent trauma, where spirituality is proposed as a coping
10 strategy do deal with higher PTSD scores. Still, the fact that spirituality does not relate
11 with any other variables is not consistent with the literature, where previous studies
12 have successfully established correlations between spirituality and happiness (Martinez
13 & Scott, 2014) and spirituality and life satisfaction (Etemadifar, Hosseiny, Ziraki,
14 Omrani, & Alijanpoor, 2016). The absence of effects can be a result of the low
15 statistical power due to the small sample size in the RECT sample. In fact, a post hoc
16 power analysis shows that the power to detect a significant correlation of 0.20 at 0.05 in
17 our sample is only 0.28.
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21 Finally, the results for the social support scale show a moderate significant correlation
22 ($r=0.48$) with the Social Provision Scale (Cutrona & Russell, 1987). Interestingly, this is
23 the only significant correlation of the Social Provision Scale, which supports the
24 assumptions that this factor is a specific dimension of resilience. Additionally, the social
25 support scale is also correlated with the SHS ($r=0.30$) and MHI5 ($r=0.26$) scales. This
26 result is consistent with the literature showing the strong impact of social support on
27 happiness especially from closer social circles (Lee & Padilla, 2016). For instance, in a
28 study with survivors from a natural disaster, the authors found that pre-disaster
29 happiness and post-disaster social support were protective against the negative effect of
30 the hurricane on survivors' post-disaster happiness (Calvo, Arcaya, Baum, Lowe, &
31 Waters, 2015). Our results also show a marginal significant negative correlation
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¹ "Note that physical health is measured using a single item where the higher the value the lower the physical health reported".

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3 between social support and vulnerability to stress ($r=-0.24$). It is becoming increasingly
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5 consensual that the lack of social support is an important risk factor in dealing with
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7 stressful and adverse life events (Brewin, Andrews, & Valentine, 2000). Finally, our
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9 results also show that social support correlates significantly with metabolic syndrome
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11 ($r=-0.13$) and cardiovascular risk ($r=-0.10$), although the magnitude of both correlations
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13 is weak. Although some of the literature describes a conflicting relation between social
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15 support and physical health (Eaker, 2005), it appears that social support is negatively
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17 associated with cardiovascular death and that it protects against recurrent events, the
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19 existing research involving the predictive relation between social support/social
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21 networks and incidence of disease, specifically cardiovascular disease.
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26 **Discussion**

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29 Resilience is a fundamental element of mental health, health assets, capabilities and
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31 positive adaptation. It enables people both to cope with adversity and to reach their full
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33 potential, and influences a wide range of outcomes at individual and community level,
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35 including healthier lifestyles, better physical health, improved recovery from illness,
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37 fewer limitations in daily living, higher educational attainment, greater productivity,
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39 employment and earnings, better relationships with adults and with children, more
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41 social cohesion and engagement and improved quality of life (Friedli & World Health
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43 Organization, 2009). It is not a surprise that resilience has been extensively measured
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45 and used to understand individual and social phenomena. In line with this, the objective
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47 of this paper is to evaluate the psychometric properties and convergent validity of the
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49 first Portuguese version of the Connor-Davidson Resilience Scale. In fact, despite the
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51 importance of this construct, to date, there is no validated scale to measure resilience
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3 in the Community of Portuguese Language Countries (CPLP, n.d.), estimated to be
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5 more than two hundred and seventy million people.
6

7 To evaluate the psychometric properties and convergent validity of the first Portuguese
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9 version of the Connor-Davidson Resilience Scale we used a translated version of the
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11 CD-RISC that was validated using a back-translation procedure and review by the
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13 original authors. Two sample sets were then studied with the translated scale, one in the
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15 context of a project on Resilience Effect in Coping with Trauma, and another on the
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17 context of a project on Health Impact Assessment of Employment Strategies.
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21 The psychometric characteristics were evaluated following Green and colleagues'
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23 (2014) procedure using i) an Exploratory Factorial Analysis (EFA) to test the factorial
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25 structure of the original 25-item 5-factor solution version of the CD-RISC and,
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27 afterwards, ii) a Confirmatory Factor Analysis (CFA) to compare a proposed solution
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29 based on the EFA results with Connor and Davidson's original one. The results do not
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31 replicate the original five factors structure, instead, the results suggest a three factors
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33 structure with self-efficacy, spirituality, and social support dimensions represented.
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36 Although this result is not consistent with the original proposal from Connor and
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38 Davidson, it is consistent with more recent studies (Karairmak, 2010; Xie, Peng, Zuo, &
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40 Li, 2016). Consistent with this, the variability of factor structures found in CD-RISC
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42 has been document and owed to methodological variations, idiosyncratic samples and,
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44 importantly, to cross-cultural factors (Davidson & Connor, 2017). We also note that
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46 similarly to the original study and to some of the following research, self-efficacy is the
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48 factor that explains the greatest variance of the original items. Still, although the results
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50 are important to understand the construct of resilience and how CD-RISC works as an
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52 instrument measuring this construct in a Portuguese sample, we note that the resulting
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54 scale should not be regarded as an improved version. In fact, we consider that improved
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3 usage of this scale would come from prior testing of the factorial structure of the
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5 original 25 items and comparison with the results of this paper and alike.
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8 The results from the validation are, with one sole and justifiable exception, consistent
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10 with evidence form the literature. In summary, regarding the self-efficacy factor, we
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12 found associations with perceived stress, vulnerability to stress, subjective happiness
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14 and mental health. Additionally, we also found associations with perceived physical
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16 health and medication consumption, what we consider to be an extension of the findings
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18 relating self-efficacy with health and life satisfaction. Regarding the spirituality factor,
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20 we found only an association with vulnerability to stress. This result is not consistent
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22 with the literature where spirituality has been related with stress, happiness and life
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24 satisfaction. As mentioned, the absence of effects here are likely due to low test power.
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27 Finally, regarding the social support scale, we found association with the Social
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29 Provision Scale, subjective happiness, mental health and vulnerability to stress.
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31 Additionally, we also found an association with the two biomedical indexes used,
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33 specifically, cardiovascular risk and metabolic syndrome. Resilience, through its self-
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35 efficacy component, showed a protective effect on the extent of the myocardial
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37 infarction, by affecting the inflammatory response (Arrebola-Moreno et al., 2014).
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39 Emotional vitality, as part of healthy psychological functioning, may protect against risk
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41 of coronary heart disease (CHD) (Kubzansky & Thurston, 2007). Resilience could have
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43 life-saving effects! Prevention and intervention in CHD must involve not only measures
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45 to reduce psychological distress but should also focus on promoting positive emotions.
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Applications for the Portuguese version of the CD-RISC

Our study extends the literature that has provided support on the importance of the construct of resilience, and, more particularly, on the use of CD-RISC as a reliable measure of this construct. In fact, using a robust psychometric method we replicated more recent studies describing three main dimensions of resilience. Additionally, using a vast array of validated measures we also showed how these factors are associated with scales, indexes and even behavioral measures in a way that is consistent with the literature. Importantly, these associations support the distinctiveness of the three factors, with different factors relating, as expected, with some different convergent measures. Take for instance the strong correlation between the social support factor and the Social Provision Scale, and the stronger correlations between the self-efficacy factor and both stress and vulnerability to stress. A curious finding here is the specific association of self-efficacy with physical health and medication consumption and the association of social support with two biomedical indexes, cardiovascular risk and metabolic syndrome.

Most importantly, our study extends the possibility to measure and investigate resilience in Portuguese communities using a rigorously validated scale. In this sense, on the psychometric side, future studies with this community can explore further the three factors structure of the CD-RISC and test for the convergent validity with new samples. On this regard, we reinforce that a limitation of the current paper is the difference in test power between the two samples used to do the convergent validity. This is particularly important because the low test power sample (from REFC project) included important and unique validation measures and because the spirituality scale did not replicate entirely the findings in the literature. Finally, and considering both research and practice, future studies with the Portuguese communities can follow the factorial

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3 structure found and validated. These studies can, again, provide additional support to
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5 the theoretical and practical relevance of resilience and its dimensions as measured by
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7 the CD-RISC.
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12 Statistical code and dataset available from the figshare repository:

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14 <https://doi.org/10.6084/m9.figshare.7111676.v1>
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29 Table 1. EFA results for the 16-item 3-factor solution in the RECT.
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Items / Explained variance	Self-Efficacy	Spirituality	Social Support
19	0.65	0.05	0.11
24	0.47	0.20	0.10
15	0.57	-0.01	0.08
18	0.52	-0.07	0.06
7	0.53	-0.01	0.28
8	0.56	0.08	0.11
1	0.52	0.04	0.14
16	0.53	0.01	0.14
4	0.61	0.14	0.00
6	0.39	0.16	0.25

10	0.35	0.20	0.11
9	0.10	0.69	0.08
21	0.14	0.60	0.28
3	-0.06	0.69	0.02
2	0.18	0.13	0.58
13	0.17	0.16	0.82

Table 2. EFA results for the 16-item 3-factor solution in the HIAES sample.

Items / Explained variance	Self-Efficacy	Spirituality	Social Support
19	0.58	-0.07	0.13
24	0.57	0.02	0.09
15	0.56	-0.04	0.07
18	0.52	-0.07	0.07
7	0.51	0.08	0.02
8	0.48	0.04	0.08
1	0.43	0.06	0.27
16	0.43	0.08	0.04
4	0.38	0.04	0.13

6	0.33	0.12	0.05
10	0.33	0.19	0.19
9	0.08	0.72	0.00
21	0.09	0.60	0.07
3	-0.06	0.59	0.13
2	0.09	0.06	0.76
13	0.21	0.14	0.54

Table 3. Descriptive of the measures used to test the convergent validity.

	M	SD	n
SPS	8.75	9.36	53
SWLS	24.72	5.26	54
PSS-10	14.51	5.49	55
23QVS	28.67	9.44	55
H&LS			
Phea	1.38	.52	405
Pact	3.14	1.45	405
Mcons	2.58	1.67	405

BI			
Met	.12	.32	260
Card	3.31	2.03	405
MHI-5	68.91	18.97	405
SHS	5.24	1.08	405

Table 4. Bivariate correlations between CD-RISC and the measures used to test the convergent validity.

	1	2	3
1. Self-Efficacy	-	.13**	.33**
2. Spirituality	.13**	-	.21**
3. Social Support	.33**	.21**	-
H&LS - Phea	-.16**	-.01	-.09
H&LS - Pact	.08	.00	.08
H&LS - Mcons	-.13**	.08	-.04
BI - Met	-.04	.02	-.13*

BI - Card	.07	.01	-.10*
MHI-5	.35**	.02	.26**
SHS	.31**	.09	.30**
SPS	.16	-.13	.48**
SWLS	.28*	.10	.11
PSS-10	-.32*	.14	.10
23QVS	-.34*	.25 ⁺	-.24 ⁺

⁺ p<0.06; * p<0.05; **p<0.01

Author's contribution

Faria-Anjos, Joana

Responsible for the CD-RISC scale translation process; substantial contribution to the conception and design of the work, acquisition, analysis and interpretation of data; drafting the work; agreement to be accountable for all aspects of the work related with integrity of the data analysis and results reporting; and final approval of the version to be published.

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Connor-Davidson Resilience Scale: Validation study in a Portuguese sample

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Abstract

Objective: The objective of this paper is to evaluate the psychometric properties and convergent validity of first Portuguese version of the Connor- Davidson Resilience Scale (CD-RISC, 2003). **Participants:** Data sets came from two studies in Portugal, respectively, 476 participants from the Resilience Effect in Coping with Trauma (RECT) project and 405 participants from the Health Impact Assessment of Employment Strategies (HIAES) project. **Method and Results:** The original CD-RISC items were translated to Portuguese and used in a survey along with additional psychosocial and biomedical measures. An Exploratory Factorial Analysis (EFA) with each of the two samples revealed that the best solution in both samples had 3 factors - Self-Efficacy, Spirituality and Social Support. A Confirmatory Factor Analysis (CFA) using the two samples together and the 3 factors model specified on the EFA revealed, in absolute, a good overall fit and, comparatively, a better fit than the model with the original 5 factors. **Conclusions:** The bivariate correlations between the 3 factors and the variables used for the convergent validity are consistent with previous research and show significant correlations with physical activity, medication, mental health, subjective happiness and stress. There may be a protective and beneficial role of positive mental health and resilience on health outcomes.

Article Summary

- Uses a Large sample of Portuguese participants studied with rigorous data collection protocols provide the right context to test the CD-RISC psychometric properties in the context of the Portuguese population.
- Applies sound validated data analysis methodologies (following Green and colleagues) for testing the psychometric properties.
- Makes available a tested (and validated by the original CD-RISC authors) translated version to the Portuguese speaking community.
- Has two different samples, requiring the adaptation of commonly used psychometric analysis.
- The two different samples also resulted in differences in test power for the convergent validity analysis.

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Competing interests

There are no competing interests.

Introduction

Resilience can be described as a dynamic process of adaptively overcoming stress and adversity while maintaining normal psychological and physical functioning, and not merely the absence of psychopathology. [1] As an individual characteristic, resilience is likely influenced by external variables, such as adequate social support, that reduce risk for stress-related mental disorders by buffering the impact of stress.[2]

In a quantitative methodological review for searching, screening and appraising resilience scales quality, the Connor-Davidson Resilience Scale (CD-RISC), the Resilience Scale for Adults and the Brief Resilience Scale received the best psychometric ratings.[3]

Based on the perspective that resilience is a personal quality that reflects the ability to cope with stress, Connor and Davidson[4] developed a brief self-report scale to quantify resilience. The original version of CD-RISC has 25 self-rated items, each of them rated a 5-point scale from 0 ('not true at all') to 4 ('true nearly all the time'). Despite the absence of a proposed cut-off value, higher scores represent higher resilience. The CD-RISC was developed with participants from different settings, including the general population, primary care outpatients, psychiatric inpatients, and clinical trial patients.[4]The CD-RISC is a generic measure which can be applied to different populations since it was not developed for a specific group.[5]The original study demonstrated solid psychometric properties, with good internal consistency and test-retest reliability, with validity being demonstrated with other measures of stress and hardiness.[4] It suggested that resilience is modifiable and can improve with treatment. Further research on violent trauma showed that survivors who exhibit better health or less distress from the trauma are more resilient.[6]

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3 The CD-RISC has been translated into over fifty languages and has been tested in
4 several different contexts and specific populations: on general population[7-9]; post-
5 9/11 U.S. military veteran[10]; United States Air Force[11]; adolescents[12]; university
6 students[13,14]; young adults[15]; older adults[16]; earthquake survivors[5];
7 adolescents' earthquake survivors[17]; homeless youth[18]; caregivers with chronic
8 stress[19]; people with spinal cord injuries[20]; rehabilitation patients after
9 unintentional injury[21]; sport performers[22], among many others.

10 Preliminary studies of the scale revealed that the CD-RISC has a multifactorial
11 structure. Connor and Davidson[4] performed exploratory factor analysis, using the
12 adults sample from general population. The factor analyses yielded 5 factors, named as
13 *personal competence, high standards, and tenacity; trust in one's instinct, tolerance of*
14 *negative affect and strengthening effects of stress; positive acceptance of change and*
15 *secure relationships with others; control; spiritual influences.* Nevertheless, the CD-
16 RISC factor structure still needs to be clarified since subsequent studies found different
17 factor structures.

18 Prince-Embury[23] suggests that the instability of factor structure might have been
19 related to insufficient numbers of items covering various aspects of the original
20 construct and that factor structure differences would be expected in studies of groups
21 that varied culturally and demographically.

22 Therefore, the objective of this study was to evaluate the psychometric properties of the
23 CD-RISC Portuguese version with the aim of determining whether it can be used as a
24 reliable and valid tool to assess Portuguese population resilience.

Method

The study of CD-RISC psychometric properties and convergent validity was conducted with data sets coming from two studies.

The first data set comes from a research project on Resilience Effect in Coping with Trauma (RECT) in Portugal, conducted at the Faculty of Psychology of the University of Lisbon. This research project was reviewed by the Ethical Committee of the University of Lisbon – Faculty of Psychology and granted authorization to perform these studies. The second data set comes from a project on Health Impact Assessment of Employment Strategies (HIAES) in Portugal, which was approved by two institutional ethical committees, the Ethics Committee for Health of the National Institute of Health Doutor Ricardo Jorge, Public Institute and the Ethics Committee for Health of the Lisbon / North Hospital Center of Faculty of Medicine of the University of Lisbon. It was also approved by the National Commission of Data Protection. This research was conducted under the Helsinki declaration code of ethics.

Patients and public involvement

All the participants, from both research projects, were informed of the investigation and gave their signed informed consent.

Sample

The RECT project has a convenience sample of 476 participants (44% female participants) comprised by master students, technical course of medical emergency students, and general population. Participants from the HIAES project consist of 405 workers (51% female participants) at a private mutualistic financial institution -

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3 Associação Mutualista Caixa Económica Montepio Geral (CEMG) – and is also a
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5 convenience non-probabilistic sample. Descriptive data from the two samples for
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7 general sociodemographic variables show noteworthy differences in age and education.
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10 Regarding the age of the participants, the mean for the RECT sample was 26
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12 (SD=6.24), while the HIAES project's mean was 41 (SD=8.3). Concerning the
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14 education variable, the RECT project's sample was composed mostly of participants
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16 with a high school degree (58%), followed by middle school (27%) and graduate or
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18 higher (15%) degrees. The HIAES project's sample, however, had a higher percentage
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20 of participants with a graduate or higher degree (69%), followed by high school (30%)
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22 and middle school (1%) degrees.
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31 **Instruments**

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33 Besides the CD-RISC Scale, we also collected data for a set of other measures relevant
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35 to each project objective. In this section we only describe the CD-RISC and the
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37 measures relevant to test for convergent validity. It is important to note that different
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39 data were collected in each of the samples and, also, for different groups within each
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41 sample.
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46 **Connor-Davidson Resilience Scale (CD-RISC)**

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48 The CD-RISC[4] is a scale developed to quantify psychological resilience and the
49
50 clinical effects of the treatment of anxiety and depression. It is composed by 25 items
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52 measured in a 5 points scale (0 - not true to 4 - almost always true) and the original
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54 study describes five factors: the notion of personal competence, high standards, and
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56 tenacity; trust in one's instincts, tolerance of negative affect, and strengthening effects
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3 of stress; positive acceptance of change, and secure relationships; control; and finally,
4 spiritual influences. Despite the Connor & Davidson's original study corroborating
5 these five factors, latter studies have reported support for only one factor.[5]
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10 **Additional measures**

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12 A set of additional 8 measures were collected in these two studies. More specifically, in
13 the RECT project the following measures were collected.
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22 • Social Provisions Scale (SPS), an instrument that measures perceived social
23 support.[24] Here we used the Portuguese version developed by Moreira and
24 Canaipa.[25]
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32 • Satisfaction With Life Scale (SWLS), an instrument that measures life
33 satisfaction based on the subjective judgement done by each person,
34 accordingly to his own pattern of life satisfaction.[26] We used the
35 Portuguese adaptation of the scale conducted by Simões.[27]
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42 • Perceived Stress Scale (PSS-10), a reduced version of PSS,[28, 29] an
43 instrument used to measure the perception of stress. We used the Portuguese
44 adaptation of the PSS-10 described by Rocha.[30]
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51 • Stress Vulnerability Questionnaire (23QVS), a measure of the individual's
52 vulnerability to stress.[31]
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54 In the HIAES project 4 additional measures were collected:

- 55 • Health and life styles (H&LS) information regarding perceived health
56 (measured using a single item - "How would you classify your general health
57 state during the last three months?" - and a three points Likert), the practice
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3 of physical exercise (measured using both a practice frequency and a practice
4 quality scales) and medication consumption (measured using a dichotomous
5 scale – yes versus no - for a set of fourteen clinical conditions).
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11 • Biomedical indexes (BI) measured by means of blood samples,
12 anthropometric parameters and blood pressure.
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16 • Mental Health Inventory (MHI-5), the reduced version of the MHI Ribeiro
17 2001[32]that measures psychological stress and well-being using 5 items and
18 a frequency scale of 1, always, to 6, never. Here, we used a Portuguese
19 adaptation of the MIH-5 described by Ribeiro.[33]
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26 • Subjective Happiness Scale (SHS), a measure of subjective happiness
27 originally developed by Lyubomirsky and Lepper,[34] composed by four
28 items responded on a Likert 7 points scale. Again, we used a Portuguese
29 version described by Pais-Ribeiro.[35]
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39 Procedure

40 41 42 Translation and adaptation to the Portuguese Language

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44 The CD-RISC items were translated through a process of translation and back-
45 translation from the original American scale[4] by specialists in psychology and fluent
46 in both Portuguese and English, and finally approved by the original CD-RISC authors.
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Survey procedure

For the RECT data a survey was conducted between April 2009 and May 2010. The protocol application was in paper and pencil format and either face to face or administered in a classroom context. Part of the sample (421 participants) only answered to the CD-RISC scale. Another part of the sample (the remaining 55 participants) was available on a second moment of the study and responded to all of the additional convergent validity measures.

For the HIAES data a survey was conducted between November 2012 and June 2013. The survey had two parts: on a first part the participants answered the survey electronically, on a second part, the participants answered to the CD-RISC in paper and pencil format. Additionally, for a subsample of 260, anthropometric measures and blood samples were also collected.

Psychometric properties

The main objective of this paper was to study the psychometric characteristics of the Portuguese version of the CD-RISC. We followed Green and colleagues' [10] procedure where an Exploratory Factorial Analysis (EFA) was used to test the factorial structure of the original 25-item 5-factor solution version of the CD-RISC and afterwards a Confirmatory Factor Analysis (CFA) was used to compare a proposed solution based on the EFA results with Connor and Davidson's original one. We note that this methodology used by Green and colleagues is particularly suited for our type of data. More specifically, this methodology allows to understand the specific behavior of the items in each of the two samples and only then to test of the factorial structure of the scale with the complete sample.

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3 Two independent EFAs were conducted in each one of the two data sets. In this
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5 analysis, the following criteria were taken into account. First, to determine the number
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7 of factors we considered the criteria an eigenvalue higher than 0.7. Second, for the
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9 interpretation of the items in each factor there were considered the oblimin rotated
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11 solutions once it is expected that the factors correlate among themselves. Additionally,
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13 for an item to be held for a particular factor communalities should be higher than 0.09,
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15 and loadings equal or higher to 0.32 and also cross-loadings lower to 0.32.[36] Finally,
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17 the resulting items in a factor were tested for internal consistency using Cronbach alpha.
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19 Following the EFA, two CFAs were conducted using the complete sample to test and
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21 compare both the proposed solution as specified by EFA and the original 25-item 5-
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23 factor solution. The statistical quality of the models was assessed using two sets of
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25 measures. First, measures of the overall goodness of fit measures considering the
26
27 following criteria: SRMR and RMSEA lower or equal to 0.08, Comparative Fit Index
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29 (CFI) and Tucker-Lewis Index (TLI) higher or equal to 0.90. Additionally, measures of
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31 the localized areas of strain with the following criteria: standardized residuals lower or
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33 equal to 2.58 and general modification indexes analysis lower or equal to 4.
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45 **Convergent validity**

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47 Another aim of the present paper is to provide data for the convergent validity of the
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49 CD-RISC. The convergent validity is a form of validation that tests for the association
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51 between a construct measured by a scale and other measures that theoretically relate to
52
53 this construct.[37, 38] For the convergent validity of the CD-RISC, variables used in the
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55 survey of the HIAES and RECT project were selected and bivariate correlations were
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57 computed. First, due to the sample dimension and the characteristics of the variables
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3 studied, only correlations with a p-value equal or lower than 0.01 are considered
4 statistically significant.[39] Second, for the interpretation we considered correlation
5 values inferior to 0.20 as weak correlations, between 0.20 and 0.60 as moderate
6 correlations, and higher than 0.60 strong correlations.
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16 **Results**

17 **Psychometric validation**

18 **Exploratory Factorial Analysis**

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25 A first set of EFAs were conducted on each data sample forcing the 25-items to the
26 original 5-factor solution and, following Karairmak[5] and Burns and Anstey,[15] to 3-
27 factor and 1-factor solutions. The results on both data set indicated that none of the
28 solutions replicated corresponding results. In fact, the factor structure for the 5 and 3-
29 factor solutions did not hold, and for the three solutions tested several items revealed
30 low communalities, low loadings and cross loadings in both samples. In line with this,
31 items 5, 11, 12, 14, 17, 20 and 23 were excluded because of systematic problems in the
32 different solutions. A second set of EFAs were conducted with the 18-items for each
33 data sample. Once the original 5-factor and 3-factor solutions could no longer be
34 interpreted, we used the scree-plot to choose the best solution. The results on both data
35 sets showed that the best solution had 3 factors but items 22 and 25 still revealed
36 problematic. A final set of EFAs was conducted with the 16-items. Results showed that
37 the best solution in both samples had 3 factors with, respectively, 37% and 31% of
38 explained variance (
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Table 1

Table 2

and Table). Factor 1 was the most representative factor, composed of 11 items and explained, respectively, 20% and 16% of variance, and an alpha of 0.82 and 0.76. This factor, that we labeled **Self-Efficacy**, describes individuals' beliefs about not only their personal competence while dealing with challenging demands, but also their ability to exercise control over their own functioning. Factor 2 was composed of 3 items and explained, respectively, 9% and 8% of variance, and an alpha of 0.71 and 0.67. This factor was named **Spirituality** and evaluates specific aspects of spirituality, namely the belief that life has a purpose and that spiritual forces can influence earthly events. Finally, Factor 3 was composed of 2 items and explained, respectively, 8% and 7% of variance, and an alpha of 0.53 and 0.44. This factor refers to the perceived **Social Support**, and evaluates how people perceive their reliance on others for emotional and functional support. We note that the alphas for Self-Efficacy and Spirituality are above 0.7. Also, for the Social Support, once there were only two items, we used bivariate correlations. Here the results show a moderate association between the two items.

A descriptive analysis of the three subscales show that the average results for Self-Efficacy are above the mid-point of the scale and have small standard deviations (SD) on both RECT and HIAES samples, respectively, 2.92 (SD=0.54) and 3.03 (SD=0.40). The same applies to the average results and standard deviations of the Spirituality subscale, respectively 2.64 (SD=0.91) and 2.47 (SD=0.84), and of the Social Support subscale, respectively 3.14 (SD=0.83) and 3.24 (SD=0.67).

Table 1

Table 2

Confirmatory Factorial Analysis

CFA was conducted to test the model specified by EFA and to compare this model with the one suggested by Connor and Davidson's original five-factor solution. Considering the meaning of both the proposed three factors solution and the original five-factors solution, in both cases the CFAs were computed allowing for factors to correlate among themselves.

A preliminary analysis of the frequency distributions and statistics for skewness and kurtosis of CD-RISC show severe negative asymmetry of the data in most of the 25 items. To reduce the impact of the data distributions on the model computations, we log transformed all the data (note that the data was previously transformed to eliminate zero values by adding a constant, and afterwards all the results were inverted). The asymmetry of the resulting log transformed frequency distributions for the 25 items were significantly reduced and consequently used in the CFA.

The results for the proposed 16-item 3-factors solution reveal a good overall fit, $\chi^2(101) = 368.64, p < .001$; SRMR = .05, RMSEA = .06 [.05, .06], CFI = .90, TLI = .89.

The analysis also shows that few standardized residuals are higher than 2.58 and, similarly, few modification indexes are above 4. Finally, all items were highly correlated with their factors, with all correlations between .40 and .77 and all $ps < .001$.

The results for the original 25-item 5-factor solution reveal a moderate overall fit, with both CFI and TLI measures slightly below the criteria, $\chi^2(263) = 1219.08, p < .001$; SRMR = .06, RMSEA = .07 [.06, .07], CFI = .82, TLI = .79. Additionally, the analysis also shows several standardized residuals above the criteria and, similarly, several

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3 modification indexes are above 4. All items were significantly correlated with their
4 factors (all $ps < .001$), but correlations ranged between a weak .20 and strong .70.
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7 Overall, the proposed 16-item 3-factors solution had better performance in the CFA.
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10 11 12 13 14 **Convergent validity**

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16 Six of the 8 measures used to test the convergent validity (i.e., SPS, SWLS, PSS-10,
17 23QVS, MHI5 and SHS) were tested for the psychometric properties on their
18 unidimensional versions (Table 3). Results all levels of explained variance are above
19 40% all Cronbach alphas' above 80. The sole exception to these results is the 23QVS
20 with a somewhat lower explained variance of 23% and alpha of 0.76. Additionally, for
21 the H&LS we consider a single item on physical health (Phea) and two indexes, one on
22 physical activity (Pact) using the average of the frequency of psychical activity and of
23 commitment to the physical activity, and an index on medication consumption (Mcons),
24 consisting in the sum of the answers for medication consumption regarding 14 clinical
25 conditions. Finally, for the BI we computed an index to identify the presence of
26 metabolic syndrome (Met) using the recommendations of the European Society of
27 Cardiology (ESC, <http://www.escardio.org>) and an index for cardiovascular risk (Card)
28 based on the norms of the Portuguese Society of Cardiology (SPC, www.spc.pt).
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46 Table 3

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49 Table 4

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53 Bivariate correlations were computed between each one of the three subscales,
54 computed based on the 16-items in the CD-RISC, and each of the 8 measures described
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3 above and used to test the convergent validity (Table. 4. Bivariate correlation coefficients
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5 between the CD-RISC scale and the measures used to test the convergent validity.
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7). The data that support the findings of this study are openly available in figshare at
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9 <https://doi.org/10.6084/m9.figshare.7111676.v1>.
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13 14 15 **Discussion**

16
17 The objective of this paper is to evaluate the psychometric properties and convergent
18
19 validity of the first Portuguese version of the CD-RISC. Despite the importance of this
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21 construct, to date, there is no validated scale to measure resilience in the Community of
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23 Portuguese Language Countries (CPLP, n.d.), estimated to be more than two hundred
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25 and seventy million people. Resilience is a fundamental element of mental health, health
26
27 assets, capabilities and positive adaptation. It enables people both to cope with adversity
28
29 and to reach their full potential, and influences a wide range of outcomes at individual
30
31 and community level, including healthier lifestyles, better physical health, improved
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33 recovery from illness, fewer limitations in daily living, higher educational attainment,
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35 greater productivity, employment and earnings, better relationships with adults and with
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37 children, more social cohesion and engagement and improved quality of life.[40]It is
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39 not a surprise that resilience has been extensively measured and used to understand
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41 individual and social phenomena.
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48 The results do not replicate the original five factors structure, instead, the results suggest
49
50 a three factors structure with self-efficacy, spirituality, and social support dimensions
51
52 represented. Although this result is not consistent with the original proposal from
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54 Connor and Davidson, it is consistent with more recent studies.[5, 41] Consistent with
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56 this, the variability of factor structures found in CD-RISC has been document and owed
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58 to methodological variations, idiosyncratic samples and, importantly, to cross-cultural
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3 factors.[42] We also note that similarly to the original study and to some of the
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5 following research, self-efficacy is the factor that explains the greatest variance of the
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7 original items. Still, although the results are important to understand the construct of
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9 resilience and how CD-RISC works as an instrument measuring this construct in a
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11 Portuguese sample, we note that the resulting scale should not be regarded as an
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13 improved version. In fact, we consider that improved usage of this scale would come
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15 from prior testing of the factorial structure of the original 25 items and comparison with
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17 the results of this paper and alike.
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22 The results from the validation are, with one sole and justifiable exception, consistent
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24 with evidence from the literature. The results for the self-efficacy factor show a
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26 significant negative association with the two measures of stress considered - perceived
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28 stress ($r=-0.32$) and vulnerability to stress ($r=-0.34$). This result is consistent with the
29
30 idea that people with high efficacy beliefs are able to overcome obstacles and focus on
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32 opportunities, and are more able to perceive stressful situations as challenging rather
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34 than as problematic events.[43] Also, the results show positive correlations between the
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36 self-efficacy factor and two additional variables, namely, subjective happiness ($r=0.31$)
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38 and mental health ($r=0.35$). Again, this is consistent with the literature where self-
39
40 efficacy beliefs are considered to regulate positive and negative emotions. In this sense,
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42 people with higher self-efficacy beliefs are less distressed and feel more capable of
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44 dealing with the problematic situations.[44] Recent studies have found that self-efficacy
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46 is indeed positively correlated with happiness[45] and satisfaction with life.[43] Finally,
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48 another set of striking correlations show, although moderately, the self-efficacy factor
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50 as a significant and negative correlation with physical health ($r=-0.17$) and medication
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3 consumption ($r=-0.13$)¹. These last results constitute an extension of the findings where
4 self-efficacy is associated with increased health and life satisfaction.
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8 The results for the spirituality factor show only a marginal significant correlation with
9 the vulnerability to stress measure ($r=0.25$). This result is consistent with Connor and
10 colleagues[6] study with survivors of violent trauma, where spirituality is proposed as a
11 coping strategy do deal with higher Posttraumatic Stress Disorder scores. Still, the fact
12 that spirituality does not relate with any other variables is not consistent with the
13 literature, where previous studies have successfully established correlations between
14 spirituality and happiness[46] and spirituality and life satisfaction.[47] The absence of
15 effects can be a result of the low statistical power due to the small sample size in the
16 RECT sample. In fact, a post hoc power analysis shows that the power to detect a
17 significant correlation of 0.20 at 0.05 in our sample is only 0.28.
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21 Finally, the results for the social support scale show a moderate significant correlation
22 ($r=0.48$) with the Social Provision Scale.[24] Interestingly, this is the only significant
23 correlation of the Social Provision Scale, which supports the assumptions that this factor
24 is a specific dimension of resilience. Additionally, the social support scale is also
25 correlated with the SHS ($r=0.30$) and MHI5 ($r=0.26$) scales. This result is consistent
26 with the literature showing the strong impact of social support on happiness especially
27 from closer social circles.[48] For instance, in a study with survivors from a natural
28 disaster, the authors found that pre-disaster happiness and post-disaster social support
29 were protective against the negative effect of the hurricane on survivors' post-disaster
30 happiness.[49] Our results also show a marginal significant negative correlation
31 between social support and vulnerability to stress ($r=-0.24$). It is becoming increasingly
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59 ¹ “Note that physical health is measured using a single item where the higher the value the lower the
60 physical health reported”.

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3 consensual that the lack of social support is an important risk factor in dealing with
4 stressful and adverse life events.[50] Finally, our results also show that social support
5 correlates significantly with metabolic syndrome ($r=-0.13$) and cardiovascular risk ($r=-$
6 0.10), although the magnitude of both correlations is weak. Although some of the
7 literature describes a conflicting relation between social support and physical
8 health,[51] it appears that social support is negatively associated with cardiovascular
9 death and that it protects against recurrent events, the existing research involving the
10 predictive relation between social support/social networks and incidence of disease,
11 specifically cardiovascular disease.
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15 In summary, regarding the self-efficacy factor, we found associations with perceived
16 stress, vulnerability to stress, subjective happiness and mental health. Additionally, we
17 also found associations with perceived physical health and medication consumption,
18 what we consider to be an extension of the findings relating self-efficacy with health
19 and life satisfaction. Regarding the spirituality factor, we found only an association with
20 vulnerability to stress. This result is not consistent with the literature where spirituality
21 has been related with stress, happiness and life satisfaction. As mentioned, the absence
22 of effects here are likely due to low test power. Finally, regarding the social support
23 scale, we found association with the Social Provision Scale, subjective happiness,
24 mental health and vulnerability to stress. Additionally, we also found an association
25 with the two biomedical indexes used, specifically, cardiovascular risk and metabolic
26 syndrome. Resilience, through its self-efficacy component, showed a protective effect
27 on the extent of the myocardial infarction, by affecting the inflammatory
28 response.[52] Emotional vitality, as part of healthy psychological functioning, may
29 protect against risk of coronary heart disease (CHD).[53] Resilience could have life-
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3 saving effects. Prevention and intervention in CHD must involve not only measures to
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5 reduce psychological distress but should also focus on promoting positive emotions.
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10 11 **Applications for the Portuguese version of the CD-RISC** 12

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14 Our study extends the literature that has provided support on the importance of the
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16 construct of resilience, and, more particularly, on the use of CD-RISC as a reliable
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18 measure of this construct. In fact, using a robust psychometric method we replicated
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20 more recent studies describing three main dimensions of resilience. Additionally, using
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22 a vast array of validated measures we also showed how these factors are associated with
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24 scales, indexes and even behavioral measures in a way that is consistent with the
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26 literature. Importantly, these associations support the distinctiveness of the three factors,
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28 with different factors relating, as expected, with some different convergent measures.
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30 Take for instance the strong correlation between the social support factor and the Social
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32 Provision Scale, and the stronger correlations between the self-efficacy factor and both
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34 stress and vulnerability to stress. A curious finding here is the specific association of
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36 self-efficacy with physical health and medication consumption and the association of
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38 social support with two biomedical indexes, cardiovascular risk and metabolic
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40 syndrome.
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47 **Future directions and research limitations** 48

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50 Most importantly, our study extends the possibility to measure and investigate resilience
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52 in Portuguese communities using a rigorously validated scale. In this sense, on the
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54 psychometric side, future studies with this community can explore further the three
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56 factors structure of the CD-RISC and test for the convergent validity with new samples.
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58 On this regard, we reinforce that a limitation of the current paper is the difference in test
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3 power between the two samples used to do the convergent validity. This is particularly
4 important because the low test power sample (from RECT project) included important
5 and unique validation measures and because the spirituality scale did not replicate
6 entirely the findings in the literature. Finally, and considering both research and
7 practice, future studies with the Portuguese communities can follow the factorial
8 structure found and validated. These studies can, again, provide additional support to
9 the theoretical and practical relevance of resilience and its dimensions as measured by
10 the CD-RISC.
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25 Abbreviations:

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27 23QVS: Stress Vulnerability Questionnaire

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30 BI: Biomedical indexes

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33 Card: cardiovascular risk

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36 CD-RISC: Connor- Davidson Resilience Scale

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38
39 CFA: Confirmatory Factor Analysis

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41
42 CHD: Coronary heart disease

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44
45 EFA: Exploratory Factorial Analysis

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47
48 H&LS: Health and life styles

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50
51 HIAES: Health Impact Assessment of Employment Strategies

52
53
54 Mcons: Medication consumption

55
56
57 Met: metabolic syndrome

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59
60 MHI-5: Mental Health Inventory

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3 RECT: Resilience Effect in Coping with Trauma
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5
6 Pact: Physical activity
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8
9 Phea: Physical health
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11
12 PSS-10: Reduced version of Perceived Stress Scale
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14
15 SHS: Subjective Happiness Scale (SHS),
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18 SPS: Social Provisions Scale
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Table 1. Factorial weights of the 16 items on each of the three factors and respective explained variance for the RECT sample.

Items / Explained variance	Communalities	Self-Efficacy	Spirituality	Social Support
19	0.44	0.65	0.05	0.11
24	0.28	0.47	0.20	0.10
15	0.33	0.57	-0.01	0.08
18	0.28	0.52	-0.07	0.06
7	0.35	0.53	-0.01	0.28
8	0.33	0.56	0.08	0.11
1	0.30	0.52	0.04	0.14
16	0.30	0.53	0.01	0.14
4	0.40	0.61	0.14	0.00
6	0.24	0.39	0.16	0.25
10	0.18	0.35	0.20	0.11
9	0.50	0.10	0.69	0.08
21	0.45	0.14	0.60	0.28
3	0.48	-0.06	0.69	0.02
2	0.38	0.18	0.13	0.58
13	0.72	0.17	0.16	0.82
Variance explained	-	20%	9%	8%
Alpha	-	0.82	0.71	0.53*
M (SD)	-	2.92 (0.54)	2.64 (0.91)	3.14 (0.83)
N	-	421	421	421

* correlation for the two items, $p < 0.05$

Table 2. Factorial weights of the 16 items on each of the three factors and respective explained variance for the HIAES sample.

Items / Explained variance	Communalities	Self-Efficacy	Spirituality	Social Support
19	0.36	0.58	-0.07	0.13
24	0.33	0.57	0.02	0.09
15	0.32	0.56	-0.04	0.07
18	0.28	0.52	-0.07	0.07
7	0.26	0.51	0.08	0.02
8	0.24	0.48	0.04	0.08
1	0.26	0.43	0.06	0.27
16	0.19	0.43	0.08	0.04
4	0.16	0.38	0.04	0.13
6	0.12	0.33	0.12	0.05
10	0.18	0.33	0.19	0.19
9	0.52	0.08	0.72	0.00
21	0.37	0.09	0.60	0.07
3	0.36	-0.06	0.59	0.13
2	0.59	0.09	0.06	0.76
13	0.35	0.21	0.14	0.54
Variance explained	-	16%	8%	7%
Alpha	-	0.76	0.67	0.44*
M (SD)	-	3.03 (0.40)	2.47 (0.84)	3.24 (0.67)
N	-	405	405	405

* correlation for the two items, $p < 0.05$

Table 3. Descriptives (mean, standard-deviation and sample size) of the measures used to test the convergent validity.

	M	SD	n
SPS	8.75	9.36	53
SWLS	24.72	5.26	54
PSS-10	14.51	5.49	55
23QVS	28.67	9.44	55
H&LS			
Phea	1.38	.52	405
Pact	3.14	1.45	405
Mcons	2.58	1.67	405
BI			
Met	.12	.32	260
Card	3.31	2.03	405
MHI-5	68.91	18.97	405
SHS	5.24	1.08	405

Table. 4. Bivariate correlation coefficients between the CD-RISC scale and the measures used to test the convergent validity.

	1	2	3
1. Self-Efficacy	-	.13**	.33**
2. Spirituality	.13**	-	.21**
3. Social Support	.33**	.21**	-
H&LS - Phea	-.16**	-.01	-.09
H&LS - Pact	.08	.00	.08
H&LS - Mcons	-.13**	.08	-.04
BI - Met	-.04	.02	-.13*
BI - Card	.07	.01	-.10*
MHI-5	.35**	.02	.26**
SHS	.31**	.09	.30**
SPS	.16	-.13	.48**
SWLS	.28*	.10	.11
PSS-10	-.32*	.14	.10
23QVS	-.34*	.25 ⁺	-.24 ⁺

⁺ p<0.06; * p<0.05; **p<0.01

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5 Author's contribution
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7
8 Faria-Anjos, Joana
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10 Responsible for the CD-RISC scale translation process; substantial contribution to the
11 conception and design of the work, acquisition, analysis and interpretation of data;
12 drafting the work; agreement to be accountable for all aspects of the work related with
13 integrity of the data analysis and results reporting; and final approval of the version to
14 be published.
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12 work related with integrity of the data analysis and results reporting; and final approval
13 of the version to be published.
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Connor-Davidson Resilience Scale: Validation study in a Portuguese sample

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50 factorial analysis; convergent validity.
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Abstract

Objective: The objective of this paper is to evaluate the structural validity and convergent validity of the first Portuguese version of Connor- Davidson Resilience Scale (CD-RISC, 2003). **Settings:** The datasets come from two studies conducted in Portugal, respectively, from the Resilience Effect in Coping with Trauma (RECT) project and from the Health Impact Assessment of Employment Strategies (HIAES) project. **Participants:** The sample is composed by 476 participants from RECT project and 405 participants from the HIAES project. In both projects convenience samples were used. **Measures:** The original CD-RISC items were translated to Portuguese and used in a survey along with additional psychosocial and biomedical measures. **Results:** Independent Exploratory Factorial Analysis (EFA) with each of the two samples revealed that the best solution in both samples had 3 factors consistent with the Self-Efficacy, Spirituality and Social Support factors from the original scale. A Confirmatory Factor Analysis (CFA) using the two samples together and specifying the 3 factors from the EFA revealed a good overall fit and, comparatively, better fit than a model specified with the 5 factors from the original scale. The study of the convergent validity revealed that bivariate correlations between the 3 factors and validated measures of stress, life satisfaction, mental health and physical health are globally consistent with previous research. **Conclusions:** This study makes available to the broad Community of Portuguese Language Countries a validated measure of resilience extensively used for research and intervention. The results encourage future studies using this translated version of CD-RISC to explore further the three factors structure found here and to test the convergent validity with new samples.

Article Summary

- Uses a Large sample of Portuguese participants studied with rigorous data collection protocols provide the right context to test the CD-RISC psychometric properties in the context of the Portuguese population.
- Applies sound validated data analysis methodologies (following Green and colleagues) for testing the structural validity.
- Makes available a tested (and validated by the original CD-RISC authors) translated version to the Portuguese speaking community.
- Has two different samples, requiring the adaptation of commonly used psychometric analysis.
- The two different samples also resulted in differences in test power for the convergent validity analysis.

Funding statement

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Competing interests

There are no competing interests.

Introduction

Resilience can be described as a dynamic process of adaptively overcoming stress and adversity while maintaining normal psychological and physical functioning, and not merely the absence of psychopathology. [1] As an individual characteristic, resilience is likely influenced by external variables, such as adequate social support, that reduce risk for stress-related mental disorders by buffering the impact of stress.[2]

In a quantitative methodological review for searching, screening and appraising resilience scales quality, the Connor-Davidson Resilience Scale (CD-RISC), the Resilience Scale for Adults and the Brief Resilience Scale received the best psychometric ratings.[3]

Based on the perspective that resilience is a personal quality that reflects the ability to cope with stress, Connor and Davidson[4] developed a brief self-report scale to quantify resilience. The original version of CD-RISC has 25 self-rated items, each of them rated a 5-point scale from 0 ('not true at all') to 4 ('true nearly all the time'). Despite the absence of a proposed cut-off value, higher scores represent higher resilience. The CD-RISC was developed with participants from different settings, including the general population, primary care outpatients, psychiatric inpatients, and clinical trial patients.[4]The CD-RISC is a generic measure which can be applied to different populations since it was not developed for a specific group.[5]The original study demonstrated solid psychometric properties, with good internal consistency and test-retest reliability, with validity being demonstrated with other measures of stress and hardiness.[4] It suggested that resilience is modifiable and can improve with treatment. Further research on violent trauma showed that survivors who exhibit better health or less distress from the trauma are more resilient.[6]

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3 The CD-RISC has been translated into over fifty languages and has been tested in
4 several different contexts and specific populations: on general population[7-9]; post-
5 9/11 U.S. military veteran[10]; United States Air Force[11]; adolescents[12]; university
6 students[13,14]; young adults[15]; older adults[16]; earthquake survivors[5];
7 adolescents' earthquake survivors[17]; homeless youth[18]; caregivers with chronic
8 stress[19]; people with spinal cord injuries[20]; rehabilitation patients after
9 unintentional injury[21]; sport performers[22], among many others.

10 Preliminary studies of the scale revealed that the CD-RISC has a multifactorial
11 structure. Connor and Davidson[4] performed exploratory factor analysis, using the
12 adults sample from general population. The factor analyses yielded 5 factors, named as
13 *personal competence, high standards, and tenacity; trust in one's instinct, tolerance of*
14 *negative affect and strengthening effects of stress; positive acceptance of change and*
15 *secure relationships with others; control; spiritual influences.* Nevertheless, the CD-
16 RISC factor structure still needs to be clarified since subsequent studies found different
17 factor structures.

18 Prince-Embury[23] suggests that the instability of factor structure might have been
19 related to insufficient numbers of items covering various aspects of the original
20 construct and that factor structure differences would be expected in studies of groups
21 that varied culturally and demographically.

22 Therefore, the objective of this study was to evaluate the psychometric properties of the
23 CD-RISC Portuguese version with the aim of determining whether it can be used as a
24 reliable and valid tool to assess Portuguese population resilience.

Method

The study of CD-RISC psychometric properties and convergent validity was conducted with data sets coming from two studies.

The first data set comes from a research project on Resilience Effect in Coping with Trauma (RECT) in Portugal, conducted at the Faculty of Psychology of the University of Lisbon. This research project was reviewed by the Ethical Committee of the University of Lisbon – Faculty of Psychology and granted authorization to perform these studies. The second data set comes from a project on Health Impact Assessment of Employment Strategies (HIAES) in Portugal, which was approved by two institutional ethical committees, the Ethics Committee for Health of the National Institute of Health Doutor Ricardo Jorge, Public Institute and the Ethics Committee for Health of the Lisbon / North Hospital Center of Faculty of Medicine of the University of Lisbon. It was also approved by the National Commission of Data Protection. This research was conducted under the Helsinki declaration code of ethics.

Sample

The RECT project has a convenience sample of 476 participants (44% female participants) comprised by master students, technical course of medical emergency students, and general population. Participants from the HIAES project consist of 405 workers (51% female participants) at a private mutualistic financial institution - Associação Mutualista Caixa Económica Montepio Geral (CEMG) – and is also a convenience non-probabilistic sample. Descriptive data from the two samples for general sociodemographic variables show noteworthy differences in age and education. Regarding the age of the participants, the mean for the RECT sample was 26

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3 (SD=6.24), while the HIAES project's mean was 41 (SD=8.3). Concerning the
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5 education variable, the RECT project's sample was composed mostly of participants
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7 with a high school degree (58%), followed by middle school (27%) and graduate or
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9 higher (15%) degrees. The HIAES project's sample, however, had a higher percentage
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11 of participants with a graduate or higher degree (69%), followed by high school (30%)
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13 and middle school (1%) degrees.
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22 **Instruments**

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24 Besides the CD-RISC Scale, we also collected data for a set of other measures relevant
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26 to each project objective. In this section we only describe the CD-RISC and the
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28 measures relevant to test for convergent validity. It is important to note that different
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30 data were collected in each of the samples and, also, for different groups within each
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32 sample.
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37 **Connor-Davidson Resilience Scale (CD-RISC)**

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39 The CD-RISC[4] is a scale developed to quantify psychological resilience and the
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41 clinical effects of the treatment of anxiety and depression. It is composed by 25 items
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43 measured in a 5 points scale (0 - not true to 4 - almost always true) and the original
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45 study describes five factors: the notion of personal competence, high standards, and
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47 tenacity; trust in one's instincts, tolerance of negative affect, and strengthening effects
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49 of stress; positive acceptance of change, and secure relationships; control; and finally,
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51 spiritual influences. Despite the Connor & Davidson's original study corroborating
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53 these five factors, latter studies have reported support for only one factor.[5]
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Additional measures

A set of additional 8 measures were collected in these two studies. More specifically, in the RECT project the following measures were collected.

- Social Provisions Scale (SPS), an instrument that measures perceived social support.[24] Here we used the Portuguese version developed by Moreira and Canaipa.[25]
- Satisfaction With Life Scale (SWLS), an instrument that measures life satisfaction based on the subjective judgement done by each person, accordingly to his own pattern of life satisfaction.[26] We used the Portuguese adaptation of the scale conducted by Simões.[27]
- Perceived Stress Scale (PSS-10), a reduced version of PSS,[28, 29] an instrument used to measure the perception of stress. We used the Portuguese adaptation of the PSS-10 described by Rocha.[30]
- Stress Vulnerability Questionnaire (23QVS), a measure of the individual's vulnerability to stress.[31]

In the HIAES project 4 additional measures were collected:

- Health and life styles (H&LS) information regarding perceived health (measured using a single item - "How would you classify your general health state during the last three months?" - and a three points Likert), the practice of physical exercise (measured using both a practice frequency and a practice quality scales) and medication consumption (measured using a dichotomous scale – yes versus no - for a set of fourteen clinical conditions).

- Biomedical indexes (BI) measured by means of blood samples, anthropometric parameters and blood pressure.
- Mental Health Inventory (MHI-5), the reduced version of the MHI Ribeiro 2001[32] that measures psychological stress and well-being using 5 items and a frequency scale of 1, always, to 6, never. Here, we used a Portuguese adaptation of the MIH-5 described by Ribeiro.[33]
- Subjective Happiness Scale (SHS), a measure of subjective happiness originally developed by Lyubomirsky and Lepper,[34] composed by four items responded on a Likert 7 points scale. Again, we used a Portuguese version described by Pais-Ribeiro.[35]

Procedure

Translation and adaptation to the Portuguese Language

The CD-RISC items were translated through a process of translation and back-translation from the original American scale[4] by specialists in psychology and fluent in both Portuguese and English, and finally approved by the original CD-RISC authors.

Survey procedure

For the RECT data a survey was conducted between April 2009 and May 2010. The questionnaires were administered in paper and pencil format. This was done either face to face or administered in a classroom context. The CD-RISC scale was completed by 421 participants while 55 participants completed the additional convergent validity measures.

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3 For the HIAES data a survey was conducted between November 2012 and June 2013.
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5 The survey had two parts: The first part of the survey with sociodemographic
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7 information and H&LS, MHI-5 and SHS scales was completed electronically while, on
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9 a second part, the participants completed the Connor-Davidson Resilience Scale (CD-
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11 RISC) in paper and pencil format. Additionally, for a subsample of 260, anthropometric
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13 measures and blood samples were collected.
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17 All the participants, from both research projects, were informed of the investigation and
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19 gave their signed informed consent. The participants were not involved in the design
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21 and planning of the study.
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28 **Structural validity**

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30 The main objective of this paper was to study the structural validity of the Portuguese
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32 version of the CD-RISC. We followed Green and colleagues'[10] procedure where an
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34 Exploratory Factorial Analysis (EFA) was used to test the factorial structure of the
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36 original 25-item 5-factor solution version of the CD-RISC and afterwards a
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38 Confirmatory Factor Analysis (CFA) was used to compare a proposed solution based on
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40 the EFA results with Connor and Davidson's original one. We note that this
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42 methodology used by Green and colleagues is particularly suited for our type of data.
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44 More specifically, this methodology allows to understand the specific behavior of the
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46 items in each of the two samples and only then to test of the factorial structure of the
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48 scale with the complete sample.
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54 Two independent EFAs were conducted in each one of the two data sets. In this
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56 analysis, the following criteria were taken into account. First, to determine the number
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58 of factors we considered the criteria an eigenvalue higher than 0.7. Second, for the
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3 interpretation of the items in each factor there were considered the oblimin rotated
4 solutions once it is expected that the factors correlate among themselves. Additionally,
5 for an item to be held for a particular factor communalities should be higher than 0.09,
6 and loadings equal or higher to 0.32 and also cross-loadings lower to 0.32.[36] Finally,
7 the resulting items in a factor were tested for internal consistency using Cronbach alpha.

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10 Following the EFA, two CFAs were conducted using the complete sample to test and
11 compare both the proposed solution as specified by EFA and the original 25-item 5-
12 factor solution. The statistical quality of the models was assessed using two sets of
13 measures. First, measures of the overall goodness of fit measures considering the
14 following criteria: SRMR and RMSEA lower or equal to 0.08, Comparative Fit Index
15 (CFI) and Tucker-Lewis Index (TLI) higher or equal to 0.90. Additionally, measures of
16 the localized areas of strain with the following criteria: standardized residuals lower or
17 equal to 2.58 and general modification indexes analysis lower or equal to 4.

18 Both analysis used pairwise deletion for missing data. Results were compared with a
19 mean replacement method and no differences were found.
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Convergent validity

45 Another aim of the present paper is to provide data for the convergent validity of the
46 CD-RISC. The convergent validity is a form of validation that tests for the association
47 between a construct measured by a scale and other measures that theoretically relate to
48 this construct.[37, 38] For the convergent validity of the CD-RISC, variables used in the
49 survey of the HIAES and RECT project were selected and bivariate correlations were
50 computed. First, due to the sample dimension and the characteristics of the variables
51 studied, only correlations with a p-value equal or lower than 0.01 are considered
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3 statistically significant.[39] Second, for the interpretation we considered correlation
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5 values inferior to 0.20 as weak correlations, between 0.20 and 0.60 as moderate
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7 correlations, and higher than 0.60 strong correlations.
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10 11 12 13 **Results**

14 15 16 **Structural validity**

17 18 19 **Exploratory Factorial Analysis**

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22 A first set of EFAs were conducted on each data sample forcing the 25-items to the
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24 original 5-factor solution and, following Karairmak[5] and Burns and Anstey,[15] to 3-
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26 factor and 1-factor solutions. The results on both data set indicated that none of the
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28 solutions replicated corresponding results. In fact, the factor structure for the 5 and 3-
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30 factor solutions did not hold, and for the three solutions tested several items revealed
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32 low communalities, low loadings and cross loadings in both samples. In line with this,
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34 items 5, 11, 12, 14, 17, 20 and 23 were excluded because of systematic problems in the
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36 different solutions. A second set of EFAs were conducted with the 18-items for each
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38 data sample. Once the original 5-factor and 3-factor solutions could no longer be
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40 interpreted, we used the scree-plot to choose the best solution. The results on both data
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42 sets showed that the best solution had 3 factors but items 22 and 25 still revealed
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44 problematic. A final set of EFAs was conducted with the 16-items. Results showed that
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46 the best solution in both samples had 3 factors with, respectively, 37% and 31% of
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48 explained variance (
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6 and Table). Factor 1 was the most representative factor, composed of 11 items and
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8 explained, respectively, 20% and 16% of variance, and an alpha of 0.82 and 0.76. This
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10 factor, that we labeled **Self-Efficacy**, describes individuals' beliefs about not only their
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12 personal competence while dealing with challenging demands, but also their ability to
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14 exercise control over their own functioning. Factor 2 was composed of 3 items and
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16 explained, respectively, 9% and 8% of variance, and an alpha of 0.71 and 0.67. This
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18 factor was named **Spirituality** and evaluates specific aspects of spirituality, namely the
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20 belief that life has a purpose and that spiritual forces can influence earthly events.
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22 Finally, Factor 3 was composed of 2 items and explained, respectively, 8% and 7% of
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24 variance, and an alpha of 0.53 and 0.44. This factor refers to the perceived **Social**
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26 **Support**, and evaluates how people perceive their reliance on others for emotional and
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28 functional support. We note that the alphas for Self-Efficacy and Spirituality are above
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30 0.7. Also, for the Social Support, once there were only two items, we used bivariate
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32 correlations. Here the results show a moderate association between the two items.
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39 A descriptive analysis of the three subscales show that the average results for Self-
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41 Efficacy are above the mid-point of the scale and have small standard deviations (SD)
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43 on both RECT and HIAES samples, respectively, 2.92 (SD=0.54) and 3.03 (SD=0.40).
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45 The same applies to the average results and standard deviations of the Spirituality
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47 subscale, respectively 2.64 (SD=0.91) and 2.47 (SD=0.84), and of the Social Support
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49 subscale, respectively 3.14 (SD=0.83) and 3.24 (SD=0.67).
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Confirmatory Factorial Analysis

CFA was conducted to test the model specified by EFA and to compare this model with the one suggested by Connor and Davidson's original five-factor solution. Considering the meaning of both the proposed three factors solution and the original five-factors solution, in both cases the CFAs were computed allowing for factors to correlate among themselves.

A preliminary analysis of the frequency distributions and statistics for skewness and kurtosis of CD-RISC show severe negative asymmetry of the data in most of the 25 items. To reduce the impact of the data distributions on the model computations, we log transformed all the data (note that the data was previously transformed to eliminate zero values by adding a constant, and afterwards all the results were inverted). The asymmetry of the resulting log transformed frequency distributions for the 25 items were significantly reduced and consequently used in the CFA.

The results for the proposed 16-item 3-factors solution reveal a good overall fit, $\chi^2(101) = 368.64$, $p < .001$; SRMR = .05, RMSEA = .06 [.05, .06], CFI = .90, TLI = .89. The analysis also shows that few standardized residuals are higher than 2.58 and, similarly, few modification indexes are above 4. Finally, all items were highly correlated with their factors, with all correlations between .40 and .77 and all $ps < .001$.

The results for the original 25-item 5-factor solution reveal a moderate overall fit, with both CFI and TLI measures slightly below the criteria, $\chi^2(263) = 1219.08$, $p < .001$; SRMR = .06, RMSEA = .07 [.06, .07], CFI = .82, TLI = .79. Additionally, the analysis also shows several standardized residuals above the criteria and, similarly, several modification indexes are above 4. All items were significantly correlated with their

factors (all $ps < .001$), but correlations ranged between a weak .20 and strong .70.

Overall, the proposed 16-item 3-factors solution had better performance in the CFA.

Convergent validity

Six of the 8 measures used to test the convergent validity (i.e., SPS, SWLS, PSS-10, 23QVS, MHI5 and SHS) were tested for the structural validity on their unidimensional versions (Table 3). Results all levels of explained variance are above 40% all Cronbach alphas' above 80. The sole exception to these results is the 23QVS with a somewhat lower explained variance of 23% and alpha of 0.76. Additionally, for the H&LS we consider a single item on physical health (Phea) and two indexes, one on physical activity (Pact) using the average of the frequency of psychical activity and of commitment to the physical activity, and an index on medication consumption (Mcons), consisting in the sum of the answers for medication consumption regarding 14 clinical conditions. Finally, for the BI we computed an index to identify the presence of metabolic syndrome (Met) using the recommendations of the European Society of Cardiology (ESC, <http://www.escardio.org>) and an index for cardiovascular risk (Card) based on the norms of the Portuguese Society of Cardiology (SPC, www.spc.pt).

Table 3

Table 4

Bivariate correlations were computed between each one of the three subscales, computed based on the 16-items in the CD-RISC, and each of the 8 measures described above and used to test the convergent validity (Table. 4. Bivariate correlation

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3 coefficients between the CD-RISC scale and the measures used to test the convergent
4 validity.
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8). The self-efficacy factor showed a significant negative association with the two
9 measures of stress considered - perceived stress ($r=-0.32$) and vulnerability to stress ($r=-$
10 0.34). There were positive correlations between the self-efficacy factor and two
11 additional variables, namely, subjective happiness ($r=0.31$) and mental health ($r=0.35$).
12 Although moderately, the self-efficacy factor as a significant and negative correlation
13 with physical health ($r=-0.17$) and medication consumption ($r=-0.13$)¹.
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17 The spirituality factor showed only a marginal significant correlation with the
18 vulnerability to stress measure ($r=0.25$).
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22 The social support factor showed a moderate significant correlation ($r=0.48$) with the
23 Social Provision Scale.[24] The social support factor is also correlated with the SHS
24 ($r=0.30$) and MHI5 ($r=0.26$) scales. There were a marginal significant negative
25 correlation between social support and vulnerability to stress ($r=-0.24$). The social
26 support factor correlates significantly with metabolic syndrome ($r=-0.13$) and
27 cardiovascular risk ($r=-0.10$), although the magnitude of both correlations is weak.
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31 The data that support the findings of this study are openly available in figshare at
32 <https://doi.org/10.6084/m9.figshare.7111676.v1>.
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42 43 44 45 46 47 48 49 **Discussion**

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51 The objective of this paper is to evaluate the structural validity and convergent validity
52 of the first Portuguese version of the CD-RISC. Despite the importance of this
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¹ “Note that physical health is measured using a single item where the higher the value the lower the physical health reported”.

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3 construct, to date, there is no validated scale to measure resilience in the Community of
4 Portuguese Language Countries (CPLP, n.d.), estimated to be more than two hundred
5 and seventy million people. Resilience is a fundamental element of mental health, health
6 assets, capabilities and positive adaptation. It enables people both to cope with adversity
7 and to reach their full potential, and influences a wide range of outcomes at individual
8 and community level, including healthier lifestyles, better physical health, improved
9 recovery from illness, fewer limitations in daily living, higher educational attainment,
10 greater productivity, employment and earnings, better relationships with adults and with
11 children, more social cohesion and engagement and improved quality of life.[40]It is
12 not a surprise that resilience has been extensively measured and used to understand
13 individual and social phenomena.

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15 The results do not replicate the original five factors structure, instead, the results suggest
16 a three factors structure with self-efficacy, spirituality, and social support dimensions
17 represented. Although this result is not consistent with the original proposal from
18 Connor and Davidson, it is consistent with more recent studies.[5, 41] Consistent with
19 this, the variability of factor structures found in CD-RISC has been document and owed
20 to methodological variations, idiosyncratic samples and, importantly, to cross-cultural
21 factors.[42]We also note that similarly to the original study and to some of the
22 following research, self-efficacy is the factor that explains the greatest variance of the
23 original items. Still, although the results are important to understand the construct of
24 resilience and how CD-RISC works as an instrument measuring this construct in a
25 Portuguese sample, we note that the resulting scale should not be regarded as an
26 improved version. In fact, we consider that improved usage of this scale would come
27 from prior testing of the factorial structure of the original 25 items and comparison with
28 the results of this paper and alike.

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3 The results from the validation are, with one sole and justifiable exception, consistent
4 with evidence from the literature. The negative association we found between the self-
5 efficacy factor and the measures of stress is consistent with the idea that people with
6 high efficacy beliefs are able overcome obstacles and focus on opportunities, and are
7 more able to perceive stressful situations as challenging rather than as problematic
8 events.[43] The positive correlations between self-efficacy and happiness and
9 satisfaction with life are consistent with the findings in the literature where self-efficacy
10 beliefs may regulate positive and negative emotions. In this sense, people with higher
11 self-efficacy beliefs are less distressed and feel more capable of dealing with the
12 problematic situations.[44] Recent studies have found that self-efficacy is indeed
13 positively correlated with happiness[45] and satisfaction with life.[43] Although
14 moderately, the negative correlation between the self-efficacy factor and the measures
15 of physical health and medication consumption constitute an extension of the findings
16 where self-efficacy is associated with increased health and life satisfaction.

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19 The positive correlation we found between the spiritual factor and the vulnerability to
20 stress is consistent with Connor and colleagues[6] study with survivors of violent trauma,
21 where spirituality is proposed as a coping strategy do deal with higher Posttraumatic
22 Stress Disorder scores. Still, the fact that spirituality does not relate with any other
23 variables is not consistent with the literature, where previous studies have successfully
24 established correlations between spirituality and happiness[46] and spirituality and life
25 satisfaction.[47] The absence of effects can be a result of the low statistical power due
26 to the small sample size in the RECT sample. In fact, a post hoc power analysis showed
27 that the power to detect a significant correlation of 0.20 at 0.05 in our sample is only
28 0.28.

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3 Interestingly, the positive correlation we found between the social support and the
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5 Social Provision Scale [24] is the only significant correlation of the Social Provision
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7 Scale, which supports the assumptions that this factor is a specific dimension of
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9 resilience. The positive correlations we found between the social support factor and the
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11 SHS and MH15 scales are consistent with the findings in the literature showing the
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13 strong impact of social support on happiness especially from closer social circles.[48]
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15 For instance, in a study with survivors from a natural disaster, the authors found that
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17 pre-disaster happiness and post-disaster social support were protective against the
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19 negative effect of the hurricane on survivors' post-disaster happiness.[49] The negative
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21 correlation we found between social support and vulnerability to stress is consistent
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23 with the findings in the literature, in which is becoming increasingly consensual that the
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25 lack of social support is an important risk factor in dealing with stressful and adverse
26
27 life events.[50] We found negative correlations between social support and metabolic
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29 syndrome and cardiovascular risk Although some of the literature describes a
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31 conflicting relation between social support and physical health,[51] it appears that social
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33 support is negatively associated with cardiovascular death and that it protects against
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35 recurrent events, the existing research involving the predictive relation between social
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37 support/social networks and incidence of disease, specifically cardiovascular disease.
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39 In summary, regarding the self-efficacy factor, we found associations with perceived
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41 stress, vulnerability to stress, subjective happiness and mental health. Additionally, we
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43 also found associations with perceived physical health and medication consumption,
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45 what we consider to be an extension of the findings relating self-efficacy with health
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47 and life satisfaction. Regarding the spirituality factor, we found only an association with
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49 vulnerability to stress. This result is not consistent with the literature where spirituality
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51 has been related with stress, happiness and life satisfaction. As mentioned, the absence
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3 of effects here are likely due to low test power. Finally, regarding the social support
4 scale, we found association with the Social Provision Scale, subjective happiness,
5 mental health and vulnerability to stress. Additionally, we also found an association
6 with the two biomedical indexes used, specifically, cardiovascular risk and metabolic
7 syndrome. Resilience, through its self-efficacy component, showed a protective effect
8 on the extent of the myocardial infarction, by affecting the inflammatory
9 response.[52] Emotional vitality, as part of healthy psychological functioning, may
10 protect against risk of coronary heart disease (CHD).[53] Resilience could have life-
11 saving effects. Prevention and intervention in CHD must involve not only measures to
12 reduce psychological distress but should also focus on promoting positive emotions.
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30 **Applications for the Portuguese version of the CD-RISC**

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32 Our study extends the literature that has provided support on the importance of the
33 construct of resilience, and, more particularly, on the use of CD-RISC as a reliable
34 measure of this construct. In fact, using a robust psychometric method we replicated
35 more recent studies describing three main dimensions of resilience. Additionally, using
36 a vast array of validated measures we also showed how these factors are associated with
37 scales, indexes and even behavioral measures in a way that is consistent with the
38 literature. Importantly, these associations support the distinctiveness of the three factors,
39 with different factors relating, as expected, with some different convergent measures.
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41 Take for instance the strong correlation between the social support factor and the Social
42 Provision Scale, and the stronger correlations between the self-efficacy factor and both
43 stress and vulnerability to stress. A curious finding here is the specific association of
44 self-efficacy with physical health and medication consumption and the association of
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3 social support with two biomedical indexes, cardiovascular risk and metabolic
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5 syndrome.
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8 Future directions and research limitations 9

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11 Our study extends the possibility to measure and investigate resilience in Portuguese
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13 communities using a rigorously validated scale. Future studies with this community can
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15 explore further the three factors structure of the CD-RISC and test for the convergent
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17 validity with new samples. A limitation of the current paper is the difference in test
18
19 power between the two samples used to do the convergent validity. This is particularly
20
21 important because the low test power sample (from RECT project) included important
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23 and unique validation measures and because the spirituality scale did not replicate
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25 entirely the findings in the literature. Finally, and considering both research and
26
27 practice, future studies with the Portuguese communities can follow the factorial
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29 structure found and validated. These studies can, again, provide additional support to
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31 the theoretical and practical relevance of resilience and its dimensions as measured by
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33 the CD-RISC.
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42 Abbreviations: 43

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45 23QVS: Stress Vulnerability Questionnaire
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48 BI: Biomedical indexes
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51 Card: cardiovascular risk
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54 CD-RISC: Connor- Davidson Resilience Scale
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57 CFA: Confirmatory Factor Analysis
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60 CHD: Coronary heart disease

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3 EFA: Exploratory Factorial Analysis
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6 H&LS: Health and life styles
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9 HIAES: Health Impact Assessment of Employment Strategies
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12 Mcons: Medication consumption
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15 Met: metabolic syndrome
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18 MHI-5: Mental Health Inventory
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21 RECT: Resilience Effect in Coping with Trauma
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24 Pact: Physical activity
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27 Phea: Physical health
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30 PSS-10: Reduced version of Perceived Stress Scale
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33 SHS: Subjective Happiness Scale (SHS),
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36 SPS: Social Provisions Scale
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Table 1. Factorial weights of the 16 items on each of the three factors and respective explained variance for the RECT sample.

Items / Explained variance	Communalities	Self-Efficacy	Spirituality	Social Support
19	0.44	0.65	0.05	0.11
24	0.28	0.47	0.20	0.10
15	0.33	0.57	-0.01	0.08
18	0.28	0.52	-0.07	0.06
7	0.35	0.53	-0.01	0.28
8	0.33	0.56	0.08	0.11
1	0.30	0.52	0.04	0.14
16	0.30	0.53	0.01	0.14
4	0.40	0.61	0.14	0.00
6	0.24	0.39	0.16	0.25
10	0.18	0.35	0.20	0.11
9	0.50	0.10	0.69	0.08
21	0.45	0.14	0.60	0.28
3	0.48	-0.06	0.69	0.02

2	0.38	0.18	0.13	0.58
13	0.72	0.17	0.16	0.82
Variance explained	-	20%	9%	8%
Alpha	-	0.82	0.71	0.53*
M (SD)	-	2.92 (0.54)	2.64 (0.91)	3.14 (0.83)
N	-	421	421	421

* correlation for the two items, $p < 0.05$

Table 2. Factorial weights of the 16 items on each of the three factors and respective explained variance for the HIAES sample.

Items / Explained variance	Communalities	Self-Efficacy	Spirituality	Social Support
19	0.36	0.58	-0.07	0.13
24	0.33	0.57	0.02	0.09
15	0.32	0.56	-0.04	0.07
18	0.28	0.52	-0.07	0.07
7	0.26	0.51	0.08	0.02
8	0.24	0.48	0.04	0.08
1	0.26	0.43	0.06	0.27
16	0.19	0.43	0.08	0.04
4	0.16	0.38	0.04	0.13
6	0.12	0.33	0.12	0.05
10	0.18	0.33	0.19	0.19
9	0.52	0.08	0.72	0.00
21	0.37	0.09	0.60	0.07

3	0.36	-0.06	0.59	0.13
2	0.59	0.09	0.06	0.76
13	0.35	0.21	0.14	0.54
Variance explained	-	16%	8%	7%
Alpha	-	0.76	0.67	0.44*
M (SD)	-	3.03 (0.40)	2.47 (0.84)	3.24 (0.67)
N	-	405	405	405

* correlation for the two items, $p < 0.05$

Table 3. Descriptives (mean, standard-deviation and sample size) of the measures used to test the convergent validity.

	M	SD	n
SPS	8.75	9.36	53
SWLS	24.72	5.26	54
PSS-10	14.51	5.49	55
23QVS	28.67	9.44	55
H&LS			
Phea	1.38	.52	405
Pact	3.14	1.45	405
Mcons	2.58	1.67	405
BI			
Met	.12	.32	260

Card	3.31	2.03	405
MHI-5	68.91	18.97	405
SHS	5.24	1.08	405

Table 4. Bivariate correlation coefficients between the CD-RISC scale and the measures used to test the convergent validity.

	1	2	3
1. Self-Efficacy	-	.13**	.33**
2. Spirituality	.13**	-	.21**
3. Social Support	.33**	.21**	-
H&LS - Phea	-.16**	-.01	-.09
H&LS - Pact	.08	.00	.08
H&LS - Mcons	-.13**	.08	-.04
BI - Met	-.04	.02	-.13*
BI - Card	.07	.01	-.10*
MHI-5	.35**	.02	.26**
SHS	.31**	.09	.30**
SPS	.16	-.13	.48**
SWLS	.28*	.10	.11

PSS-10	-.32*	.14	.10
23QVS	-.34*	.25 ⁺	-.24 ⁺

⁺ p<0.06; * p<0.05; **p<0.01

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5 Author's contribution

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7 Faria-Anjos, Joana

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10 Responsible for the CD-RISC scale translation process; substantial contribution to the
11
12 conception and design of the work, acquisition, analysis and interpretation of data;
13
14 drafting the work; agreement to be accountable for all aspects of the work related with
15
16 integrity of the data analysis and results reporting; and final approval of the version to
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18 be published.

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21 Accountable for the following sections: Introduction, Method, Results and Discussion.
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28 Heitor, Maria João

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30 Substantial contribution to the conception and design of the work, acquisition, analysis
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32 and interpretation of data; drafting the work; agreement to be accountable for all aspects
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34 of the work related with integrity of the data analysis and results reporting; and final
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11 the work and revising it critically; agreement to be accountable for all aspects of the
12 work related with integrity of the data analysis and results reporting; and final approval
13 of the version to be published.
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19 Accountable for the following sections: Method, Results and Discussion.
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Connor-Davidson Resilience Scale: Validation study in a Portuguese sample

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50 factorial analysis; convergent validity.
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Abstract

Objective: The objective of this paper is to evaluate the structural validity and convergent validity of the first Portuguese version of Connor- Davidson Resilience Scale (CD-RISC, 2003). **Settings:** The datasets come from two studies conducted in Portugal, respectively, from the Resilience Effect in Coping with Trauma (RECT) project and from the Health Impact Assessment of Employment Strategies (HIAES) project. **Participants:** The sample is composed by 476 participants from RECT project and 405 participants from the HIAES project. In both projects convenience samples were used. **Measures:** The original CD-RISC items were translated to Portuguese and used in a survey along with additional psychosocial and biomedical measures. **Results:** Independent Exploratory Factorial Analysis (EFA) with each of the two samples revealed that the best solution in both samples had 3 factors consistent with the Self-Efficacy, Spirituality and Social Support factors from the original scale. A Confirmatory Factor Analysis (CFA) using the two samples together and specifying the 3 factors from the EFA revealed a good overall fit and, comparatively, better fit than a model specified with the 5 factors from the original scale. The study of the convergent validity revealed that bivariate correlations between the 3 factors and validated measures of stress, life satisfaction, mental health and physical health are globally consistent with previous research. **Conclusions:** This study makes available to the broad Community of Portuguese Language Countries a validated measure of resilience extensively used for research and intervention. The results encourage future studies using this translated version of CD-RISC to explore further the three factors structure found here and to test the convergent validity with new samples.

Article Summary

- Uses a Large sample of Portuguese participants studied with rigorous data collection protocols provide the right context to test the CD-RISC psychometric properties in the context of the Portuguese population.
- Applies sound validated data analysis methodologies (following Green and colleagues) for testing the structural validity.
- Makes available a tested (and validated by the original CD-RISC authors) translated version to the Portuguese speaking community.
- Has two different samples, requiring the adaptation of commonly used psychometric analysis.
- The two different samples also resulted in differences in test power for the convergent validity analysis.

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Competing interests

None declared.

Introduction

Resilience can be described as a dynamic process of adaptively overcoming stress and adversity while maintaining normal psychological and physical functioning, and not merely the absence of psychopathology. [1] As an individual characteristic, resilience is likely influenced by external variables, such as adequate social support, that reduce risk for stress-related mental disorders by buffering the impact of stress.[2]

In a quantitative methodological review for searching, screening and appraising resilience scales quality, the Connor-Davidson Resilience Scale (CD-RISC), the Resilience Scale for Adults and the Brief Resilience Scale received the best psychometric ratings.[3]

Based on the perspective that resilience is a personal quality that reflects the ability to cope with stress, Connor and Davidson[4] developed a brief self-report scale to quantify resilience. The original version of CD-RISC has 25 self-rated items, each of them rated a 5-point scale from 0 ('not true at all') to 4 ('true nearly all the time'). Despite the absence of a proposed cut-off value, higher scores represent higher resilience. The CD-RISC was developed with participants from different settings, including the general population, primary care outpatients, psychiatric inpatients, and clinical trial patients.[4]The CD-RISC is a generic measure which can be applied to different populations since it was not developed for a specific group.[5]The original study demonstrated solid psychometric properties, with good internal consistency and test-retest reliability, with validity being demonstrated with other measures of stress and hardiness.[4] It suggested that resilience is modifiable and can improve with treatment. Further research on violent trauma showed that survivors who exhibit better health or less distress from the trauma are more resilient.[6]

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3 The CD-RISC has been translated into over fifty languages and has been tested in
4 several different contexts and specific populations: on general population[7-9]; post-
5 9/11 U.S. military veteran[10]; United States Air Force[11]; adolescents[12]; university
6 students[13,14]; young adults[15]; older adults[16]; earthquake survivors[5];
7 adolescents' earthquake survivors[17]; homeless youth[18]; caregivers with chronic
8 stress[19]; people with spinal cord injuries[20]; rehabilitation patients after
9 unintentional injury[21]; sport performers[22], among many others.

10 Preliminary studies of the scale revealed that the CD-RISC has a multifactorial
11 structure. Connor and Davidson[4] performed exploratory factor analysis, using the
12 adults sample from general population. The factor analyses yielded 5 factors, named as
13 *personal competence, high standards, and tenacity; trust in one's instinct, tolerance of*
14 *negative affect and strengthening effects of stress; positive acceptance of change and*
15 *secure relationships with others; control; spiritual influences.* Nevertheless, the CD-
16 RISC factor structure still needs to be clarified since subsequent studies found different
17 factor structures.

18 Prince-Embury[23] suggests that the instability of factor structure might have been
19 related to insufficient numbers of items covering various aspects of the original
20 construct and that factor structure differences would be expected in studies of groups
21 that varied culturally and demographically.

22 Therefore, the objective of this study was to evaluate the psychometric properties of the
23 CD-RISC Portuguese version with the aim of determining whether it can be used as a
24 reliable and valid tool to assess Portuguese population resilience.

Method

The study of CD-RISC psychometric properties and convergent validity was conducted with data sets coming from two studies.

The first data set comes from a research project on Resilience Effect in Coping with Trauma (RECT) in Portugal, conducted at the Faculty of Psychology of the University of Lisbon. This research project was reviewed by the Ethical Committee of the University of Lisbon – Faculty of Psychology and granted authorization to perform these studies. The second data set comes from a project on Health Impact Assessment of Employment Strategies (HIAES) in Portugal, which was approved by two institutional ethical committees, the Ethics Committee for Health of the National Institute of Health Doutor Ricardo Jorge, Public Institute and the Ethics Committee for Health of the Lisbon / North Hospital Center of Faculty of Medicine of the University of Lisbon. It was also approved by the National Commission of Data Protection. This research was conducted under the Helsinki declaration code of ethics. Ethics approval was obtained for the scientific use of the data in both studies. This involves the usage of the data and publication of the results in thesis and scientific journals.

Sample

The RECT project has a convenience sample of 476 participants (44% female participants) comprised by master students, technical course of medical emergency students, and general population. Participants from the HIAES project consist of 405 workers (51% female participants) at a private mutualistic financial institution - Associação Mutualista Caixa Económica Montepio Geral (CEMG) – and is also a convenience non-probabilistic sample. Descriptive data from the two samples for general sociodemographic variables show noteworthy differences in age and education.

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3 Regarding the age of the participants, the mean for the RECT sample was 26
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5 (SD=6.24), while the HIAES project's mean was 41 (SD=8.3). Concerning the
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7 education variable, the RECT project's sample was composed mostly of participants
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9 with a high school degree (58%), followed by middle school (27%) and graduate or
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11 higher (15%) degrees. The HIAES project's sample, however, had a higher percentage
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13 of participants with a graduate or higher degree (69%), followed by high school (30%)
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15 and middle school (1%) degrees.
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23 **Instruments**

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25 Besides the CD-RISC Scale, we also collected data for a set of other measures relevant
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27 to each project objective. In this section we only describe the CD-RISC and the
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29 measures relevant to test for convergent validity. It is important to note that different
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31 data were collected in each of the samples and, also, for different groups within each
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33 sample.
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39 **Connor-Davidson Resilience Scale (CD-RISC)**

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41 The CD-RISC[4] is a scale developed to quantify psychological resilience and the
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43 clinical effects of the treatment of anxiety and depression. It is composed by 25 items
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45 measured in a 5 points scale (0 - not true to 4 - almost always true) and the original
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47 study describes five factors: the notion of personal competence, high standards, and
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49 tenacity; trust in one's instincts, tolerance of negative affect, and strengthening effects
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51 of stress; positive acceptance of change, and secure relationships; control; and finally,
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53 spiritual influences. Despite the Connor & Davidson's original study corroborating
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55 these five factors, latter studies have reported support for only one factor.[5]
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Additional measures

A set of additional 8 measures were collected in these two studies. More specifically, in the RECT project the following measures were collected.

- Social Provisions Scale (SPS), an instrument that measures perceived social support.[24] Here we used the Portuguese version developed by Moreira and Canaipa.[25]
- Satisfaction With Life Scale (SWLS), an instrument that measures life satisfaction based on the subjective judgement done by each person, accordingly to his own pattern of life satisfaction.[26] We used the Portuguese adaptation of the scale conducted by Simões.[27]
- Perceived Stress Scale (PSS-10), a reduced version of PSS,[28, 29] an instrument used to measure the perception of stress. We used the Portuguese adaptation of the PSS-10 described by Rocha.[30]
- Stress Vulnerability Questionnaire (23QVS), a measure of the individual's vulnerability to stress.[31]

In the HIAES project 4 additional measures were collected:

- Health and life styles (H&LS) information regarding perceived health (measured using a single item - "How would you classify your general health state during the last three months?" - and a three points Likert), the practice of physical exercise (measured using both a practice frequency and a practice quality scales) and medication consumption (measured using a dichotomous scale – yes versus no - for a set of fourteen clinical conditions).

- Biomedical indexes (BI) measured by means of blood samples, anthropometric parameters and blood pressure.
- Mental Health Inventory (MHI-5), the reduced version of the MHI Ribeiro 2001[32] that measures psychological stress and well-being using 5 items and a frequency scale of 1, always, to 6, never. Here, we used a Portuguese adaptation of the MIH-5 described by Ribeiro.[33]
- Subjective Happiness Scale (SHS), a measure of subjective happiness originally developed by Lyubomirsky and Lepper,[34] composed by four items responded on a Likert 7 points scale. Again, we used a Portuguese version described by Pais-Ribeiro.[35]

Procedure

Translation and adaptation to the Portuguese Language

The CD-RISC items were translated through a process of translation and back-translation from the original American scale[4] by specialists in psychology and fluent in both Portuguese and English, and finally approved by the original CD-RISC authors.

Survey procedure

For the RECT data a survey was conducted between April 2009 and May 2010. The questionnaires were administered in paper and pencil format. This was done either face to face or administered in a classroom context. The CD-RISC scale was completed by 421 participants while 55 participants completed the additional convergent validity measures.

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3 For the HIAES data a survey was conducted between November 2012 and June 2013.
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5 The survey had two parts: The first part of the survey with sociodemographic
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7 information and H&LS, MHI-5 and SHS scales was completed electronically while, on
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9 a second part, the participants completed the Connor-Davidson Resilience Scale (CD-
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11 RISC) in paper and pencil format. Additionally, for a subsample of 260, anthropometric
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13 measures and blood samples were collected.
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17 All the participants, from both research projects, were informed of the investigation and
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19 gave their signed informed consent. The participants were not involved in the design
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21 and planning of the study.
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28 **Structural validity**

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30 The main objective of this paper was to study the structural validity of the Portuguese
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32 version of the CD-RISC. We followed Green and colleagues'[10] procedure where an
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34 Exploratory Factorial Analysis (EFA) was used to test the factorial structure of the
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36 original 25-item 5-factor solution version of the CD-RISC and afterwards a
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38 Confirmatory Factor Analysis (CFA) was used to compare a proposed solution based on
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40 the EFA results with Connor and Davidson's original one. We note that this
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42 methodology used by Green and colleagues is particularly suited for our type of data.
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44 More specifically, this methodology allows to understand the specific behavior of the
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46 items in each of the two samples and only then to test of the factorial structure of the
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48 scale with the complete sample.
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54 Two independent EFAs were conducted in each one of the two data sets. In this
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56 analysis, the following criteria were taken into account. First, to determine the number
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58 of factors we considered the criteria an eigenvalue higher than 0.7. Second, for the
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3 interpretation of the items in each factor there were considered the oblimin rotated
4 solutions once it is expected that the factors correlate among themselves. Additionally,
5 for an item to be held for a particular factor communalities should be higher than 0.09,
6 and loadings equal or higher to 0.32 and also cross-loadings lower to 0.32.[36] Finally,
7 the resulting items in a factor were tested for internal consistency using Cronbach alpha.

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10 Following the EFA, two CFAs were conducted using the complete sample to test and
11 compare both the proposed solution as specified by EFA and the original 25-item 5-
12 factor solution. The statistical quality of the models was assessed using two sets of
13 measures. First, measures of the overall goodness of fit measures considering the
14 following criteria: SRMR and RMSEA lower or equal to 0.08, Comparative Fit Index
15 (CFI) and Tucker-Lewis Index (TLI) higher or equal to 0.90. Additionally, measures of
16 the localized areas of strain with the following criteria: standardized residuals lower or
17 equal to 2.58 and general modification indexes analysis lower or equal to 4.

18 Both analysis used pairwise deletion for missing data. Results were compared with a
19 mean replacement method and no differences were found.
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Convergent validity

45 Another aim of the present paper is to provide data for the convergent validity of the
46 CD-RISC. The convergent validity is a form of validation that tests for the association
47 between a construct measured by a scale and other measures that theoretically relate to
48 this construct.[37, 38] For the convergent validity of the CD-RISC, variables used in the
49 survey of the HIAES and RECT project were selected and bivariate correlations were
50 computed. First, due to the sample dimension and the characteristics of the variables
51 studied, only correlations with a p-value equal or lower than 0.01 are considered
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3 statistically significant.[39] Second, for the interpretation we considered correlation
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5 values inferior to 0.20 as weak correlations, between 0.20 and 0.60 as moderate
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7 correlations, and higher than 0.60 strong correlations.
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10 **Patient and public involvement**

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13 Patients and public were not involved in the conception, design or interpretation of this
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15 study.
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20 **Results**

21 **Structural validity**

22 **Exploratory Factorial Analysis**

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31 A first set of EFAs were conducted on each data sample forcing the 25-items to the
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33 original 5-factor solution and, following Karairmak[5] and Burns and Anstey,[15] to 3-
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35 factor and 1-factor solutions. The results on both data set indicated that none of the
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37 solutions replicated corresponding results. In fact, the factor structure for the 5 and 3-
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39 factor solutions did not hold, and for the three solutions tested several items revealed
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41 low communalities, low loadings and cross loadings in both samples. In line with this,
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43 items 5, 11, 12, 14, 17, 20 and 23 were excluded because of systematic problems in the
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45 different solutions. A second set of EFAs were conducted with the 18-items for each
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47 data sample. Once the original 5-factor and 3-factor solutions could no longer be
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49 interpreted, we used the scree-plot to choose the best solution. The results on both data
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51 sets showed that the best solution had 3 factors but items 22 and 25 still revealed
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53 problematic. A final set of EFAs was conducted with the 16-items. Results showed that
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3 the best solution in both samples had 3 factors with, respectively, 37% and 31% of
4 explained variance (
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16 and Table). Factor 1 was the most representative factor, composed of 11 items and
17 explained, respectively, 20% and 16% of variance, and an alpha of 0.82 and 0.76. This
18 factor, that we labeled **Self-Efficacy**, describes individuals' beliefs about not only their
19 personal competence while dealing with challenging demands, but also their ability to
20 exercise control over their own functioning. Factor 2 was composed of 3 items and
21 explained, respectively, 9% and 8% of variance, and an alpha of 0.71 and 0.67. This
22 factor was named **Spirituality** and evaluates specific aspects of spirituality, namely the
23 belief that life has a purpose and that spiritual forces can influence earthly events.
24 Finally, Factor 3 was composed of 2 items and explained, respectively, 8% and 7% of
25 variance, and an alpha of 0.53 and 0.44. This factor refers to the perceived **Social**
26 **Support**, and evaluates how people perceive their reliance on others for emotional and
27 functional support. We note that the alphas for Self-Efficacy and Spirituality are above
28 0.7. Also, for the Social Support, once there were only two items, we used bivariate
29 correlations. Here the results show a moderate association between the two items.
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49 A descriptive analysis of the three subscales show that the average results for Self-
50 Efficacy are above the mid-point of the scale and have small standard deviations (SD)
51 on both RECT and HIAES samples, respectively, 2.92 (SD=0.54) and 3.03 (SD=0.40).
52 The same applies to the average results and standard deviations of the Spirituality
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3 subscale, respectively 2.64 (SD=0.91) and 2.47 (SD=0.84), and of the Social Support
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5 subscale, respectively 3.14 (SD=0.83) and 3.24 (SD=0.67).
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20 **Confirmatory Factorial Analysis**

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23 CFA was conducted to test the model specified by EFA and to compare this model with
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25 the one suggested by Connor and Davidson's original five-factor solution. Considering
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27 the meaning of both the proposed three factors solution and the original five-factors
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29 solution, in both cases the CFAs were computed allowing for factors to correlate among
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31 themselves.
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35 A preliminary analysis of the frequency distributions and statistics for skewness and
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37 kurtosis of CD-RISC show severe negative asymmetry of the data in most of the 25
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39 items. To reduce the impact of the data distributions on the model computations, we log
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41 transformed all the data (note that the data was previously transformed to eliminate zero
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43 values by adding a constant, and afterwards all the results were inverted). The
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45 asymmetry of the resulting log transformed frequency distributions for the 25 items
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47 were significantly reduced and consequently used in the CFA.
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51 The results for the proposed 16-item 3-factors solution reveal a good overall fit, χ^2
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53 (101) = 368.64, $p < .001$; SRMR = .05, RMSEA = .06 [.05, .06], CFI = .90, TLI = .89.

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55 The analysis also shows that few standardized residuals are higher than 2.58 and,
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3 similarly, few modification indexes are above 4. Finally, all items were highly
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5 correlated with their factors, with all correlations between .40 and .77 and all $ps < .001$.

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8 The results for the original 25-item 5-factor solution reveal a moderate overall fit, with
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10 both CFI and TLI measures slightly below the criteria, $\chi^2 (263) = 1219.08, p < .001$;
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12 SRMR = .06, RMSEA = .07 [.06, .07], CFI = .82, TLI = .79. Additionally, the analysis
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14 also shows several standardized residuals above the criteria and, similarly, several
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16 modification indexes are above 4. All items were significantly correlated with their
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18 factors (all $ps < .001$), but correlations ranged between a weak .20 and strong .70.
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20 Overall, the proposed 16-item 3-factors solution had better performance in the CFA.
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28 **Convergent validity**

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30 Six of the 8 measures used to test the convergent validity (i.e., SPS, SWLS, PSS-10,
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32 23QVS, MHI5 and SHS) were tested for the structural validity on their unidimensional
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34 versions (Table 3). Results all levels of explained variance are above 40% all Cronbach
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36 alphas' above 80. The sole exception to these results is the 23QVS with a somewhat
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38 lower explained variance of 23% and alpha of 0.76. Additionally, for the H&LS we
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40 consider a single item on physical health (Phea) and two indexes, one on physical
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42 activity (Pact) using the average of the frequency of psychical activity and of
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44 commitment to the physical activity, and an index on medication consumption (Mcons),
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46 consisting in the sum of the answers for medication consumption regarding 14 clinical
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48 conditions. Finally, for the BI we computed an index to identify the presence of
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50 metabolic syndrome (Met) using the recommendations of the European Society of
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52 Cardiology (ESC, <http://www.escardio.org>) and an index for cardiovascular risk (Card)
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54 based on the norms of the Portuguese Society of Cardiology (SPC, www.spc.pt).
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10 Bivariate correlations were computed between each one of the three subscales,
11 computed based on the 16-items in the CD-RISC, and each of the 8 measures described
12 above and used to test the convergent validity (Table. 4. Bivariate correlation
13 coefficients between the CD-RISC scale and the measures used to test the convergent
14 validity.
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22). The self-efficacy factor showed a significant negative association with the two
23 measures of stress considered - perceived stress ($r=-0.32$) and vulnerability to stress ($r=-$
24 0.34). There were positive correlations between the self-efficacy factor and two
25 additional variables, namely, subjective happiness ($r=0.31$) and mental health ($r=0.35$).
26 Although moderately, the self-efficacy factor as a significant and negative correlation
27 with physical health ($r=-0.17$) and medication consumption ($r=-0.13$)¹.
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36 The spirituality factor showed only a marginal significant correlation with the
37 vulnerability to stress measure ($r=0.25$).
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42 The social support factor showed a moderate significant correlation ($r=0.48$) with the
43 Social Provision Scale.[24] The social support factor is also correlated with the SHS
44 ($r=0.30$) and MHI5 ($r=0.26$) scales. There were a marginal significant negative
45 correlation between social support and vulnerability to stress ($r=-0.24$). The social
46 support factor correlates significantly with metabolic syndrome ($r=-0.13$) and
47 cardiovascular risk ($r=-0.10$), although the magnitude of both correlations is weak.
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¹ “Note that physical health is measured using a single item where the higher the value the lower the physical health reported”.

Discussion

The objective of this paper is to evaluate the structural validity and convergent validity of the first Portuguese version of the CD-RISC. Despite the importance of this construct, to date, there is no validated scale to measure resilience in the Community of Portuguese Language Countries (CPLP, n.d.), estimated to be more than two hundred and seventy million people. Resilience is a fundamental element of mental health, health assets, capabilities and positive adaptation. It enables people both to cope with adversity and to reach their full potential, and influences a wide range of outcomes at individual and community level, including healthier lifestyles, better physical health, improved recovery from illness, fewer limitations in daily living, higher educational attainment, greater productivity, employment and earnings, better relationships with adults and with children, more social cohesion and engagement and improved quality of life.[40] It is not a surprise that resilience has been extensively measured and used to understand individual and social phenomena.

The results do not replicate the original five factors structure, instead, the results suggest a three factors structure with self-efficacy, spirituality, and social support dimensions represented. Although this result is not consistent with the original proposal from Connor and Davidson, it is consistent with more recent studies.[5, 41] Consistent with this, the variability of factor structures found in CD-RISC has been documented and owed to methodological variations, idiosyncratic samples and, importantly, to cross-cultural factors.[42] We also note that similarly to the original study and to some of the following research, self-efficacy is the factor that explains the greatest variance of the original items. Still, although the results are important to understand the construct of resilience and how CD-RISC works as an instrument measuring this construct in a

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3 Portuguese sample, we note that the resulting scale should not be regarded as an
4 improved version. In fact, we consider that improved usage of this scale would come
5 from prior testing of the factorial structure of the original 25 items and comparison with
6 the results of this paper and alike.
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12 The results from the validation are, with one sole and justifiable exception, consistent
13 with evidence from the literature. The negative association we found between the self-
14 efficacy factor and the measures of stress is consistent with the idea that people with
15 high efficacy beliefs are able overcome obstacles and focus on opportunities, and are
16 more able to perceive stressful situations as challenging rather than as problematic
17 events.[43] The positive correlations between self-efficacy and happiness and
18 satisfaction with life are consistent with the findings in the literature where self-efficacy
19 beliefs may regulate positive and negative emotions. In this sense, people with higher
20 self-efficacy beliefs are less distressed and feel more capable of dealing with the
21 problematic situations.[44] Recent studies have found that self-efficacy is indeed
22 positively correlated with happiness[45] and satisfaction with life.[43] Although
23 moderately, the negative correlation between the self-efficacy factor and the measures
24 of physical health and medication consumption constitute an extension of the findings
25 where self-efficacy is associated with increased health and life satisfaction.
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45 The positive correlation we found between the spiritual factor and the vulnerability to
46 stress is consistent with Connor and colleagues[6] study with survivors of violent trauma,
47 where spirituality is proposed as a coping strategy do deal with higher Posttraumatic
48 Stress Disorder scores. Still, the fact that spirituality does not relate with any other
49 variables is not consistent with the literature, where previous studies have successfully
50 established correlations between spirituality and happiness[46] and spirituality and life
51 satisfaction.[47] The absence of effects can be a result of the low statistical power due
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3 to the small sample size in the RECT sample. In fact, a post hoc power analysis showed
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5 that the power to detect a significant correlation of 0.20 at 0.05 in our sample is only
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8 0.28.
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10 Interestingly, the positive correlation we found between the social support and the
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12 Social Provision Scale [24] is the only significant correlation of the Social Provision
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14 Scale, which supports the assumptions that this factor is a specific dimension of
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16 resilience. The positive correlations we found between the social support factor and the
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18 SHS and MH15 scales are consistent with the findings in the literature showing the
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20 strong impact of social support on happiness especially from closer social circles.[48]
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22 For instance, in a study with survivors from a natural disaster, the authors found that
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24 pre-disaster happiness and post-disaster social support were protective against the
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26 negative effect of the hurricane on survivors' post-disaster happiness.[49] The negative
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28 correlation we found between social support and vulnerability to stress is consistent
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30 with the findings in the literature, in which is becoming increasingly consensual that the
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32 lack of social support is an important risk factor in dealing with stressful and adverse
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34 life events.[50] We found negative correlations between social support and metabolic
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36 syndrome and cardiovascular risk Although some of the literature describes a
37
38 conflicting relation between social support and physical health,[51] it appears that social
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40 support is negatively associated with cardiovascular death and that it protects against
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42 recurrent events, the existing research involving the predictive relation between social
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44 support/social networks and incidence of disease, specifically cardiovascular disease.
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52 In summary, regarding the self-efficacy factor, we found associations with perceived
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54 stress, vulnerability to stress, subjective happiness and mental health. Additionally, we
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56 also found associations with perceived physical health and medication consumption,
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58 what we consider to be an extension of the findings relating self-efficacy with health
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3 and life satisfaction. Regarding the spirituality factor, we found only an association with
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5 vulnerability to stress. This result is not consistent with the literature where spirituality
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7 has been related with stress, happiness and life satisfaction. As mentioned, the absence
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9 of effects here are likely due to low test power. Finally, regarding the social support
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11 scale, we found association with the Social Provision Scale, subjective happiness,
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13 mental health and vulnerability to stress. Additionally, we also found an association
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15 with the two biomedical indexes used, specifically, cardiovascular risk and metabolic
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17 syndrome. Resilience, through its self-efficacy component, showed a protective effect
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19 on the extent of the myocardial infarction, by affecting the inflammatory
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21 response.[52] Emotional vitality, as part of healthy psychological functioning, may
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23 protect against risk of coronary heart disease (CHD).[53] Resilience could have life-
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25 saving effects. Prevention and intervention in CHD must involve not only measures to
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27 reduce psychological distress but should also focus on promoting positive emotions.
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37 **Applications for the Portuguese version of the CD-RISC**

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39 Our study extends the literature that has provided support on the importance of the
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41 construct of resilience, and, more particularly, on the use of CD-RISC as a reliable
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43 measure of this construct. In fact, using a robust psychometric method we replicated
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45 more recent studies describing three main dimensions of resilience. Additionally, using
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47 a vast array of validated measures we also showed how these factors are associated with
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49 scales, indexes and even behavioral measures in a way that is consistent with the
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51 literature. Importantly, these associations support the distinctiveness of the three factors,
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53 with different factors relating, as expected, with some different convergent measures.
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55 Take for instance the strong correlation between the social support factor and the Social
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57 Provision Scale, and the stronger correlations between the self-efficacy factor and both
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3 stress and vulnerability to stress. A curious finding here is the specific association of
4 self-efficacy with physical health and medication consumption and the association of
5 social support with two biomedical indexes, cardiovascular risk and metabolic
6 syndrome.
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13 Future directions and research limitations

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15 Our study extends the possibility to measure and investigate resilience in Portuguese
16 communities using a rigorously validated scale. Future studies with this community can
17 explore further the three factors structure of the CD-RISC and test for the convergent
18 validity with new samples. A limitation of the current paper is the difference in test
19 power between the two samples used to do the convergent validity. This is particularly
20 important because the low test power sample (from RECT project) included important
21 and unique validation measures and because the spirituality scale did not replicate
22 entirely the findings in the literature. Finally, and considering both research and
23 practice, future studies with the Portuguese communities can follow the factorial
24 structure found and validated. These studies can, again, provide additional support to
25 the theoretical and practical relevance of resilience and its dimensions as measured by
26 the CD-RISC.
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46 **Data sharing**

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49 The data that support the findings of this study are openly available in figshare at
50 <https://doi.org/10.6084/m9.figshare.7111676.v1>.
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56 **Author's contribution**

57
58 Faria-Anjos, Joana
59
60

1
2
3 Responsible for the CD-RISC scale translation process; substantial contribution to the
4 conception and design of the work, acquisition, analysis and interpretation of data;
5
6 drafting the work; agreement to be accountable for all aspects of the work related with
7
8 integrity of the data analysis and results reporting; and final approval of the version to
9
10 be published.
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19 Heitor, Maria João
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21 Substantial contribution to the conception and design of the work, acquisition, analysis
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23 of the work related with integrity of the data analysis and results reporting; and final
24 approval of the version to be published.
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4 the work and revising it critically; agreement to be accountable for all aspects of the
5 work related with integrity of the data analysis and results reporting; and final approval
6 of the version to be published.
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23 of paper construction.
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33 **Abbreviations:**

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35 23QVS: Stress Vulnerability Questionnaire
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38 BI: Biomedical indexes
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41 Card: cardiovascular risk
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44 CD-RISC: Connor- Davidson Resilience Scale
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47 CFA: Confirmatory Factor Analysis
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50 CHD: Coronary heart disease
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53 EFA: Exploratory Factorial Analysis
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56 H&LS: Health and life styles
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59 HIAES: Health Impact Assessment of Employment Strategies
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3 Mcons: Medication consumption
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6 Met: metabolic syndrome
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9 MHI-5: Mental Health Inventory
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12 RECT: Resilience Effect in Coping with Trauma
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15 Pact: Physical activity
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18 Phea: Physical health
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21 PSS-10: Reduced version of Perceived Stress Scale
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24 SHS: Subjective Happiness Scale (SHS),
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27 SPS: Social Provisions Scale
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34 Table 1. Factorial weights of the 16 items on each of the three factors and respective
35 explained variance for the RECT sample.
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Items / Explained variance	Communalities	Self-Efficacy	Spirituality	Social Support
19	0.44	0.65	0.05	0.11
24	0.28	0.47	0.20	0.10
15	0.33	0.57	-0.01	0.08
18	0.28	0.52	-0.07	0.06
7	0.35	0.53	-0.01	0.28
8	0.33	0.56	0.08	0.11
1	0.30	0.52	0.04	0.14
16	0.30	0.53	0.01	0.14

4	0.40	0.61	0.14	0.00
6	0.24	0.39	0.16	0.25
10	0.18	0.35	0.20	0.11
9	0.50	0.10	0.69	0.08
21	0.45	0.14	0.60	0.28
3	0.48	-0.06	0.69	0.02
2	0.38	0.18	0.13	0.58
13	0.72	0.17	0.16	0.82
Variance explained	-	20%	9%	8%
Alpha	-	0.82	0.71	0.53*
M (SD)	-	2.92 (0.54)	2.64 (0.91)	3.14 (0.83)
N	-	421	421	421

* correlation for the two items, $p < 0.05$

Table 2. Factorial weights of the 16 items on each of the three factors and respective explained variance for the HIAES sample.

Items / Explained variance	Communalities	Self-Efficacy	Spirituality	Social Support
19	0.36	0.58	-0.07	0.13
24	0.33	0.57	0.02	0.09
15	0.32	0.56	-0.04	0.07
18	0.28	0.52	-0.07	0.07
7	0.26	0.51	0.08	0.02
8	0.24	0.48	0.04	0.08
1	0.26	0.43	0.06	0.27

16	0.19	0.43	0.08	0.04
4	0.16	0.38	0.04	0.13
6	0.12	0.33	0.12	0.05
10	0.18	0.33	0.19	0.19
9	0.52	0.08	0.72	0.00
21	0.37	0.09	0.60	0.07
3	0.36	-0.06	0.59	0.13
2	0.59	0.09	0.06	0.76
13	0.35	0.21	0.14	0.54
Variance explained	-	16%	8%	7%
Alpha	-	0.76	0.67	0.44*
M (SD)	-	3.03 (0.40)	2.47 (0.84)	3.24 (0.67)
N	-	405	405	405

* correlation for the two items, $p < 0.05$

Table 3. Descriptives (mean, standard-deviation and sample size) of the measures used to test the convergent validity.

	M	SD	n
SPS	8.75	9.36	53
SWLS	24.72	5.26	54
PSS-10	14.51	5.49	55
23QVS	28.67	9.44	55
H&LS			
Phea	1.38	.52	405

Pact	3.14	1.45	405
Mcons	2.58	1.67	405
BI			
Met	.12	.32	260
Card	3.31	2.03	405
MHI-5	68.91	18.97	405
SHS	5.24	1.08	405

Table 4. Bivariate correlation coefficients between the CD-RISC scale and the measures used to test the convergent validity.

	1	2	3
1. Self-Efficacy	-	.13**	.33**
2. Spirituality	.13**	-	.21**
3. Social Support	.33**	.21**	-
H&LS - Phea	-.16**	-.01	-.09
H&LS - Pact	.08	.00	.08
H&LS - Mcons	-.13**	.08	-.04
BI - Met	-.04	.02	-.13*

BI - Card	.07	.01	-.10*
MHI-5	.35**	.02	.26**
SHS	.31**	.09	.30**
SPS	.16	-.13	.48**
SWLS	.28*	.10	.11
PSS-10	-.32*	.14	.10
23QVS	-.34*	.25 ⁺	-.24 ⁺

⁺ p<0.06; * p<0.05; **p<0.01