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Original research article

Psychometric properties of the Slovak version of the nine-item European Heart Failure Self-Care Behaviour Scale

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Abstract
Introduction: The ability to self-care is considered essential in heart failure management. One of the valid and reliable instruments that allow the measurement of heart failure self-care behaviour is the European Heart Failure Self-Care Behaviour Scale (EHFScBS-9).
Objective: To adapt and assess psychometric properties of the Slovak version of the EHFScBS-9.
Methods: In this descriptive validation study, 122 Slovak heart failure patients completed the EHFScBS-9, the Cardiac Self-Efficacy Questionnaire (CSEQ), and Personal Well-being Index (PWI). Item analysis, confirmatory factor analysis (CFA), and convergent and discriminant validity were evaluated. Cronbach's alpha was calculated to assess reliability.
Results: The results of CFA confirmed a good fit of the two- respectively three-factor structure of the Slovak EHFScBS-9. Convergent validity was confirmed by positive correlation between the Slovak EHFScBS-9 and the CSEQ. Discriminant validity was supported by poor correlation between EHFScBS-9 and PWI. Cronbach's alpha coefficient for the total EHFScBS-9 instrument of Slovak version was 0.77.
Conclusion: The Slovak version of the EHFScBS-9 instrument is valid and reliable to measure self-care behaviour in heart failure patients.

Keywords: Confirmatory factor analysis; European Heart Failure Self-Care Behaviour Scale- 9; Reliability; Validity

Introduction

Heart failure (HF) is a condition in which the heart, with satisfactory venous return, is unable to maintain a minute volume sufficient to meet the oxygen requirements of the individual tissues. The most common risk factors for the development of heart failure are coronary artery disease and arterial hypertension. Heart failure is often referred to as the epidemic of the 21st century. It is characterised by rising incidence and prevalence (especially with an ageing population), which is reflected in the increasing number of morbidities, mortalities, hospital admissions, and health care costs for heart failure patients, both globally (Emmons-Bell et al., 2022; Roger, 2021) and in the Slovak Republic (Gonçalvesová and Danková, 2018; National Health Information Center, 2023). Despite advanced treatment, the prevalence and unfavourable prognosis of heart failure is increasing. Thus, heart failure is becoming a major social and health care problem (Urbich et al., 2020). In light of this, it is necessary to focus on those factors that influence the success of its treatment.

Specific self-care interventions in heart failure (e. g., educational sessions, psychosocial strategies, motivational interviewing) belong to some of the strategies that lead to improved health outcomes in patients with heart failure (Huang et al., 2022; Liu et al., 2022). Current systematic reviews and meta-analyses of randomized controlled trials (Huang et al., 2022; Liu et al., 2022) and international guidelines for heart failure therapy (Heidenreich et al., 2022; Humbert et al., 2022, McDonagh et al., 2022) recommend their application in clinical practice, as they contribute to the reduction of hospitalisations and mortality in patients with heart failure, as well as to healthcare cost savings, increased adherence to treatment, and improved quality of life.

The ability to self-care is considered essential in chronic disease management. Riegel et al. (2012) proposed a moderate theory focusing on self-care in chronic illness. Riegel et al. (2012; 2019) and Jaarsma et al. (2017) define self-care as the process of maintaining health through processes focused on health-promoting practices and disease management. The process of self-care includes the processes of: (a) maintaining self-care (e.g., adherence to self-care behaviours such as regular exercise, taking medications as prescribed), (b) monitoring self-care (e.g., regular measurement and evaluation of changes, routine testing), and (c) managing self-care (e.g., changing diet or medication dosage according to symptoms detected).

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Self-care processes are influenced by several factors, such as an individual's knowledge, skills and abilities, previous experiences, intrinsic and extrinsic motivation, cultural beliefs and values, self-confidence, daily routines, functional and cognitive abilities, social support, and availability of health care.

Successful strategies to improve health outcomes in patients with heart failure include activities focused on self-care maintenance (e.g., adherence to medication, regular physical activity, adherence to a low-sodium diet, no smoking), symptom monitoring (e.g., daily body weight monitoring, incidence of swelling), and disease management (medication adjustment, diet and exercise adaptation, seeking support and medical care) (Heidenreich et al., 2022; Humbert et al., 2022, Jaarsma et al., 2021; McDonagh et al., 2022). Although systematic reviews and meta-analyses point to the benefit of heart failure self-care interventions (Huang et al., 2022; Liu et al., 2022), self-care practices are insufficient in heart failure patients (Aghajanloo et al., 2021). In light of this, it is important to regularly monitor self-care in heart failure and to design programmes that lead to an increase in the effectiveness of self-care activities.

According to the National Health Information Center (2023), the diagnosis of heart failure is one of the leading causes of hospital admissions in Slovakia. To improve health outcomes and quality of life and to reduce the number of hospital admissions and other complications of HF patients, increasing patients' self-care skills seems to be vital. Naturally, this requires adequate screening for self-care abilities in this group of patients. One of the instruments that allow us to measure patient self-care behaviour in heart failure is the European Heart Failure Self-Care Behaviour Scale (EHFScBS) (Jaarsma et al., 2009). The nine-item EHFScB-9 was identified as a valid and reliable instrument (with one, two, and/or three factors solution) to measure heart failure-related self-care behaviour internationally (Jaarsma et al., 2009; Sedlar et al., 2017; Vellone et al., 2014). However, to the best of our knowledge, there is no version of this tool in the Slovak language, or another valid and reliable tool to assess self-care in heart failure in Slovakia. Thus, the objective of this study was to conduct a linguistic and cultural adaptation of the Slovak version of the EHFScBS-9 instrument and to assess the psychometric properties and structural composition of this instrument.

Materials and methods

Design

A cross-sectional quantitative descriptive validation research design was chosen to test the measurement properties of the Slovak EHFScBS-9 instrument. To evaluate the reliability and validity (construct, convergent, discriminant) of the instrument based on its items, traditional principles of Classical Testing Theory (Lord et al., 2008) were followed.

Translation and cultural adaptation

The translation process and cultural adaptation of the Slovak EHFScBS-9 version was carried out in accordance with the guidelines for the translation and cultural adaptation process for patient-reported outcomes measures (Wild et al., 2005) after obtaining the author's permission to use the instrument. The EHFScBS-9 was translated from its original English version into Slovak by two independent bilingual translators. The forward-translated versions were compared. Any ambiguities and discrepancies of words, sentences, and meanings related to medical terminology, cultural and linguistic nuances were discussed by translators and researchers. On the basis of the consensus reached, a preliminary first Slovak version of the tool was created. The preliminary Slovak version was translated back into English by two independent professional bilingual translators (linguists). Both versions were compared between each other and with the original version. Content, meaning, linguistic and cultural accuracy were discussed by both certificated translators, a methodologist, researchers (authors), and a physician. The translations did not differ in terms of professional and linguistic meaning; the individual translations conveyed the same meaning and contents of the instrument (instructions, items, scale). Based on the consensus of the working group, a preliminary final version of the tool in Slovak language was approved. Next, a cognitive debriefing was conducted with five adult patients diagnosed with heart failure, focusing on clarity, intelligibility, content and meaning of the instructions, items, and scales. After completing the questionnaire, patients declared its unambiguous clarity, comprehensibility, and content appropriateness. The Slovak version of the instrument was approved and issued to patients with heart failure for the purpose of this study.

Sample and setting

The nonprobability convenience sampling method was used to select the study participants. We included patients with a diagnosis of heart failure determined by a physician (verified in the patient's medical record), who were aged 18 years and over, spoke Slovak, were willing to cooperate, and had signed an informed consent form. Age less than 18 years, pregnancy, severe neurological diseases, cognitive deficit or mental disorder were exclusion criteria. According to the Classical Testing Theory, a sufficient sample size should also be ensured to achieve the required level of measurement precision. For both exploratory and confirmatory factor analysis, rules were offered stating the minimum number of subjects for each item of the instrument to be estimated, e.g., at least 10 subjects per parameter (Cappelleri et al., 2014; Krabbe, 2016). Considering the 9 items constituting the EHFScBS-9 instrument, we needed a minimum of 90 research subjects. The questionnaires were distributed and collected by general nurses who were informed about the purpose of the study and trained on how to complete the questionnaires. We issued 200 questionnaires at outpatient clinics of two hospitals in Slovakia between March 2022 and June 2023. 129 questionnaires were returned completed by patients. 7 questionnaires were excluded due to insufficient completion of the questionnaire (data loss more than 10%). 122 questionnaires were included in the final statistical analysis (response rate 61%).

Data collection

HF patients completed the Slovak version of the EHFScBS-9 (Jaarsma et al., 2009) after its linguistic and cultural validation, the Cardiac Self-Efficacy Questionnaire (Sullivan et al., 1998) (to assess convergent validity), Personal Wellbeing Index (International Wellbeing Group, 2013) (to evaluate discriminant validity), and a questionnaire aimed at assessing socio-demographic and clinical characteristics. Selected clinical characteristics were obtained by transcribing them from the patient's medical records or assessing them on-site during completion of the questionnaire.

The EHFScBS-9 (Jaarsma et al., 2009; Sedlar et al., 2017) is a 9-item scale assessed "Consulting behaviours" and "Adherence to regimen" in HF patients. Patients select responses from a Likert scale ranging from 1 – strongly agree to 5 – strongly disagree. The total score of an instrument can be calculated in

two ways: as a total raw score and/or as a total standardized score. The total raw score is obtained by summing the responses to the individual items. It can range from 9 to 45 points, with higher scores representing poorer self-care. We also calculated a standardised score. Item scores were recoded first and then standardised scores ranging from 0–100 were calculated, with higher scores indicating better self-care. The instrument is considered valid and reliable, and recommended for assessing self-care behaviours in clinical practice and research (Sedlar et al., 2017; Vellone et al., 2014).

The Cardiac Self-Efficacy Questionnaire (Sullivan et al., 1998) is a valid and reliable instrument consisting of 13 items aimed at assessing symptom control self-efficacy and maintaining the functions in coronary artery disease. The patient selects answers from a Likert scale ranging from 0 – not at all confident, to 4 – completely confident. The scores of the two domains are obtained by summing the responses from the items comprising the domain. The total raw score is calculated as a sum of the responses from the items. Higher scores indicate higher levels of self-efficacy. Reliability of the CSEQ was excellent (Cronbach's alpha = 0.83) in this study.

The Personal Wellbeing Index (PWI-8) (International Wellbeing Group, 2013) is a valid and reliable instrument assessing the cognitive dimension of subjective well-being in the adult population. It includes eight items, focusing on satisfaction with standard of living, health, life achievements, relationships, safety, community, future security, and religious life. Respondents rate the items on a scale of 0 (completely dissatisfied) to 10 (completely satisfied with life). The total score is calculated as the arithmetic mean of the sum of the individual items on a 0–100 point (percentage) scale. Higher scores indicate higher personal well-being. The Cronbach's alpha of the PWI confirms the excellent reliability of the instrument as a whole (0.88).

Socio-demographic data included assessment of age, gender, marital status, and education level. Clinical characteristics included poly-morbidity rate, New York Heart Association functional assessment (NYHA, stage I–IV), and ejection fraction of heart left ventricle (normal – 50% and more, lower than normal – 40–49%, very low – 40% and lower).

Ethical considerations

The study was approved by the local Ethics Committee of the Faculty of Medicine, Pavol Jozef Šafárik University in Košice (no. 9N/2020 and 20N/2022), as well as by medical institutions in the Slovak Republic. The study was conducted in accordance with the principles of human subjects' research according to the 1964 Declaration of Helsinki and its subsequent amendments and national documents regulating the ethical aspects of research. All participants were informed in advance of the content and objectives of the research study, that participation in the study was anonymous, voluntary, and they could cancel their participation at any stage. Patients confirmed their participation in the research study by signing an informed consent form.

Data analysis

Descriptive statistical methods [absolute value (*N*), percentages (%), median, interquartile range, mean, standard deviation (± SD)] were used to describe the socio-demographic and clinical characteristics of the patients and their responses on the EHFScBS-9 instrument. Item analysis, confirmatory factor analysis, and convergent validity were used to assess construct validity. Item distribution, item total correlation, and Cronbach's alpha in case the item was deleted were tested as part of the item analysis. Confirmatory factor analysis models were conducted to evaluate the theoretical assumption that the 9-item version of the EHFScBS instrument has a 2-factor structure (Jaarsma et al., 2009) and/or 3-factor structure (Vellone et al., 2014). The Chi-square value (χ^2), $p > 0.05$, the Root Mean Square Error of Approximation (RMSEA) <0.07, the Goodness-of-Fit Index (GFI) ≥0.95, the Tucker–Lewis Index (also known as Not-Normed Fit Index) (TLI) ≥0.95, and Comparative Fit Index (CFI) ≥0.95 were considered as acceptable fit indices of the confirmatory factor analysis models in this study (Hooper et al., 2008). Convergent validity was assessed by Pearson's correlation coefficient (*r*) between the EHFScBS-9 and the Cardiac Self-Efficacy Questionnaire. Differences in the EHFScBS-9 scores by ejection fraction of heart left ventricle and NYHA were calculated by analysis of variance. Discriminant validity was assessed by Pearson's correlation coefficient (*r*) between the EHFScBS-9 and PWI. Cronbach's alpha was calculated to assess internal consistency reliability. A *p*-value of ≤0.05 was chosen as the cut-off for statistical significance.

Data were processed and analysed using the statistical software packages IBM SPSS 25.0 (IBM Corp., 2017) and IBM AMOS 23.0 (Arbuckle, 2014).

Results

Sample characteristics

The mean age of Slovak heart failure patients was 71.49 (± 10.44) years. The majority of the sample was female (60%), 59.0% of patients lived with a partner, and most of them had completed secondary education (73.8%) followed by university education (15.6%). On average, there were 5.80 diseases per patient, including heart failure. The mean left ventricle ejection fraction was 50.43% (± 9.04). The majority of patients (51.6%) had normal heart left ventricle ejection fraction (50% and more), 23.8 % had 40–49%, and 9.0% had 40% and lower ejection fraction of heart left ventricle. However, we missed 15.6% of data of heart left ventricle ejection fraction. 41.0% of the sample was in NYHA stage II, 14.8% stage I, 16.4% stage III, and 0.8% (1 patient) stage IV. Nevertheless, we lost 27.0% data of NYHA stages.

Item analysis

An initial analysis of the items of the Slovak version of the EHFScBS-9 is displayed in Table 1. Item analysis revealed that the most common self-care activity (score 1) conducted by patients was taking medications as prescribed, followed by items consulting shortess of breathing, consulting for the occurrence of oedema, and adherence to a non-salted diet. Heart failure patients were least likely (score 5) to consult with a doctor or nurse about weight gain and the occurrence of fatigue. The mean raw total score of the Slovak EHFScBS-9 was 24.14 (± 7.31) and the mean standardised score of the instrument was 57.94 (± 20.31). The correlations between the above means were completely negative ($r = -1.00$, $p = 0.000$). Most items demonstrated a satisfactory item-total correlation ≥0.3. Only two items (8 and 9) had weak item-total correlations of lower than 0.2, and for these items "Cronbach's alpha if item deleted" increased slightly.

Table 1. Item analysis for the Slovak version of the European Heart Failure Self-Care Behaviour Scale – 9 (*N* = 122)

Item	Median (interquartile range)	Percentages of responses per each Likert point					Item-total correlation	Cronbach's alpha if item deleted
		1	2	3	4	5		
1. I weigh myself every day	3 (1–4.25)	34.4	14.8	18.0	8.2	24.6	0.37	0.77
2. If shortness of breath increases, I contact my doctor or nurse	2 (1–3)	35.2	21.3	25.4	5.7	12.3	0.55	0.74
3. If legs/feet are more swollen, I contact my doctor or nurse	2 (1–3)	32.0	23.0	23.0	7.4	14.8	0.67	0.72
4. If I gain my weigh more than 2 kg in 7 days I contact my doctor or nurse	3 (2–5)	15.6	13.1	25.4	14.8	31.1	0.52	0.74
5. I limit the amount of fluids	3 (1–5)	28.7	9.8	20.5	15.6	25.4	0.50	0.75
6. If I experience fatigue, I contact my doctor or nurse	3 (2–5)	18.0	13.9	24.6	14.8	28.7	0.59	0.73
7. I eat a low-salt diet	2 (1–3)	32.0	22.1	27.0	12.3	6.6	0.54	0.74
8. I take my medication as prescribed	1 (1–1)	83.6	7.4	4.9	3.3	0.8	0.15	0.78
9. I exercise regularly	3 (2–4)	11.5	14.8	31.1	19.7	23.0	0.18	0.79

Confirmatory factor analysis

Previous studies have identified a 1-factor, 2-factor (Jaarsma et al., 2009), and/or 3-factor structure of the EHFScBS-9 (Vellone et al., 2014). In the Slovak version of the EHFScBS-9, no single-factor model was confirmed. We then proceeded to test a two-factor and a three-factor model for the Slovak version of the EHFScBS-9 (Table 2).

Initially, the first confirmatory factor analysis was conducted to test the hypothesised 2-factors model (consulting and adherence behaviours) of the Slovak EHFScBS-9. This resulted in an acceptable fit: χ^2 = 40.32, p = 0.036; RMSEA = 0.067; CFI = 0.943; TLI = 0.921; GFI = 0.934. However, the value of CFI, TLI, and GFI was lower than 0.95. The second confirmatory factor analysis was performed taking into con-

Table 2. Factor loadings, factor correlations, and goodness-of-fit indices for two measurement models on the Slovak EHFScBS-9, based on confirmatory factor analysis (*N* = 122)

Item	Two factor model		Three factor model		
	Factor I	Factor II	Factor I	Factor II	Factor III
2. If shortness of breath increases, I contact my doctor or nurse	0.75	–	0.76	–	–
3. If legs/feet are more swollen, I contact my doctor or nurse	0.83	–	0.83	–	–
4. If I gain my weigh more than 2 kg in 7 days, I contact my doctor or nurse	0.62	–	0.62	–	–
6. If I experience fatigue, I contact my doctor or nurse	0.68	–	0.69	–	–
1. I weigh myself every day	–	0.48	–	0.46	–
5. I limit the amount of fluids	–	0.59	–	0.57	–
7. I eat a low-salt diet	–	0.64	–	0.64	–
8. I take my medication as prescribed	–	0.22	–	–	0.34
9. I exercise regularly	–	0.26	–	–	0.41
Modification indices Covariance u9 ↔ u2	–0.33		–0.32		
Factor correlations					
Factor I	–	0.75	–	0.79	0.38
Factor II		–		–	0.70
Factor III		–			–
Goodness-of-fit					
χ^2 (df)	29.57 (25)		27.73 (23)		
P-value	0.241		0.226		
RMSEA	0.039		0.041		
GFI	0.951		0.955		
CFI	0.982		0.981		
TLI	0.974		0.971		

Note: EHFScBS-9 – 9-item version of the European Heart Failure Self-Care Behaviour Scale; RMSEA – Root Mean Square Error of Approximation; GFI – Goodness-of-Fit Index; CFI – Comparative Fit Index, TLI – Tucker-Lewis Index

sideration modifying indices (Table 2). The following values of fit statistics indicated a good fit of the second confirmatory factor analysis model of the EHFScBS-9: $\chi^2 = 29.57$, $p = 0.241$; RMSEA = 0.039; CFI = 0.982; TLI = 0.974; GFI = 0.951. Next, we tested the 3-factor structure of the EHFScBS-9. The fit indices showed an acceptable structure of the 3-factor model: $\chi^2 = 36.16$, $p = 0.053$; RMSEA = 0.065; CFI = 0.952; TLI = 0.928; GFI = 0.941. Further confirmatory factor analysis was implemented that took into account modifying indices (Table 2) and resulted in a good fit of the second confirmatory factor analysis of the 3-factor model of the EHFScBS-9.

Convergent and discriminant validity

Convergent validity was determined for the EHFScBS-9 instrument. The Slovak EHFScBS-9 standardised score significantly correlated with the total score of the Cardiac Self-Efficacy Questionnaire ($r = 0.23$, $p = 0.014$). However, in our sample, no differences were found in the EHFScBS-9 standardised score by heart left ventricle ejection fraction nor NYHA stages ($p > 0.05$). Discriminant validity was assessed by correlation between EHFScBS-9 and PWI. The outcomes of correlation analysis confirmed that there was no significant relationship between these variables ($r = -0.047$, $p = 0.616$), confirming that the EHFScBS-9 instrument assesses a more distinct construct than PWI.

Reliability analysis

The reliability of the overall EHFScBS-9 instrument was satisfactory (Cronbach's alpha value was 0.77), as well as for the "Consulting behaviour" subscale (Cronbach's alpha = 0.81). However, reliability of the "Adherence behaviour" subscale of the two-factor model was lower (Cronbach's alpha = 0.56). In the 3-factor model of the Slovak EHFScBS-9, Cronbach's alpha for the "Consulting behaviour" subscale remained unchanged. For the "Autonomy based adherence" subscale it was 0.58, and the reliability of "Provider based adherence" subscale was unsatisfactory (Cronbach's alpha was 0.22).

Discussion

This study showed that the Slovak version of the EHFScBS-9 instrument is valid and reliable to measure self-care behaviour in heart failure patients. These results are consistent with previous findings supporting the satisfactory psychometric properties of the EHFScBS-9 in other languages and cultures (Ben Gal et al., 2020; Jaarsma et al., 2009; Østergaard et al., 2017; Son and Won, 2020; Uchmanowicz and Wleklik, 2016; Vellone et al., 2014).

The mean raw total score and the mean standardised score of the Slovak version of the EHFScBS-9 was similar to the results reported in previous studies by several authors (Ben Gal et al., 2020; Jaarsma et al., 2009; Son and Won, 2020; Vellone et al., 2014). In our study, most items revealed satisfactory item-total correlations and the decrease in reliability in case that an item would be deleted in both versions of tested instruments. Weak item-total correlations were identified only in two items – medication adherence and regular exercise. This is similar to the Hebrew (Ben Gal et al., 2020), Danish (Østergaard et al., 2017), or Polish (Uchmanowicz and Wleklik, 2016) versions, but in contrast to the results of the original study of Jaarsma et al. (2009) and the Korean study of Son and Won (2020). In the case of the item on medication adherence in the Slovak version, the low total-item correlation could also be explained by the fact that the item has very low variability in the answer categories – many patients responded in the same way. This could be related to the greater homogeneity of the sample, as patients were recruited from a limited number of health facilities.

The results of confirmatory factor analysis models pointed to a good fit for the two- and three-factor solution of the Slovak version of the EHFScBS-9. This supports the theoretical assumption that the EHFScBS-9 consists of two domains: "Consulting behaviour" (Factor I) and "Adherence behaviour" (Factor II) demonstrated in the original study (Jaarsma et al., 2009), or three domains: "Consulting behaviour" (Factor I), "Autonomy-based behaviour" (Factor II), and "Provider-based behaviour" (Factor III) described in a revisited study (Vellone et al., 2014). Factor I "Consulting behaviour" was saturated with the same items in both the 2- and 3-factor model of the Slovak EHFScBS-9. In the 3-factor solution of the EHFScBS-9, Factor II "Autonomy-based behaviour" was filled with items focused on fluid management (weighing oneself, water, and salt restriction), and the third factor – "Provider-based behaviour" – was filled with items focused on medication adherence and regular exercise. The items saturating factors II and III (salt restriction, regular exercise) in the 3-factor solution were slightly different compared to those reported by Vellone et al. (2014) or Østergaard et al. (2017), but the same as in the Korean (Son and Won, 2020) and Greek studies (Lambrinou et al., 2014). However, in the Slovak version, a negative association was found between the items "I exercise regularly" and "If shortness of breath increases I contact my doctor or nurse". This suggests that when heart failure symptoms worsen (in this case, dyspnoea), patients will limit their physical activity. The limitation of physical activity could also be related to heart failure patients' fear of physical activity and subsequent fear of worsening heart failure symptoms (dyspnoea, angina, etc.) due to exercise (Qin et al., 2023). Having said that, patients would need a deeper understanding and support from health professionals in relation to regular physical activity.

In this study, Cronbach's alpha coefficient for the total of the Slovak EHFScBS-9 version was a satisfactory 0.77, comparable with other studies (Jaarsma et al., 2009). In the 2-factor structure model of the Slovak EHFScBS-9, the "Consulting behaviour" subscale was also satisfactory and comparable to the results of most previous studies (Ben Gal et al., 2020; Jaarsma et al., 2009; Østergaard et al., 2017; Son and Won, 2020; Vellone et al., 2014). However, the "Adherence behaviour" subscale scored lower (Cronbach's alpha 0.56). This could be related to lower factor loading and weak item-total correlations of items 8 and 9 ("medication adherence" and "regular exercise"), as well as the heterogeneous construct of items 8 and 9 versus items 1, 5, 7 that focus on fluid management (Tavakol and Dennick, 2011). This result is similar to the study of Jaarsma et al. (2009) (Cronbach's alpha in pooled sample was 0.56, in the separates samples it ranged from 0.17 to 0.78) and Østergaard et al. (2017) (Cronbach's alpha = 0.54). Meanwhile, higher internal consistency was found, for example, in the Hebrew version (Cronbach's alpha was 0.68) (Ben Gal et al., 2020). In the case of the 3-factor model of the instrument, the reliability of the "Consulting behaviour" subscale was not changed, the "Autonomy based adherence" subscale had lower reliability (Cronbach's alpha was 0.58), and the "Provider based adherence" subscale had unsatisfactory reliability (0.22). This is inconsistent with some previous studies (Østergaard et al., 2017; Son and Won, 2020; Vellone et al., 2014). The 3-factor solution has lower internal consistency compared to the 2-factor solution, which is related to the reduction in the number of items in factors 2 and 3. The lower number and heteroge-

neity of items in the 2nd and 3rd factor may explain the low reliability of the 3-factor model of the EHFScBS-9. From this perspective, the 2-factor solution of the instrument appears to be psychometrically more robust and reliable.

Several studies (Ben Gal et al., 2020; Jaarsma et al., 2009; Son and Won, 2020; Uchmanowicz and Wleklik, 2016) demonstrated convergent and/or discriminant validity of the EHFScBS-9. In this study, convergent validity was confirmed by identifying a positive correlation between the Slovak EHFScBS-9 and the Cardiac Self-Efficacy Questionnaire, which measures a similar construct. We found no associations between the Slovak EHFScBS-9, heart left ventricle ejection fraction, and NYHA stages. However, most of the Slovak heart failure patients had normal ejection fraction and were included in NYHA stage II. As expected, discriminant validity was supported by a poor correlation between EHFScBS-9 and PWI, which means that EHFScBS-9 measures a different construct than personal wellbeing.

In our opinion, the strengths of this study include the rigorous translation of the original questionnaire, its cultural adaptation, the testing of the one-, two-, and three-factor solution, as well as the confirmation of the validity and reliability of the Slovak version of the instrument. However, the study had several limitations. We only considered face validity and did not assess the content validity index as part of the linguistic validation, and we did not perform some psychometric tests, e.g., test-retest reliability. We sampled patients from a limited number of health facilities from the Košice region, which may have affected the homogeneity of some patient statements (some items may reflect a similar local situation, e.g. in the way healthcare is provided, social and cultural circumstances). In the Slovak sample, we lost more than 10% of data related to heart left ventricle ejection fraction and NYHA. We had an unequal distribution of patients with ejection fraction of the heart left ventricle and NYHA in our sample. Patients in stage IV according to NYHA classification were also absent, which may be because we collected data in outpatient clinics – and a large proportion of these patients tended to be in acute inpatient setting. Future research should be conducted in a variety of healthcare settings that provide both general and specialised cardiac care. The reliability of the instrument as a whole was satisfactory, but another limitation was the lower reliability of its three-factor structure. In light of this, it seems more appropriate to evaluate patients' statements by calculating a total score rather than scoring individual domains.

Conclusion

The Slovak EHFScBS-9 instrument has proved to be a psychometrically robust, valid, and reliable tool for the assessment of self-care behaviour in Slovak patients with heart failure. The instrument may be used in clinical practice as well as in future research trials.

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Author considerations
All authors have contributed significantly to the manuscript preparation. *Mária Sováriová Soósová* and *Elena Gurková* contributed to the study conception and design, data collection, statistical analysis and interpretation, writing the manuscript, and critical final revision. *Renáta Suchanová* contributed to administration and data collection. *Peter Kolarčik* took part in statistical analysis revision, data interpretation, and critical review. *Ewelina Bąk* contributed to the study conception, design, and critical review. The manuscript has been seen and approved by all authors.

Ethical considerations
The study was approved by the Ethical Committee of the Faculty of Medicine, Pavol Jozef Šafárik University in Košice (no. 9N/2020 and 20N/2022) and by the local ethics committee and/or local review board of health facilities. All procedures performed that involved human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments (or comparable ethical standards). All study subjects gave informed consent and the anonymity of patients was preserved.

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Conflict of interest
The authors have no conflict of interest to declare.

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