

THE PERCEIVED STRESS SCALE: RELIABILITY AND VALIDITY STUDY IN THE CZECH REPUBLIC

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ABSTRACT

Objectives. The aim of this study was to create a Czech translation of the Perceived Stress Scale (PSS), to assess its psychometric properties on a representative sample of the Czech general adult population, and to compare the original 14-item version (PSS-14) with the shortened 10-item (PSS-10) and four-item (PSS-4) versions.

Sample and setting. Two pilot studies were conducted to create the final Czech translation of the scale ($n = 365$ and $n = 420$). The final version of the Czech PSS was administered to a sample of the Czech general adult population ($n = 1725$ of whom 981 were women, $M = 44.32$, $SD = 12.8$). The Beck Depression Inventory (BDI-II) or the State-Trait Anxiety Inventory (STAI) were administered alongside the PSS to a part of the sample. A retest measurement after 14 days was conducted ($n = 159$).

Statistical analysis. Using the confirmatory factor analysis, the one-factor, two-factor and bifactor models were compared. The internal consistency, stability in time, and convergent validity of the scale, as well as the known-group differences were assessed. The three versions of the PSS were compared.

Results. The confirmatory factor analysis supported the bifactor model of the PSS-14 and PSS-10, and the two-factor model of the PSS-4. All versions of the scale showed good internal consistency and stability in time. There was a moderate to strong positive correlation between the PSS and the BDI-II and STAI. Differences based on age, sex, education level, and situational factors were found. Overall, the PSS-10 showed the best psychometric properties of all three versions of the scale.

Study limitation. The sample consisted mostly of highly educated respondents.

key words:

Perceived Stress Scale,
translation,
reliability,
validity,
scale

klíčová slova:

Škála vnímaného stresu,
překlad,
reliabilita,
validita,
škála

The *Perceived Stress Scale* (PSS), developed by Cohen, Kamarck, and Mermelstein (1983), is a self-report scale designed to evaluate how unpredictable, uncontrollable, and overloaded respondents find their lives (Cohen & Williamson, 1988). The PSS is a brief and easy-to-use scale, originally consisting of 14 items. The questions are of a general nature and ask about feelings and thoughts during the last month. Respondents mark their answer on a 4-point Likert-like scale. The total score is obtained by reversing the scores for the positively stated items (items 4r, 5r, 6r, 7r, 9r, 10r, 13r) and then summing all items across the scale. Two shorter versions, derived from the original PSS, exist (Cohen & Williamson, 1988): the ten-item PSS-10 (items 1, 2, 3,

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6r, 7r, 8, 9r, 10r, 11, 14) and four-item PSS-4 (items 2, 6r, 7r, 14). Below, *PSS* is used as a general name for the scale, *PSS-14*, *PSS-10*, and *PSS-4* refer to specific versions of the scale.

Despite its short range, the PSS shows satisfactory psychometrical properties. The three versions of the scale were previously compared in various cultural and language contexts (Andreou et al., 2011; Cohen & Williamson, 1988; Lesage et al., 2012; Leung et al., 2010). These authors consensually indicated comparable or higher internal consistency and better factor structure of the PSS-10 compared to the original 14-item version. The PSS-4 suffers from a significant loss of reliability, which can be attributed to its shortness. Cohen and Williamson (1988) recommend preferring the PSS-10 in further research over the original version. The PSS-4 is recommended to be used in situations, in which very fast evaluation is necessary and the researcher needs an indicative result only.

Validity of the PSS

The *construct validity* of the PSS was previously evaluated using exploratory factor analysis (*EFA*) and confirmatory factor analysis (*CFA*). We detected seven exploratory studies. For the PSS-14, a two-factor model explaining from 41.6% (Cohen & Williamson, 1988) to 50.9% (Lee et al., 2014) of the variance was explored. Similarly, for the PSS-10 a two-factor model explaining from 48.9% (Cohen & Williamson, 1988) to 61.9% (Roberti et al., 2006) was explored. In the case of the PSS-4, one study indicated a one-factor model explaining 45.6% of the variance (Cohen & Williamson, 1988) and one study preferred a two-factor model explaining 52.6% of the variance (Lee et al., 2014). Names, given to the factors by other authors, reflect that one factor is loaded solely by positively stated items, while the second factor is loaded solely by negatively stated items.

The one-factor and two-factor models were also compared using the *CFA*. The two-factor model was observed to be of a better fit for the PSS-14 (Andreou et al., 2011; Leung et al., 2010), as well as for the PSS-10 (Andreou et al., 2011; Leung et al., 2010; Smith et al., 2014). A high positive correlation between these two factors was reported, ranging from $r = .60$ (Golden-Kreutz et al., 2004) to $r = .84$ (Maroufizadeh et al., 2014). Moreover, a hierarchical second-order structure (Smith et al., 2014) and a bifactor model (Jovanovic & Gavrilov-Jerkovic, 2015) were compared for the PSS-10. Both models showed to be of a better fit than a two-factor model. However, for adequate use of the second-order model, at least three first-order factors are needed (Kline, 2011). Because the theory assumes that only two first-order factors are present in the PSS, we argue that a bifactor model is more appropriate. In the case of the PSS-4, the two-factor solution showed the best fit (Andreou et al., 2011; Leung et al., 2010).

To evaluate the *convergent validity* of the PSS, other authors commonly used methods measuring depression and anxiety. The correlation between the PSS and the Beck Depression Inventory-II (Beck et al., 1996) ranged from $r = .55$ (Ramírez & Hernández, 2007) to $r = .67$ (Wang et al., 2011). The most common measure of anxiety was the State-Trait Anxiety Inventory (Spielberger, 1983), which correlated with the PSS in a range from $r = .60$ (Wongpakaran & Wongpakaran, 2010) to $r = .80$ (Pbert et al., 1992).

Reliability of the PSS

We analyzed 20 studies reporting the internal consistency of the PSS. The Cronbach's α coefficient ranged from $\alpha = .75$ (Cohen & Williamson, 1988; Lee et al., 2014) to

$\alpha = .86$ (Cohen et al., 1983) for the PSS-14, from $\alpha = .74$ (Chaaya et al., 2010; Lee et al., 2014) to $\alpha = .91$ (Cohen & Janicki-Deverts, 2012) for the PSS-10, and from $\alpha = .55$ (Lee et al., 2014) to $\alpha = .77$ (Warttig et al., 2013) for the PSS-4.

The stability in time of the PSS-14 and PSS-10 was previously assessed. A test-retest method was used, with the retest period being from seven days to one year. With increasing time, the retest stability decreased. While a seven-day retest shows a very high positive correlation, $r = .86$ (Reis et al., 2010), after one year the correlation dropped to $r = .53$ (Golden-Kreutz et al., 2004).

As the PSS has repeatedly shown overall satisfactory psychometric characteristics and is widely used abroad in a vast array of contexts, we decided to create a Czech adaptation of the scale. The purpose of this article is to assess the reliability and validity of the Czech translation of the scale, and to compare the full scale with the shorter versions.

METHODOLOGY

Translation

We used the back-translation method to create a pilot translation of the PSS. The pilot translation was administered to a sample of teachers ($n = 365$). A preliminary data analysis detected several problematic items (items 6r, 7r, 8, 9r, and 10r) with low factorial loadings and low correlation with the rest of the scale. We took inspiration from the test development process and created multiple translations of each problematic item. A 22-item-long experimental version was created, containing nine single items, two twin items, and three triplet items. The experimental version of the PSS was administered to a sample taken from the general population ($n = 420$). A series of *EFA* and item analyses were conducted to identify the translation alternative with the best psychometric properties. The data were analyzed in FACTOR (Lorenzo-Seva & Ferrando, 2013). We used polychoric correlations and 500 bootstrap samples. To explore the number of dimensions, multiple procedures were combined. We computed the factors' eigenvalues and applied the Minimum Average Partial method (*MAP*; Velicer, 1976), the Hull Method for selecting the number of common factors (Lorenzo-Seva et al., 2011), and the Optimal Implementation of Parallel Analysis (*PA*; Timmerman & Lorenzo-Seva, 2011). To assess the factor structure, we used Minimum Rank Factor Analysis (*MRFA*; Berge & Kiers, 1991), which enables the interpretation of the proportion of common variance explained by the retained factors (Lorenzo-Seva & Ferrando, 2006). Because of the high correlation between the factors we used Normalized Promax rotation. Finally, the twin and triplet items were compared. The alternatives of poorer quality were eliminated and a final version of the Czech PSS containing 14 items was created. The final translation is presented in the Appendix A.

Participants

We collected data from the general adult population of the Czech Republic. The sample consisted of 1725 adults aged 18–91 years ($M = 44.32$, $SD = 12.83$), of whom 56.9% were women, mostly with university education (70.7%) or secondary education (28.4%). In total, 19.0% of participants had previously sought professional mental healthcare (4.8% in the past month), and 6.8% had reported the current use of psychopharmaceutical medication. In the past month, some participants had experienced important life changes (31.6%), family-related problems (40.5%), health-related problems (35.7%), or work-related problems (24.5%).

Sampling Procedure and Ethics

The participants were randomly chosen from a database of contacts representing the general Czech population. All the contacts included in the database were provided voluntarily in previous research activities of the Department of Psychology, Palacký University Olomouc. The participants were addressed directly by email. This procedure was consulted with, and approved by, the Czech Office for the Personal Data Protection. Furthermore, the participants were asked to take part in a retest two weeks after the initial testing. We collected 159 valid retest protocols.

All data were anonymized and processed according to the General Data Protection Regulation (GDPR). The participants were offered the opportunity to opt out of the database of contacts. At all stages of the research, the participants had to provide an informed consent prior to the administration and were informed that their participation was voluntary and could be terminated at any time.

Methods

The participants were asked to provide basic demographic characteristics, to fill in the Czech adaptation of the PSS-14, and to answer a set of screening questions. These questions were focused on the utilization of mental health services, occurrence of chronic stressors, and important life changes, as these domains had previously been linked to perceived stress (Cohen & Williamson, 1988; Feizi et al., 2012; Simo et al., 2018; Weissman et al., 2016).

To assess convergent validity, we administered the *Beck Depression Inventory-II* (BDI-II; Beck et al., 1996), which is a 22-item self-administered instrument measuring the severity of depression symptoms in the previous week. The BDI-II was administered to 341 participants randomly selected from the sample. Furthermore, we administered the *State-Trait Anxiety Inventory* (STAI; Spielberger, 1983). The STAI is a 40-item self-administered inventory, consisting of two scales with separate scores: STAI-S, assessing the anxiety state (20 items), and STAI-T, assessing the anxiety trait (20 items). The STAI scales were administered to 373 participants randomly selected from the sample.

Analytic strategy

We collected data using an online survey platform. To submit the questionnaire, the participants had to answer all items, hence there were no missing values in the data matrix. Item analysis was conducted with a focus on an item's mean, inter-item correlation, item-total correlation, and Cronbach's α if the item was deleted. The *CFA* was performed in the *lavaan* package (Rosseel, 2012) in the RStudio. We used the standard settings of the function *cfa*. All estimates were standardized. Equality constraints were applied in order of correct identification of a model in case of the PSS-4. The items were set as ordered; hence the weighted least square mean and variance adjusted (*WLSMV*) estimator was used. We compared the one-factor, two-factor, and bifactor models of the PSS-14 and PSS-10. In case of the PSS-4, only the one-factor and two-factor models were compared, as the four-item version does not meet the criteria for defining a bifactor model (Chen & Zhang, 2018). The reliability of the scale was examined, we used both Cronbach's α and McDonald's ω . The stability in time is expressed using the Pearson's correlation coefficient r . Descriptive analysis, know-group difference analysis, and convergent validity analysis were performed using SPSS, version 23.

RESULTS

Factor structure

The results of the *CFA* are presented in Table 1.

Table 1 Results of the *CFA* comparing different models of the PSS

Version	Model	Absolute Fit Indices				Relative Fit Indices			
		χ^2	df	SRMR	RMSEA	NFI	TLI	CFI	IFI
PSS-14	one-factor	4189.583*	77	.095	.176	.841	.815	.843	.843
	two-factor	2713.119*	76	.077	.142	.897	.880	.899	.900
	bifactor	813.688*	63	.036	.083	.969	.959	.971	.971
PSS-10	one-factor	1880.828*	35	.070	.175	.915	.893	.916	.916
	two-factor	943.152*	34	.050	.125	.957	.946	.959	.959
	bifactor	365.026*	25	.025	.089	.984	.972	.985	.985
PSS-4	one-factor	61.775*	5	.031	.081	.988	.987	.989	.989
	two-factor	11.530*	3	.015	.041	.998	.997	.998	.998

Note: χ^2 = chi-square; * = $p < .001$; df = degrees of freedom; SRMR = Standardized root mean square of residuals; RMSEA = Root mean square of approximation, NFI = Normed fit index; TLI = Tucker-Lewis index; CFI = Comparative fit index, IFI = Incremental fit index

The χ^2 statistics indicate a poor fit for all the models; however, it is very sensitive to sample size and is no longer used as a basis for the acceptance or rejection of the model (Vandenberg, 2006). The one-factor model is not adequate either for the PSS-14 or for the PSS-10. The two-factor model shows a better fit for both the PSS-14 and PSS-10; however, the RMSEA remains considerably higher than the recommended threshold for a good fit ($> .06$; Kline, 2011). The bifactor model shows the best fit for both the PSS-14 and PSS-10 in all indices, even though the RMSEA value is above the threshold recommended by Kline (2011) and indicates only a mediocre fit (Mac-callum et al., 1996). Although the relative fit indices show a good fit of both models of

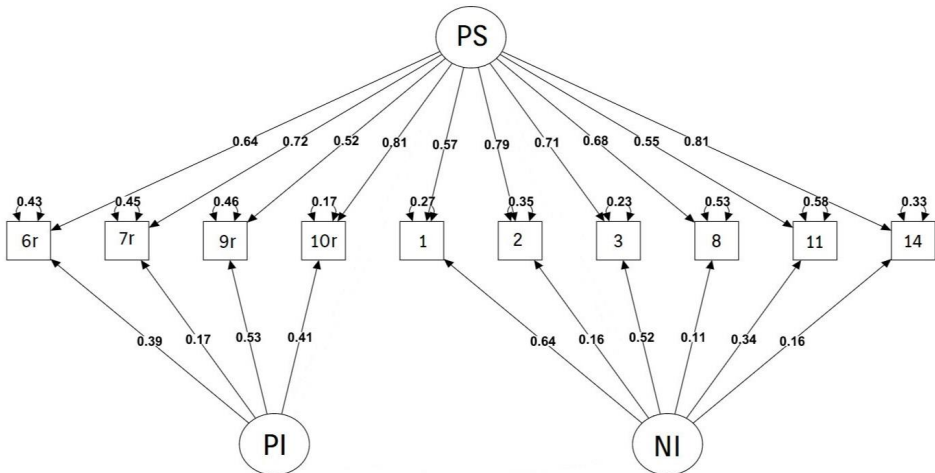


Fig. 1 Bifactor model of the PSS-10

Note: PS = Perceived Stress; PI = Positively Stated Items; NI = Negatively Stated Items; the item error variance is stated above each item; standardized factor loadings are stated between the item and the group/general factor.

the PSS-4, the RMSEA value shows a good fit only in case of the two-factor model. A graphic representation of the bifactor model of the PSS-10 with the items' factor loadings is presented in Figure 1.

Overall, we detected three items of the PSS-14 as having factor loadings $< .50$ on the general factor (.08, .46, and .39 for items 4r, 5r, and 12, respectively). However, all these items are eliminated in the shortened versions of the scale. All ten items of the PSS-10 have high loading on the general factor ($> .50$). A somewhat low factor loading of the items on the group factors was found. However, the low loading of the items on the group factors is not problematic if the scores for these factors are not reported individually (DeMars, 2013).

Reliability

The results of the item analysis are presented in the Appendix B. We found that items 4r, 12, and 13r had a lower correlation with the rest of the scale. All these items are eliminated in the PSS-10. The minimum corrected item-total correlation within the PSS-10 was .50. We found that the exclusion of any item would not significantly change the level of internal consistency.

To assess the internal consistency of the PSS, we computed both Cronbach's α and McDonald's ω . Values of the coefficients are presented in the Table 2.

Table 2 Internal consistency of the PSS

Version	Model	α	ω
PSS-14	one-factor	.90	.89
	two-factor	.90	.90
	bifactor	.90	.91
PSS-10	one-factor	.91	.90
	two-factor	.91	.91
	bifactor	.91	.92
PSS-4	one-factor	.83	.80
	two-factor	.83	.81

The PSS showed good stability in time. The correlations between the initial testing and retest scores after 14 days were $r = .85, .88,$ and $.83$ ($p < .001$) for the PSS-14, PSS-10, and PSS-4, respectively.

Convergent validity

Table 3 presents the Pearson correlation coefficient between the PSS and other measures we administered. We also present the correlation between different versions of the PSS. All correlations are significant on the $p < .001$ level.

Table 3 Convergent validity of the PSS

Measure	BDI-II	STAI-S	STAI-T	PSS-14	PSS-10	PSS-4
PSS-14	.67	.77	.78		.98	.93
PSS-10	.67	.77	.79	.98		.94
PSS-4	.65	.74	.76	.93	.94	

Note: BDI-II = Beck Depression Inventory-II; STAI-S = scale State of the State-Trait Anxiety Inventory; STAI-T = scale Trait of the State-Trait Anxiety Inventory

Descriptive characteristics and known-group differences

The mean score of the PSS was 25.60 ($SD = 8.40$) for the PSS-14, 18.04 ($SD = 6.83$) for the PSS-10, and 6.23 ($SD = 3.13$) for the PSS-4. The average score for the PSS decreased with age ($r = -.34, -.34, -.31$ for the PSS-14, PSS-10, PSS-4, respectively). Descriptive characteristics, t-test results, and effect sizes exploring the known-group differences are presented in Appendix C. Women and participants with lower education exhibited higher levels of perceived stress. However, only a small to medium effect size was detected. The participants who had sought professional mental health services in the past reported higher average scores, with a medium to large effect, especially those with experience from the past month and those who reported the current use of pharmaceutical medication. Higher levels of perceived stress were found in those participants who had experienced important life changes in the past month, struggled with health-related problems, or experienced work-related or family-related problems in the past month.

DISCUSSION

Our results support the adequate validity and reliability of all three versions of the Czech translation of the PSS.

The results of the *EFA* in the pilot study suggested that the one-factor solution is more appropriate for the PSS-14, PSS-10, and PSS-4. This finding is in contrast with previous empirical studies reporting the results of the *EFA* (Hewitt et al., 1992; Lee et al., 2014; Mimura & Griffiths, 2004; Ramírez & Hernández, 2007; Reis et al., 2010; Roberti et al., 2006), consensually suggesting the two-factor model. We believe our result might be biased by the strong correlation between the factors ($r = .71$ and $.72$ for the PSS-14 and the PSS-10, respectively), which led to the underestimation of the total number of factors detected by the *MAP* and *PA* (Caron, 2018). Therefore, we decided to compare both models together with a bifactor model, which was previously indicated to be the best fit for both the PSS-14 and PSS-10 (Jovanovic & Gavrilov-Jerkovic, 2015). As we expected, the bifactor model shows the best values in all the observed indices in both the PSS-14 and PSS-10. For the PSS-4, the two-factor model showed a good fit for the data. The bifactor model results are not included for the PSS-4, because it does not meet the criteria for defining a bifactor model.

Our findings support the intention of Cohen and Williamson (1988), who claim that even though the scale consists of two theoretical factors, the distinction between them is irrelevant for the purposes of measuring the perception of stress. Another question arises with the fact that one of the factors is loaded solely by positively stated items, while the other one is loaded solely by negatively stated items. This might lead to a discussion whether the two-factor structure is reasonable, or whether it is just an effect of different wording of the items. However, only one of the positively stated items have similar content to the negatively stated items (Golden-Kreutz et al., 2004). Supported by other authors (Golden-Kreutz et al., 2004; Smith et al., 2014), we argue that the two-factor structure is reasonable.

The internal consistency of the Czech PSS-14 and the PSS-10 is comparable to values reported previously, and the internal consistency of the PSS-4 is higher than in most previous studies (for an overview see Lee, 2012). To evaluate the internal consistency, both the Cronbach's α and total McDonald's ω were computed. While the Cronbach's α is the most widely used measure and therefore allows the comparison of the results with previous studies, the total McDonald's ω is more appropriate for multidimensional data (Dunn et al., 2014). Additionally, the stability in time of the Czech

PSS has been tested with overall satisfactory results, and is comparable to previous findings (Chaaya et al., 2010; Cohen et al., 1983; Golden-Kreutz et al., 2004; Reis et al., 2010; Remor, 2006; Wang et al., 2011).

A moderate to high positive correlation with measures of depression and anxiety is observed. The correlation coefficient is as high as .79 between the PSS and the STAI-T. It raises a question whether the PSS and the STAI-T really measure different constructs. For the future research we recommend observing this problematic closely, as correlations over .70 with measures of anxiety are shown repeatedly (Pbert et al., 1992; Remor, 2006; Roberti et al., 2006).

The results of the known-group differences are in accordance with previous reports – women exhibit higher levels of stress compared to men (Andreou et al., 2011; Hewitt et al., 1992; Lesage et al., 2012; Leung et al., 2010; Remor, 2006); participants with lower education exhibit higher levels of stress (Cohen & Williamson, 1988), and participants with mental health-related problems exhibit higher levels of perceived stress (Reis et al., 2010). The average score for the PSS in the present study decreases with the age of the respondents. Other authors' observations concerning the age and level of perceived stress are variable – while Remor (2006) also observed decreasing scores for the PSS with age, Lesage et al. (2012) detected the opposite trend, and Cohen et al. (1983) did not find a significant relationship between age and the PSS score. We believe that this inconsistency is caused by the different cultural and time contexts of each study.

In this project, several limitations might be detected. First, we tested the instrument on a heterogeneous, highly educated sample. Given that there are significant differences in the average score according to the level of education, we recommend thoughtful interpretation of the scores. Second, the data might be biased by the online administration of the instrument. In further research, we recommend comparing both forms of administration specifically for the PSS.

In conclusion, the reliability and validity of the Czech translation of the PSS is satisfactory. We recommend using the shortened ten-item version of the PSS in the Czech environment. It shows comparable or better factor structure, internal consistency, stability in time, and convergent validity than the PSS-14. The PSS-4, although showing overall satisfactory psychometric properties, is recommended to be used to gain indicative results only, preferably combined with other methods. The Czech adaptation of the PSS is a useful instrument applicable in both clinical and research settings, and we are glad to be broadening the number of methods translated and psychometrically evaluated in the Czech environment.

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SOUHRN

Škála vnímaného stresu: psychometrické charakteristiky české verze

Cíle. Cílem předkládané studie bylo vytvořit český překlad Škály vnímaného stresu (PSS), ověřit jeho psychometrické vlastnosti na reprezentativním vzorku běžné české dospělé populace, a porovnat psychometrické vlastnosti původní čtrnáctipoložkové škály (PSS-14) se zkrácenou desetipoložkovou (PSS-10) a čtyřpoložkovou (PSS-4) verzí.

Výzkumný soubor a metody získávání dat. Při tvorbě českého překladu škály byly provedeny dvě pilotní studie ($n = 365$ a $n = 420$). Finální překlad škály byl administrován vzorku běžné české populace ($n = 1725$, z toho 981 žen, $M = 44,32$, $SD = 12,8$). Části vzorku byla také administrována Beckova škála deprese (BDI-II) nebo Dotazník na měření úzkosti a úzkostlivosti (STAI). Po 14 dnech proběhl retest, kterého se zúčastnilo 159 respondentů.

Analýza dat. Pomocí konfirmační faktorové analýzy autoří porovnali jednofaktorový, dvoufaktorový a bifaktorový model škály. Ověřili vnitřní konzistenci škály, její stabilitu v čase, konvergentní validitu a rozdíly mezi známými skupinami. Porovnali vlastnosti jednotlivých forem PSS.

Výsledky. Konfirmační faktorová analýza podpořila bifaktorový model PSS-14 i PSS-10 a dvoufaktorový model PSS-4. Všechny tři formy škály dosahovaly dobré hodnoty vnitřní konzistence i stability v čase. Korelace PSS s BDI-II a STAI ukázaly středně silný až silný pozitivní vztah. Byly nalezeny rozdíly v závislosti na věku, pohlaví, vzdělání a řadě situačních faktorů. Nejlepších psychometrických vlastností dosahovala desetipoložková verze škály.

Limity studie. Ve zkoumaném vzorku dominují respondenti s vysokoškolským vzděláním.

Appendix A Items of the PSS

Item	Original	Czech translation
1	In the last month, how often have you been upset because of something that happened unexpectedly?	Jak často jste v posledním měsíci byl/a rozrušen/a něčím neočekávaným?
2	In the last month, how often have you felt that you were unable to control the important things in your life?	Jak často jste v posledním měsíci měl/a pocit, že nemáte kontrolu nad důležitými věcmi ve svém životě?
3	In the last month, how often have you felt nervous and/or stressed?	Jak často jste se v posledním měsíci cítil/a nervózní a ve stresu?
4r	In the last month, how often have you dealt successfully with irritating life hassles?	Jak často jste v posledním měsíci úspěšně vyřešil/a rozčilující nepříjemnosti ve svém životě?
5r	In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?	Jak často jste v posledním měsíci měl/a pocit, že se zvládáte efektivně vyrovnávat s důležitými změnami, které se objevily ve vašem životě?
6r	In the last month, how often have you felt confident about your ability to handle your personal problems?	Jak často jste v posledním měsíci věřil/a, že dokážete sebejistě zvládat své osobní problémy?
7r	In the last month, how often have you felt that things were going your way?	Jak často Vám v posledním měsíci přišlo, že jdou věci podle plánu?
8	In the last month, how often have you found that you could not cope with all the things that you had to do?	Jak často jste v posledním měsíci zjistil/a, že nezvládáte všechny věci, které musíte udělat?
9r	In the last month, how often have you been able to control irritations in your life?	Jak často jste v posledním měsíci cítil/a, že dokážete kontrolovat nepříjemné situace ve svém životě?
10r	In the last month, how often have you felt that you were on top of things?	Jak často jste v posledním měsíci cítil/a, že máte věci pod kontrolou?
11	In the last month, how often have you been angered because of things that were outside of your control?	Jak často jste byl/a v posledním měsíci rozzlobený/á kvůli věcem, které jste nemohl/a ovlivnit?
12	In the last month, how often have you found yourself thinking about things that you have to accomplish?	Jak často jste se v posledním měsíci přistihl/a přemýšlet nad věcmi, které ještě musíte udělat?
13r	In the last month, how often have you been able to control the way you spend your time?	Jak často jste v posledním měsíci byl/a schopen/a kontrolovat, jakým způsobem trávíte svůj čas?
14	In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	Jak často jste v posledním měsíci cítil/a, že se potíže hromadí tak moc, že je nedokážete zvládnout?

Note: PSS-10 consists of items 1, 2, 3, 6r, 7r, 8, 9r, 10r, 11, 14; PSS-4 consists of items 2, 6r, 7r, 14; respondents mark their answer on a scale: never – almost never – sometimes – fairly often – very often, in Czech: nikdy – téměř nikdy – občas – poměrně často – velmi často

Appendix B Results of the item analysis

Item	<i>M</i>	<i>SD</i>	Response option					Item-Total Correlation			α if Item Deleted		
			0	1	2	3	4	PSS-14	PSS-10	PSS-4	PSS-14	PSS-10	PSS-4
1	2.19	.89	.02	.18	.45	.28	.07	.55	.60		.88	.89	
2	1.68	1.03	.13	.32	.36	.15	.05	.69	.71	.65	.87	.88	.74
3	2.35	.96	.02	.16	.39	.31	.12	.68	.71	–	.87	.88	–
8	1.99	1.04	.06	.27	.36	.22	.08	.60	.60	–	.88	.89	–
11	2.20	.97	.04	.20	.38	.29	.08	.52	.55	–	.88	.89	–
12	3.06	.81	.00	.03	.21	.44	.32	.39	–	–	.88	–	–
14	1.60	1.08	.15	.35	.30	.14	.06	.72	.73	.65	.87	.88	.74
4r	1.54	.91	.11	.41	.36	.11	.02	.18	–	–	.89	–	–
5r	1.49	.88	.11	.43	.35	.10	.02	.50	–	–	.88	–	–
6r	1.37	.92	.16	.44	.29	.10	.02	.64	.60	.58	.87	.89	.77
7r	1.60	.91	.09	.41	.33	.15	.02	.63	.64	.60	.87	.88	.76
9r	1.66	.88	.07	.38	.39	.14	.02	.55	.50	–	.88	.89	–
10r	1.45	.84	.11	.45	.34	.09	.01	.75	.74	–	.87	.88	–
13r	1.48	.93	.13	.43	.29	.13	.02	.42	–	–	.88	–	–

Note: *M* = Mean; *SD* = Standard Deviation; Item-Total Correlation = Corrected Item-Total Correlation; α if Item Deleted = Cronbach's Alpha if item deleted

Appendix C Known-group differences in the PSS score

Variable	n	Version	Group	M	SD	t-test		
						t	df	
Gender	men = 742	PSS-14	men	24.01	8.09	-6.98	1721	0.34
	women = 981	PSS-10	women	26.80	8.27	-7.64	1721	0.37
Level of education	lower = 505	PSS-4	men	19.12	6.75	-6.06	1721	0.30
		PSS-14	women	5.71	3.01	6.63	3.17	
	higher = 1220	PSS-14	lower	27.09	8.82	4.65	865	-0.26
		PSS-10	higher	24.98	8.00	4.38	863	-0.24
Sought professional mental healthcare in the past	no = 1398	PSS-4	lower	17.56	6.58	4.68	851	-0.26
		PSS-14	higher	6.80	3.37	5.99	3.00	
	yes = 327	PSS-14	no	24.85	8.11	-7.81	1723	0.48
		PSS-10	yes	28.77	8.38	-8.24	1723	0.51
Sought professional mental health care in the past month	no = 1643	PSS-4	yes	17.39	6.67	7.39	3.19	
		PSS-14	no	20.79	6.81	5.96	3.06	
	yes = 82	PSS-14	yes	25.31	8.17	-6.55	1723	0.74
		PSS-10	no	31.39	8.80	-7.06	1723	0.80
Current use of psychopharmaceutic medication	no = 1608	PSS-4	yes	23.16	6.82	-6.77	1723	0.77
		PSS-14	no	6.12	3.09	-7.25	1723	0.69
	yes = 117	PSS-10	yes	8.49	3.23	-7.30	1723	0.70
		PSS-4	no	25.21	8.15	-7.61	1723	0.73
			30.89	8.61	8.32	3.29		

Variable	<i>n</i>	Version	Group	<i>M</i>	<i>SD</i>	t-test	
						<i>t</i>	<i>df</i>
Important life changes in the past month	no = 1180	PSS-14	no	24.68	8.16	-6.81	1723
	yes = 545	PSS-10	yes	27.57	8.27	-7.72	1723
Health-related problems in the past month	no = 1109 yes = 616	PSS-4	no	17.19	6.70	-7.38	1723
		PSS-4	yes	19.87	6.75	-7.70	1723
Work-related problems in the past month	no = 1303 yes = 422	PSS-14	no	5.86	3.07	-7.03	1723
		PSS-14	yes	7.04	3.12	-13.98	795
Family-related problems in the past month	no = 1027 yes = 698	PSS-10	no	24.47	8.23	-14.59	804
		PSS-10	yes	27.63	8.05	-11.28	1723
		PSS-4	no	17.08	6.76	-11.14	1723
		PSS-4	yes	19.76	6.62	-11.91	1723
		PSS-14	no	5.84	3.07	-11.75	1723
		PSS-14	yes	6.93	3.12	-11.75	1723
		PSS-10	no	30.00	7.21	-11.75	1723
		PSS-10	yes	16.82	6.68	-11.75	1723
		PSS-4	no	21.78	5.86	-11.75	1723
		PSS-4	yes	5.76	3.05	-11.75	1723
		PSS-14	no	7.67	2.95	-11.75	1723
		PSS-14	yes	23.82	8.21	-11.75	1723
		PSS-10	no	28.20	7.74	-11.75	1723
		PSS-10	yes	16.48	6.73	-11.75	1723
		PSS-4	no	20.32	6.31	-11.75	1723
		PSS-4	yes	5.53	3.00	-11.75	1723
				7.27	3.04		

Note: *d* = Cohen's *d*