

Construct validity of the perceived stress scale (PSS-10) in a sample of health professionals in family medicine in Bosnia and Herzegovina

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ABSTRACT

Background: The 10-item Perceived Stress Scale (PSS-10) has not been translated into Bosnian, nor has a study been conducted employing a sample of family medicine physicians and nurses to examine the instrument's reliability, validity, and factorial structure. Thus, the goal of this study was to investigate the reliability and construct validity of the Bosnian version of the PSS-10 among family medicine professionals.

Study design: Cross-sectional descriptive study provided among healthcare professionals in family medicine, using Google forms questionnaire (PSS-10) in Bosnian language.

Methods: Translation of PSS-10 in Bosnian is performed according to the proposed set of standardized guidelines. The questionnaire was sent on the email addresses of family physicians and nurses in whole Bosnia and Herzegovina. The collected data were subjected to reliability testing, exploratory and confirmatory factor analysis, which tested three alternative plausible models suggested by the extant literature: single factor, correlated two-factor and bifactor.

Results: A total of 272 out of 440 (RR = 61.3) nurses and physician working in family medicine in Bosnia and Herzegovina completed the PSS-10 Bosnia and Herzegovina version (BH). Participants were aged 25 to 69, with a mean age of 44.7 (± 10.55). Most participants were women (86.8%) and physicians (58.8%) with specialisation in family medicine (43%). The overall Cronbach's alpha was 0.87 and the test-retest reliability coefficient was 0.88. Exploratory Factor Analysis yielded 2 factors with eigenvalues of 4.77 and 1.35, accounting for 61.2% of variance. Factor 1 consisted of 6 items representing "perceived distress", whereas Factor 2 consisted of 4 items representing "perceived coping". The Confirmatory factor analysis indicated a very good fit of this bifactor model to this sample.

Conclusions: Our results implies that the PSS-10-BH, as a bifactor model with good reliability and validity, may accurately measure the stress levels of family medicine physicians and nurses.

1. Introduction

The Perceived Stress Scale (PSS) was developed by Cohen, Kamarck and Mermelstein in 1983 [1] and has since been widely used as a measuring instrument for self-assessment of stress levels. It was developed within the theoretical framework of the transactional model of stress, which emphasizes the interaction between stressful events and the individual's assessment of available coping resources. According to this model, stress results from a disproportionality between the perceived demands of an event and the individual's resources to meet

those demands [2].

The original scale consisted of 14 items (PSS-14) aimed at assessing life circumstances and situations as stressful for individuals. In addition to the original scale of 14 items, shortened scales containing ten (PSS-10) and four (PSS-4) items were also developed. In research, the PSS-10 version is most often used, due to its brevity, simple application, comprehensibility of the items and favourable psychometric properties [3].

The PSS-10 has been translated into more than 20 languages used in measuring perceived stress across various populations. The 10-item

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version has proven to be a valuable tool for stress research. The questions in the PSS-10 ask about feelings and thoughts during the last month, and participants were asked to rate how often they felt and thought a certain way in the past month. The PSS-10 consists of 10 items rated on a 5-point Likert scale, ranging from 0 (never) to 4 (very often), and contains six negatively worded items ("Negative", perceived distress - PD) and four positively worded items ("Positive", Perceived coping - PC). PSS scores are obtained by reversing responses (e.g., 0 = 4, 1 = 3, 2 = 2, 3 = 1 & 4 = 0) to the four positively stated items (items 4, 5, 7, and 8) and then summing across all scale items [4].

In a review of the psychometric properties of the PSS, Lee showed in 19 included studies that the PSS-10 was superior to the 14-item version. Cronbach's alpha consistently exceeded the standard threshold of 0.70 in the range between 0.74 and 0.91 [3]. The review also found consistent results supporting a two-factor structure, which contrasts with the original one-factor structure presented by Cohen et al. [1].

Although the PSS-10 has been translated into more than 20 languages and used in measuring perceived stress across various populations and languages, many psychometric studies on the PSS-10 require continued testing in more diverse and representative populations [5–11].

The issue of work-related stress is a prominent concern within the domain of family medicine and primary care, primarily attributable to the inherently demanding nature of the profession. The main factors that contribute to work-related stress in these domains encompass a heavy workload, the persistent pressure to deliver high-quality care within constrained timeframes, extended working hours that may include evening or weekend shifts, a disrupted equilibrium between work and personal life, emotional demands, administrative burdens, apprehension regarding complaints, legal claims, and litigation, elevated expectations and professional responsibility, unrealistic expectations from patients and their families, misinformation propagated by the media about the healthcare profession, and a negative public perception towards healthcare professionals [12,13].

The goal of this study was to investigate the reliability and construct validity of the Bosnian version of the PSS-10 among family medicine professionals.

2. Methods

Translation of PSS-10 is performed according to the proposed set of standardized guidelines for this process based on previous research in psychology and sociology and on published methodological frameworks [14]. Two physicians independently translated the PSS-10 into Bosnian language. After that, the differences in translation were thoroughly discussed and resolved by consensus and the translation was harmonized in an into the first version. Backward translation into English was done by the independent English language professor who had no insight into the original version of the questionnaire. After the adoption of the second version of the translation, the PSS-10-BH was validated in two ways: face validity and construct validity. Expert committee finally approved final version of translated PSS-10-BH.

The link of Google Forms questionnaire was sent on the email addresses of family physicians and nurses in whole Bosnia and Herzegovina. The sample size was based on the suggestion that 10–20 subjects are needed per item of the questionnaire [15] with a minimum number of 100 respondents to ensure the stability of the covariance-variance matrix [16].

The inclusion criteria were healthcare professionals (physicians and nurses) who work in the department of family medicine, voluntarily agreed to fill out the questionnaire, and answered all questions in accordance with the instructions. The exclusion criteria included healthcare professionals who did not work in the department of family medicine, did not provide informed consent to participate in the study, and did not fully complete the questionnaire.

The reliability of PSS-10-BH was assessed by testing internal

consistency and test-retest. Internal consistency is most often measured with an alpha coefficient (Cronbach's alpha) which reveals the extent to which questionnaire items are interrelated or whether they are consistent in measuring the same construct. Cronbach's alpha coefficient was accepted as satisfactory (values from 0.6 to 0.7) and high internal consistency (values from 0.7 to 0.9) [17]. Test-retest reliability is conducted to determine the ability of PSS-10-BH to measure subject performance consistently. Standard limits for test-retest reliability have not been firmly defined; therefore, any conclusion should be made with caution. We considered Intraclass Correlation Coefficient (ICC) < 0.5 poor, between 0.50 and 0.75 moderate, between 0.75 and 0.90 good, and a correlation of > 0.90 excellent [17,18].

An Exploratory Factor Analysis (EFA) was performed with the principal component and maximum likelihood extraction methods, followed by varimax rotation. The sample adequacy was assessed by the Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity. Factors with eigenvalues higher than 1.0 and items with loadings greater than 0.4 were accepted [15].

A Confirmatory Factor Analysis (CFA) will include information regarding the goodness-of-fit indicators for each factor model and the factor loadings, or relative weights, for each factor. The absolute fit was measured using Goodness-of-Fit Index (GFI), Root Mean Square of Error Approximation (RMSEA), and standardized root mean square residual (SRMR) with level of acceptance respectively $\geq .9$, < 0.08 and < 0.08 ^{3,4}. Incremental fit was calculated using Comparative Fit Index (CFI) expected to be more than 0.9 [5]. All statistics Size of the factor loading, average variance extracted (AVE), with a required value of more than ≥ 0.5 [19,20], and composite reliability (CR), with a required value of ≥ 0.7 or more, were used to estimate convergent validity [19,21].

The fit indices of three models were evaluated to see how well each model fit the data. The initial model is a one-factor model in which all ten PSS-10-BH items are loaded onto a single general factor (GF). In the second model six negatively worded questions are put onto one component as the perceived distress (PD) factor (items 1, 2, 3, 6, 9, 10), whereas four positively written items are loaded onto a separate factor as the perceived coping (PC) factor (items 4, 5, 7, 8). The third model, a bifactor model, is used to determine if the PSS is a generic measure of perceived stress with two distinct dimensions.

To address concurrent validity, indicated by the correlation between PSS-10, PD, and PC scores and two questions on self-perceived professional and family stress in the last month. Possible answers were 0 = no stress, 1 = mild stress, 2 = moderate stress, 3 = pronounced stress and 4 = very pronounced stress.

Descriptive statistics were obtained with comparisons made between the genders and profession (physician, nurse). The levels of perceived stress between the gender and profession were compared using independent sample t-tests with Cohen's d used as the effect size.

The statistical analysis was performed with Statistical Package for Social Sciences (SPSS) version 26 and IBM SPSS AMOS 21v except for AVE and CR which were calculated in MS EXCEL.

3. Results

The study participants (272) were family medicine health care professionals aged 25 to 69, with a mean age of 44.7 (± 10.55). Most participants were women ($n = 236$; 86.8%) and physicians ($n = 160$; 58.8%) with specialisation in family medicine (43%).

The mean PSS-10-BH total score for the sample was 21.26 (± 6.77) with range from 3 to 36; the means of subscales Perceived Distress and Perceived Coping were subsequently 14.77 (± 4.96) and 6.49 (± 2.68). Higher scores indices more stress.

The results of an independent-samples t-test indicate a not significant difference in perceived stress between male ($M = 19.38$, ± 6.60) and female ($M = 21.55$, ± 6.76), [$t(270) = 1.789$, $p = .075$, 95%CI - 0.216, 4.532]. The same test revealed a significant differences in perceived stress between nurses ($M = 22.67$, ± 6.99) and physicians ($M = 20.28$,

± 6.45), [$t(270) = 2.7912, p = .004, 95\%CI - 0.776, 4.014$]. Cohen's d subsequently was 0.32 and 0.36 which indicates a medium effect size.

Pearson correlation coefficients between perceived distress and perceived coping were .52 ($p < .01$). These moderate correlations suggest that the two subscales represent two related components of perceived stress.

Cronbach's α was calculated for the total PSS-10-BH items, perceived distress, and perceived coping items. Reliability estimates (Cronbach's α) of the total scale in the current sample was .87, .89 for the perceived distress factor and 0.72 for the perceived coping factor. For all the study variables skewness values and kurtosis values subsequently were found to be well within acceptable ranges ($\pm 0.5, \pm 3.00$). Analyses indicated that the AVE were for PSS-10 (GF), PD and PC consecutively equal to 0.478, 0.595 and 0.492. CR index of the GF, PD and PC were consecutively equal to 0.898, 0.898, 0.794. Therefore, reliability and the convergent validity of the construct was confirmed (Table 1).

Fifty participants of the total sample were asked to complete the PSS-10-BH twice with a one-week interval to assess the test-retest reliability. The questionnaire was completed out a second time by 41 (82%) respondents. Table 2 presents the test-retest reliability data. ICC values exceeded the value of 0.70, implying the presence of temporal stability. Mean age of test-retest responders was 44.7 (± 10.12), and 39 (95%) of them were women. Is worthy notice that all mean values of PSS-10, PD, and PC are way higher than the means of the whole sample.

To explore the factorial structure of PSS 10-BH, all 10 items of the instrument were subjected to an EFA with Varimax with Kaiser Normalization.

The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = 0.886. Bartlett's test of sphericity $\chi^2 (45) = 1178.005, p < .001$, indicating that correlation structure is adequate for factor analyses. The maximum likelihood factor analysis with a cut-off point of .40 and the Kaiser's criterion of eigenvalues greater than 1 yielded a two-factor solution as the best fit for the data with eigenvalues of 4.77 and 1.35, accounting for 61.2% of variance. The results of this factor analysis and factor loading are presented in Table 3.

Table 4 summarizes the fit indices for the alternative CFA models. The results indicate that the single factor for the PSS-10 scale

Table 1
Items, Means (SD), and Cronbach's α , AVE and CR for PSS-10 Items.

Item	In the last month, how often have you ...	M	SD	α	AVE	CR
PSS-10 Total		21.26	6.77	.87	.90	.48
Perceived distress		14.77	4.96	.89	.90	.60
Q1	... been upset because of something that happened unexpectedly?	2.69	0.92			
Q2	... felt that you were unable to control the important things in your life?	2.27	1.04			
Q3	... felt nervous and "stressed"?	2.75	0.98			
Q6	... found that you could not cope with all the things that you had to do?	2.13	1.07			
Q9	... been angered because of things that were outside your control?	2.68	1.02			
Q10	... felt difficulties were piling up so high that you could not overcome them?	2.25	1.17			
Perceived coping		6.49	2.68	.72	.79	.49
Q4	... felt confident about your ability to handle your personal problems?	1.47	0.90			
Q5	... you felt that things were going your way?	1.64	0.90			
Q7	... been able to control irritations in your life?	1.60	0.90			
Q8	... felt that you were on top of things?	1.78	0.93			

Notes: N = 272. PSS-10 item scores can range from 0 to 4. PSS-10 total score can range from 0 to 40.

Table 2

Test-retest reliability: Mean, SD and ICC values for the PSS-10-BH, PD and PC.

	Test Mean (SD)	Retest Mean (SD)	ICC
PSS-10-BH	24.46 (2.50)	24.66 (2.16)	0.88
PD	12.98 (3.17)	12.90 (2.58)	0.93
PC	11.49 (0.84)	11.76 (0.77)	0.73

Notes: ICC = Intraclass Correlation Coefficients; SD = Standard Deviation PD = Perceived distress; PC = Perceived coping.

Table 3

Exploratory factor analysis of the items of the PSS-10-BH

Item	In the last month, how often have you ...	Component		
		GF	PD	PC
Q1	... been upset because of something that happened unexpectedly?	.702	.738	
Q2	... felt that you were unable to control the important things in your life?	.792	.754	
Q3	... felt nervous and "stressed"?	.793	.833	
Q6	... found that you could not cope with all the things that you had to do?	.761	.692	
Q9	... been angered because of things that were outside your control?	.711	.794	
Q10	... felt difficulties were piling up so high that you could not overcome them?	.822	.806	
Q4	... felt confident about your ability to handle your personal problems?	.399		.757
Q5	... you felt that things were going your way?	.700		.664
Q7	... been able to control irritations in your life?	.468		.666
Q8	... felt that you were on top of things?	.632		.715

Notes: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. GF = General factor; PD = Perceived distress; PC = Perceived coping.

demonstrated an unacceptable fit to the data ($\chi^2 = 186.72, df = 35; \chi^2/df = 5.3; CFI = 0.60; GFI = 0.863; SRMR = 0.076; RMSEA = 0.224$).

The two-factor model fits the data better than the single-factor model, as evidenced by the decrease in the χ^2 -value and the improved CFI, GFI, SRMR, and RMSEA; however, the fit indices did not meet the accepted fit criteria ($\chi^2 = 95.73, df = 34; \chi^2/df = 2.8; CFI = 0.946; GFI = 0.935; SRMR = 0.047; RMSEA = 0.082$). In contrast to the single- and two-factor models, the bifactor model was judged to fit best with the early childhood teacher candidate sample ($\chi^2 = 60.04, df = 26; \chi^2/df = 2.3; CFI = 0.823; GFI = 0.956; SRMR = 0.034; RMSEA = 0.070$). The χ^2/df value for the bifactor model was smaller than those for the single- and two-factor models—another indication of a good fit (Fig. 1).

Concurrent validity was established, with a positive correlation with self-perceived professional and familial stress assessed using only one question for each stress. A moderate correlation was found PSS-10, PD with self-perceived professional stress, $r(270) = 0.563, p < .001$. Weak correlation was found with PSS-10, PD and self-perceived family stress, $r(270) = 0.426, p < .001$. Weak correlation was found with PC and professional stress, $r(270) = 0.252, p < .001$, and PC and family stress, $r(270) = 0.247, p < .001$.

4. Discussion

This is, to the best of our knowledge, the first study to evaluate the psychometric features of the Bosnian version of the PSS-10 in a sample of family medicine physicians and nurses. Our study was prompted by the growing concern about the impact of perceived stress on health workers in PHC and the adoption of the PSS-10 as a generalized stress measure for other populations. The objective of the present study was to examine the construct validity of a Bosnian translation of the PSS-10. The specification and evaluation of three competing models included a single-factor model, a two-factor model, and a bifactor model. In general, the CFA results give preliminary support for the validity and

Table 4

Goodness-of-fit indices of models for the PSS-10-BH (N = 272).

Model	k	x2	df	x2/df	CFI	GFI	SRMR	RMSEA (CI90)
Single-factor model	10	186.72*	35	5.3	0.868	0.863	0.076	0.126 (.109–.145)
Two-factor model (correlated)	10	95.73*	34	2.8	0.946	0.935	0.047	0.082 (.063–.101)
Bifactor model _a	10	60.04*	26	2.3	0.823	0.956	0.034	0.070 (.046–.093)

Notes: k = number of items; df = degrees of freedom; CFI = comparative fit index; GFI = goodness of fit index; SRMR = standardized root mean residual; RMSEA = root mean square error of approximation.

a Represents a final model used in the study. * $p < .01$.

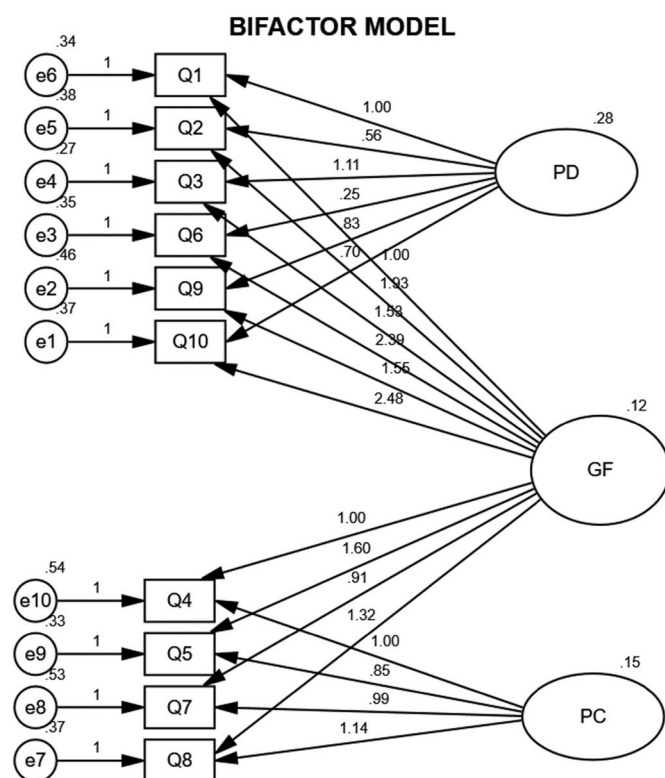


Fig. 1. Final PSS-10-BH bifactor model retrieved from confirmatory factor analysis. PD = Perceived distress; PC = Perceived coping; GF = General factor.

reliability of the PSS-10-BH among primary health care practitioners.

In the current study, the internal consistency estimates of the PSS-10-BH (all 10 items) and its two subscales were sufficient, meeting the cut-off of > 0.70 . According with previous research, the PSS-10-BH and its two subscales have acceptable and even greater reliability estimates than those published by others [1,22,23].

Based on the fit indices from the CFA, it was determined that the bifactor model, which indicated a unidimensional construct with two distinct factors (perceived distress and perceived coping), provided an adequate and better fit to the data than alternative models. Bifactor model have been favoured and validated in prior research in several countries with diverse participant structures. Additionally, perceived distress and perceived coping components had higher item loadings than general factor. While perceived distress and perceived coping factors exist independently, the PSS-10 is driven by a single underlying component of perceived stress. In conclusion, these results are similar with those of earlier research and imply that both the overall and subscale scores of the PSS are useable, as the measure is sufficiently unidimensional [10,22], [23–25]. Due to the similarity between the Serbian and Bosnian languages, it is especially intriguing that Jovanovic and Gavrilov-Jankovic also found that the bifactor model best fits their sample in Serbia [10].

In contrast of our findings, results from multiple current studies in

different countries with clinical and nonclinical samples indicate that the model with two distinct components (PD and PC) now predominates in PSS-10 research. The two components found by EFA had distinct contributions in a subsequent regression analysis. The results were supported by a CFA which indicated that the two-factor solution is well-fitting [3,5,7,26], [27], [28–33].

Prior study on the sources of work-related stress among healthcare employees in Bosnia and Herzegovina revealed that doctors and nurses, as well as participants in primary and secondary healthcare, have a distinct hierarchy of stressors. The research indicates that primary health care respondents perceive more difficult organizational, emotional, and communication issues [12]. Our results may urge to the management of the health system that they should optimize the organisation of work to reduce stressors and provide psychological and work support systems to reduce the stress of health professionals.

Nurses and physicians working in primary health care are particularly vulnerable due to high perceived stress. This research gives support to the PSS-10's suitability for usage in PHC workers. Despite its lack of validity as a measure of psychological symptomatology, the PSS-10 can be useful in identifying individuals at risk for certain clinical diseases related to high stress level. As an example of how the measure might be used in a PHC environment, it can be used as a screening tool to determine which PHC professionals require more care [30].

The strengths of this study include the utilisation of a widely recognised and validated instrument, the PSS-10, which has demonstrated credibility and reliability through extensive research conducted across diverse populations and languages. The PSS-10-BH's reliability and construct validity were thoroughly evaluated through a comprehensive psychometric assessment, encompassing measures such as Cronbach's alpha for internal consistency, test-retest reliability, exploratory and confirmatory factor analysis, as well as concurrent validity. Furthermore, the study addresses practical implications, such as the potential use of the PSS-10-BH for screening primary care patients.

Also, several limitations must be considered when interpreting the results. Firstly, the small sample size of only nurses and physicians from family medicine implies that our findings do not apply to other primary health care providers. Second, when all items and two factors were considered, positive correlations were revealed, justifying the calculation of a PSS-10-BH total score. Another weakness of our study is that we only evaluated the concurrent validity of PSS-10-BH scores with self-perceived professional and familial stress using one question for each stress. Furthermore, even though many study results show the existence of a two-factor structure, it should be highlighted that these factors may represent the directionality of item wording. Ultimately, no data were acquired regarding the temporal dependability of this scale. It will be essential to examine the stability of scores over time.

Replication with a larger, randomized sample would expand the knowledge on perceived stress among PHC workers. In line with many other studies on psychometric properties, the data was based on self-report questionnaires, the responses to which might have been swayed by social desirability. The findings would therefore be strengthened through interviews and physiological assessments.

5. Conclusion

Our findings revealed that the PSS-10-BH did not fit as a unidimensional or two-factor model. In line with prior studies, our findings support the use of a bifactor model for the PSS-10. This implies that the PSS-10-BH, as a bifactor model with good reliability and validity, may accurately measure the stress levels of family medicine physicians and nurses. Given that family medicine health professionals continue to suffer high levels of stress, the PSS-10-BH could be employed in a variety of future research on work-related stress in family medicine.

6. What this study adds

- Before this study, 10-item Perceived Stress Scale (PSS-10) has not been translated into Bosnian, nor has a study been conducted employing a sample of family medicine physicians and nurses to examine the instrument's reliability, validity, and factorial structure.
- This study has confirmed that the PSS-10-BH, as a bifactor model with good reliability and validity, may accurately measure the stress levels of family medicine physicians and nurses.
- By aligning with previous studies that have found support for the bifactor structure and evaluating the PSS-10 within the context of family medicine professionals, this study strengthens and expands the existing literature on stress assessment and measurement.

7. Implications for policy and practice

- The study validates the use of the Bosnian version of the Perceived Stress Scale (PSS-10-BH) as a reliable instrument for assessing stress levels among family medicine professionals in Bosnia and Herzegovina. This provides a practical tool that can be used in healthcare settings to measure perceived stress and identify individuals who may be at risk of high stress levels.
- The findings of this study highlight the specific stressors faced by family medicine professionals, such as heavy workloads, time constraints, and disrupted work-life balance. Healthcare organizations can use this information to develop targeted interventions aimed at reducing stress in these areas.
- The study contributes to raising awareness about the impact of stress on family medicine professionals and the need for addressing this issue. By disseminating the findings and promoting education on stress management, healthcare organizations can help create a culture that recognizes and prioritizes mental health and well-being among healthcare professionals.

Authors' contributions

Conception and design: Zaim Jatic (family physician, DSc) and Natasa Trifunovic (family physician, MSc); Acquisition, analysis, and interpretation of data: Zaim Jatic, Natasa Trifunovic, Hasiba Erkocevic (family physician), Elvira Hasanovic (family physician, MSc.), Irma Dzambo (psychologist, DSc.); Drafting the article: Zaim Jatic and Aida Pilav (public health specialist, DSc) Revising it critically for important intellectual content: Zaim Jatic, Irma Dzambo and Aida Pilav; Approved final version of the manuscript: Zaim Jatic.

Statements of ethical approval

This work has been approved by the Ethical committee of The Family Medicine Physicians Association (N° EK-01-011-CS/22, date 18.05.2022) and participants gave informed consent to participate, after receiving detailed information about the purpose, method of conducting the research and data storage.

Availability of data and materials

The datasets analysed during the current study are available from the corresponding author on reasonable request.

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Declarations of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.puhip.2023.100413>.

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