

VALIDATION OF THE CROATIAN VERSION OF WORK ABILITY INDEX (WAI) IN POPULATION OF NURSES ON TRANSFORMED ITEM-SPECIFIC SCORES OVREDNOTENJE HRVAŠKE RAZLIČICE INDEKSA DELOVNE SPOSOBNOSTI V POPULACIJI MEDICINSKIH SESTER NA PREOBLIKOVANIH REZULTATIH, SPECIFIČNIH ZA POSAMEZNO POSTAVKO

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ABSTRACT

Aim: To assess the psychometric properties of the Croatian version of a Work Ability Index Questionnaire (WAIQ-CRO) in the population of nurses by using a specific methodological approach.

Keywords: psychometric properties, work ability index questionnaire, validation, nurses, occupational health

Methods: A cross-sectional survey was conducted in a sample of 711 Croatian nurses in 2018 in Zagreb, Croatia. The instrument's internal consistency was assessed by using Cronbach's alpha coefficient (α). The factor structure was verified by confirmatory (CFA) and exploratory factor analysis (EFA), with the assumption of a single-factor structure. To ensure the equality of importance of items in the assessment, the item-specific scores were transformed.

Results: The internal consistency of the instrument was satisfactory ($\alpha=0.71$). CFA showed poor first model (Model-1) compatibility data ($p<0.001$, CFI=0.85, GFI=0.93, RMSEA=0.13). The modified indexes suggested the introduction of correlation parameters residual variances of results from WAIQ-CRO Item-1 and Item-2. After introducing these covariances, the index model assessment (Model-2) showed desirable assessment measures ($p<0.001$, CFI=0.95, GFI=0.97, RMSEA=0.08). Comparison showed better compatibility of Model-2 ($p<0.001$). The implementation of EFA has identified three factors. Replication of this model in CFA resulted in relatively good model assessment approaches with data ($p<0.001$, CFI=0.96, GFI=0.98, RMSEA=0.07). Comparison of this model (Model-3) with Model-2 showed a significantly better compatibility of Model-3 ($p<0.001$).

Conclusion: The WAIQ-CRO proved to be a reliable and valid instrument which can be used in research among Croatian nurses. The results suggest that it would be better to consider a three-factor structure than a single-factor structure, as a three-factor structure can direct decision-makers to which segment to locate interventions.

IZVLEČEK

Namen: Ovređnotiti psihometrične lastnosti hrvaške različice vprašalnika indeksa delovne sposobnosti (WAIQ-CRO) v populaciji medicinskih sester ob uporabi posebnega metodološkega pristopa.

Ključne besede: psihometrične lastnosti, vprašalnik indeksa delovne sposobnosti, validacija, medicinske sestre, poklicno zdravje

Metode: Presečna raziskava je bila opravljena na vzorcu 711 hrvaških medicinskih sester leta 2018 v Zagrebu, Hrvaška. Notranja skladnost instrumenta je bila ocenjena z uporabo Cronbachovega koeficienta alfa (α), za ovrednotenje njegove faktorске strukture pa sta bili uporabljeni tako konfirmativna (CFA) kot eksplorativna (EFA) faktorška analiza s predpostavko eno-faktorске strukture. Da bi zagotovili enakost pomembnosti postavk pri vrednotenju, so bili rezultati, specifični za posamezno postavko, preoblikovani.

Rezultati: Notranja konsistentnost instrumenta je bila zadovoljiva ($\alpha = 0,71$). Rezultati prvega modela CFA (Model-1) niso bili ugodni ($p < 0,001$; CFI = 0,85; GFI = 0,93; RMSEA = 0,13). Preoblikovane vrednosti so nakazale uvedbo kovariacij pri postavkah 1 in 2. Po njihovi uvedbi so se rezultati v drugem modelu (Model-2) močno izboljšali ($p < 0,001$, CFI = 0,95, GFI = 0,97, RMSEA = 0,08). Rezultati EFA so nato pokazali trifaktorsko strukturo. Ponovitev tega modela v CFA je pokazala relativno dobre rezultate ($p < 0,001$, CFI = 0,96, GFI = 0,98, RMSEA = 0,07). Primerjava tega (Model-3) z Modelom-2 je pokazala, da je Model-3 bistveno boljši ($p < 0,001$).

Zaključek: WAIQ-CRO se je izkazal kot zanesljiv in veljaven instrument, ki ga lahko uporabljamo pri raziskavah med hrvaškimi medicinskimi sestrami. Rezultati kažejo, da bi bilo bolje razmisliti o tri- kot eno-faktorski strukturi instrumenta, saj lahko trifaktorska struktura pomaga pri presoji, v kateri segment naj odločevalci usmerijo intervencije.

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1 INTRODUCTION

Due to aging of the workforce, work demands, stress, occupational hazards and other workplace challenges it is important to take action in the preservation of health and work ability (WA) among the working population. Poor organisation at work, lack of leadership, work overload, work under pressure and stress, and exposure to occupational hazards can have a negative impact on workers' health and their WA causing work-related illness, early retirement and death (1).

In the early 1980s, Finnish Institute of Occupational Health (FIOH) researchers developed a WA concept (2) based on the Finnish Longitudinal Study on Municipal Employees (FLAME), defining it as the balance between human resources and the demands of work (3). They illustrated it as a four-floor house. The first and second floors consist of individual resources, the third consists of values, attitudes and motivation, while the fourth represents work, work arrangements, work community and work leadership (3).

Nurses are constantly exposed to various occupational hazards - biological (e.g. infectious patients' excretions), chemical (e.g. toxic substances), physical (e.g. radiation and noise), biomechanical (e.g. lifting patients and high levels of workload) and psychological (e.g. shift work, overtime work, performing of complex tasks in critical situations, and verbal abuse and violence) (4-7). Several studies have identified also a high level of occupational stress among them (4,8-11). It is therefore very important to constantly monitor WA in this professional group in order to ensure timely reaction.

For measuring different aspects of WA, e.g. prediction of long-term sickness absence, work disability and retirement (2, 12, 13), the Work Ability Index Questionnaire (WAIQ) was developed by the FIOH (14, 15). WAIQ is a widely used instrument all over the world (3). Its reliability and validity have been tested in various working populations so far (16-27), including among nurses, where it proved to be a very predictive instrument (17).

Occupational stress is present also among Croatian nurses (28-30). Six major groups of occupational stressors were identified: organization of work and financial issues, public criticism, workplace hazards, workplace interpersonal conflicts, shift work, and professional and intellectual demands, indicating that hospital managers should develop strategies to address and improve the quality of working conditions for Croatian nurses (28).

The WAIQ was already translated into Croatian (WAIQ-CRO) by using the standard procedure (forward translation by two independent translators, synthesis of the results and back translation by a certified translator) about a decade ago in the frame of a research project of Ministry of Science, Education and Sports of the Republic of Croatia entitled Health at work and healthy environment

(code 108-1080316-0300; project duration 2007-2012), and led by Andrija Stampar of the School of Public Health, School of Medicine, University of Zagreb (31). However, we could not find any explicit reporting on validation results, although it was used in several studies so far (28, 32, 33). Consequently, the aim of the present study was to assess the psychometric properties of the WAIQ-CRO in Croatian nurses, with inclusion of a specific methodological approach.

2 MATERIALS AND METHODS

2.1 Study Design, Timeframe and Study Population

This cross-sectional study, which was a part of a larger research project on the impact of a sense of coherence on WA in nurses, was carried out from December 2017 to June 2018 at the University Hospital Centre Sisters of Mercy (UHCSM) in Zagreb, Croatia.

The total population of 1465 nurses employed in UHCSM was considered for inclusion in the study. However, due to various absences (sick, annual or study leave), it was possible to deliver the questionnaire to 1300 nurses.

2.2 Procedure

An initial meeting was held with the head nurses of the hospital where the study aim/objectives and the procedure were presented. Afterwards, the WAIQ-CRO was distributed to all departments. Written informed consent was obtained from each participant, gathered separately from completed questionnaires. Questionnaires were marked by the same identification code for each participant. Participants were given the possibility to take the questionnaire home, fill it in and return it back at the workplace. All questionnaires were returned anonymously in sealed envelopes to protect the nurses' privacy.

2.3 Questionnaire

The WAIQ consists of 10 questions arranged in 7 items (15) (Table 1). All questions are closed-ended with a different number of answers. The measure provided by the WAIQ is a summary score Work Ability Index (WAI), obtained by summing the values of individual responses to all items, ranging from 7-49 points, with higher values indicating better WA. Scores ranging from 7-27 indicate poor WA, 28-36 moderate WA, 37-43 good WA, and 44-49 excellent WA (15).

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Table 1. Work Ability Index Questionnaire items and scoring (15).

Item		Number of questions	Scoring (min-max)
Item-1	Current work ability compared with the lifetime best	1	0-10
Item-2	Work ability in relation to the demands of the job	2	2-10
Item-3	Number of current diseases diagnosed by a physician	1	1-7
Item-4	Estimated work impairment due to diseases	1	1-6
Item-5	Sick leave during the past year (12 months)	1	1-5
Item-6	Own prognosis of work ability 2 years from now	1	1,4,7
Item-7	Mental resources	3	1-4

2.4 Psychometric Validation

The instrument's reliability was assessed using the internal consistency method. Cronbach's alpha coefficient (α) was applied.

To assess the factor structure of the instrument, first the confirmatory factor analysis (CFA) with the assumption of one factor in the background, as proposed by the authors of the instrument (15), was performed. As input data, item-specific scores were used. Since these scores are measured on a different scale, before the implementation of the factor analysis, each of the seven scales was transformed to a range of 0-1. Specifically, the scores of Item-1 were collected on a scale of 0-10 so the transformation implied the partition of each result with 10; the scores of Item-3 varied in the range of 1-7 so that each score was deducted 1 (consequently scores ranged 0-6) and this new score was divided by six; etc. Consequently, we obtained two summary scores: one on the raw item-specific scores (the larger-scale groups are of greater importance in the overall assessment of the WA), and the other on transformed item-specific scores (each item is equally important in the assessment of WA). With prior checking of the factor structure, the assumptions for the factor analysis implementation were verified, primarily those of the multivariate normality of the distribution of item-specific scores. Mardia's multivariate normality tests were used. The robust maximum likelihood estimator was applied. The criteria for the fit measures were a relative chi-square (χ^2) 2.0-5.0 (34), a comparative fit index (CFI) ≥ 0.95 (35,36), a goodness-of-fit index (GFI) ≤ 0.95 (37), and a root mean squared error of approximation (RMSEA) 0.06-0.07 (34). Finally, the exploratory factor analysis (EFA) (a common factor model with limited number of factors) was applied in order to check whether the full exploratory approach could replicate the obtained factor structure.

The data were processed with MATLAB and JASP programmes.

2.5 Ethical Considerations

The study was carried out in accordance with the ethical principles of the Helsinki Declaration. All respondents gave their informed consent to participate in the study, which was approved by the UHCSM (code EP-7811/16-19).

3 RESULTS

3.1 Study Participants' Characteristics

The study ultimately involved the participation of 711/1300 nurses (response rate 54.7%) (630 (88.4%) females; 81 (11.4%) males; mean age 38.4 ± 12.5 years.

The mean value of the total WAI score was 40.5 ± 5.6 points.

3.2 Psychometric Validation

3.2.1 Reliability

Cronbach's alpha coefficient showed satisfactory internal consistency ($\alpha=0.71$).

3.2.2 Factor Structure

The correlation between raw and transformed scores was very high ($r=0.988$, $p<0.001$).

Table 2 shows the intercorrelations between the scores of seven items. All coefficients were statistically highly significant ($p<0.001$). A close look at the correlation matrix did not reveal a systematic relationship and grouping of individual indicators, with the exception of the relatively low relationship of Item-7 with the rest of the indicators, suggesting that in the background of Item-7 probably stood a factor that is common throughout the entire WAIQ-CRO. Multivariate normality tests showed significant deviation of the observed multivariate distribution in terms of asymmetry ($\chi^2(84)=1790.83$, $p<0.001$) and flattening ($z=35.28$), meaning that sampled indicators did not satisfy the assumption of multivariate normality.

Table 2. Intercorrelations between the scores of seven items of the Croatian version of the Work Ability Index Questionnaire in Croatian nurses (n=711).

	Item-1	Item-2	Item-3	Item-4	Item-5	Item-6	Item-7
Item-1	1.000						
Item-2	0.636	1.000					
Item-3	0.279	0.208	1.000				
Item-4	0.416	0.408	0.444	1.000			
Item-5	0.183	0.160	0.271	0.298	1.000		
Item-6	0.383	0.341	0.309	0.393	0.218	1.000	
Item-7	0.257	0.374	0.127	0.272	0.126	0.276	1.000

In the CFA, two models were defined and tested. The first model (Model-1) showed poor compatibility ($\chi^2(14)=174.41$, $p<0.001$, CFI=0.85, GFI=0.93, RMSEA=0.13). This basic model implied assessment of the factor saturations of seven items by one factor. The modification indices suggested the introduction of correlation parameters residual variances of scores of Item-1 and Item-2. After the introduction of this covariance, the index model assessment (Model-2) showed desirable assessment measures ($\chi^2(13)=72.78$, $p<0.001$, CFI=0.95, GFI=0.97, RMSEA=0.08). The comparison of the original model (Model-1) and the model with the allowed covariance residual of the two measurement indicators (Model-2) showed a better compatibility of the latter model ($\chi^2(1)=101.63$, $p<0.010$). Consequently, the accepted model was Model-2 with one latent factor that estimated factor saturation and one covariance of the residual indicators. The parameters of this model are shown in Table 3. The saturation of all indicators was significant, whereby the highest saturation has been noted in Item-4, and the lowest in Item-5 (Table 3). The residual correlation between Item-1 and Item-2 was $r=0.470$ ($p<0.001$). This correlation was somewhat expected given that Item-1 and Item-2 reflect explicit self-assessment of WA (Item-1 reflects current WA compared with the lifetime best, while Item-2 measures WA in relation to the demands of the job).

The implementation of the EFA has identified three factors (Table 4). From the factor saturation, it is apparent that Factor-1 was defined by Item-1 and Item-2 (corresponding to self-assessment of WA), Factor-3 by Item-7 (corresponding to general mental state), and Factor-2 by the remaining items (Item-3, Item-4, Item-5 and Item-6) (corresponding to general health problems). Table 5 shows the correlations of three factors identified by EFA.

Table 3. Factor saturation estimated by confirmatory factor analysis of the Croatian version of the Work Ability Index Questionnaire in Croatian nurses (n=711).

Indicator	b	se	p	B
Item-1	1.000	0.000		0.577
Item-2	0.916	0.061	<0.001	0.554
Item-3	1.940	0.187	<0.001	0.535
Item-4	1.326	0.110	<0.001	0.733
Item-5	1.000	0.123	<0.001	0.386
Item-6	1.426	0.130	<0.001	0.582
Item-7	0.773	0.091	<0.001	0.407

Legend: b=non-standardized saturation; se=saturation estimation error; p=significance of saturation; B=standardized saturation

Table 4. Factor saturation estimated by exploratory factor analysis of the Croatian version of the Work Ability Index Questionnaire in Croatian nurses (n=711).

Indicator	Factor-1	Factor-2	Factor-3
Item-1	0.784		
Item-2	0.803		
Item-3		0.693	
Item-4		0.614	
Item-5		0.446	
Item-6		0.380	
Item-7			0.997

Table 5. Correlations of factors identified by exploratory factor analysis of the Croatian version of the Work Ability Index Questionnaire in Croatian nurses (n=711).

	Factor-1	Factor-2	Factor-3
Factor-1	1.000		
Factor-2	0.697	1.000	
Factor-3	0.436	0.317	1.000

The attempt to replicate this model in the CFA resulted in relatively good model assessment approaches with data ($\chi^2(12)=55.48$, $p<0.001$, CFI=0.96, GFI=0.98, RMSEA=0.07). A comparison of this model (Model-3) with the previously described one-factor model (Model-2) found by CFA showed a significantly better compatibility of Model-3 ($\chi^2(1)=17.3$, $p<0.001$). Table 6 shows the factor saturation of the three factors and the indicators which were used.

Table 6. Factor saturation estimated by confirmatory factor analysis of the Croatian version of the Work Ability Index Questionnaire in Croatian nurses (n=711).

Factor	Indicator	b	se	p	B
Factor-1	Item-1	1.000	0.000		0.785
	Item-2	0.986	0.064	<0.001	0.811
Factor-2	Item-3	1.000	0.000		0.551
	Item-4	0.683	0.058	<0.001	0.754
	Item-5	0.510	0.063	<0.001	0.393
Factor-3	Item-6	0.699	0.066	<0.001	0.570
	Item-7	1.000	0.000		1.000

Legend: b=non-standardized saturation; se=saturation estimation error; p=significance of saturation; B=standardized saturation

The correlation assessments of three factors in the CFA are shown in Table 7. All three factors were in significant positive correlations, with the high correlation between the first two factors.

Table 7. Correlations of factors identified by exploratory factor analysis of the Croatian version of the Work Ability Index Questionnaire in Croatian nurses (n=711).

	Factor-1	Factor-2	Factor-3
Factor-1	1.000		
Factor-2	0.669	1.000	
Factor-3	0.400	0.358	1.000

The arithmetic means of the three factors are shown in Table 8. It is important to note that not all the items are expressed in the same scales. The result for each participant is calculated as the sum of results on the items belonging to each factor.

Table 8. Arithmetic mean and standard deviation of the three factors of the Croatian version of the Work Ability Index Questionnaire in Croatian nurses (n=711).

Typical value	Factor-1	Factor-2	Factor-3
Arithmetic mean	16.76	20.40	3.31
Standard deviation	2.81	4.05	0.77

When the total transformed WAI score was divided by the number of items on which the factors were obtained, we obtained the result for Factor-1 of 8.38, and for Factor-2 5.10, while for Factor-3 it remained 3.31 because it was based on only one item.

4 DISCUSSION

The results of our study showed that the WAIQ-CRO is a valid instrument which can be used in occupational health research among the Croatian nurse population.

The internal consistency of WAIQ-CRO was satisfactory and its Cronbach's alpha very similar to the overall Cronbach's alpha ($\alpha=0.72$) in the study of Radkiewicz et al. (17). However, in the same study some country-specific coefficients were lower (Slovakia 0.54; Belgium 0.68; Italy 0.68), some were similar (France 0.70; Poland 0.70; Netherlands 0.72), while others were higher (Norway 0.74; Germany 0.78; Finland 0.79) (17). Cronbach's alpha was higher also among Brazilian nurses ($\alpha=0.80$) (19), Argentinian primary care workers ($\alpha=0.80$) (20), and among Iranian nurses/healthcare workers ($\alpha=0.79$) (21).

Factor structure analysis revealed a three-factor structure of the WAIQ-CRO with good fit. These results are partially consistent with the results of other similar studies. The study among nurses from different European countries found a single-factor structure in Germany and Finland, but a two-factor structure in Belgium, France, Italy, Norway, Netherlands, Poland and Slovakia (Factor-1: subjective assessment of ability to work and one's own mental resources, Factor-2: objective information concerning one's own health and absenteeism due to diseases) (17). However, there was some overlapping of two factors from our study with one factor from this study. A two-factor structure was found also in the Brazilian study (19), while in the Argentinian study among primary care workers a three-factor structure was confirmed (20). A three-factor structure was confirmed also in Iranian nurses/healthcare

workers with factors being very similar to the factors in our study (Factor-1: self-perceived WA, Factor-2: mental resources, Factor-3: presence of disease and health related limitation) (21). Comparisons were also made using the results of studies that did not include nursing/healthcare personnel. The study among German workers confirmed a two-factor structure (Factor-1: subjective WA and resources, Factor-2: health related factor) (26), while the study among Brazilian electrical company workers confirmed a three-factor structure (Factor-1: mental resources, Factor-2: self-perceived WA, Factor-3: presence of diseases and health-related limitations) (18). Recently, a three-factor structure was also confirmed among Iranian workers in petrochemical and car manufacturing industries (25). Again, these factors are very similar to the factors in our study. Basing on previous and present knowledge it would make sense to consider in further analyses the three-factor structure, especially in Croatia. However, it is also evident that we can use the overall result on the WAIQ as well, and explain moderate to high correlations between the factors. This is a common and quite powerful argument for using the overall result of the questionnaire, although there a multi-factor structure was detected.

We can also make a rough comparison of the WAI summary score mean value obtained in our study. Similar results (median value 39) were found in the study of Sorić et al. (33), both assessing WA of Croatian nurses as good.

This study has potential limitations. First, our study involved participants from only one health institution, which is specific regarding its working conditions. However, this institution is a large healthcare facility where a large number of nurses performing various tasks are employed. Consequently, this allows a detailed assessment of WA related to the nurses' workplace, which is a strength rather than a limitation. Second, one could argue the transformation of raw scores which was implemented in our study. However, one of the prerequisites for implementing the factor analysis is that all the items are measured on the same scales (38). Also, this transformation does not change the form of distribution, the correlation between the analyzed variables, and the correlation of the analyzed variables with any third variable. Importantly, this transformation changes variance and covariant variables. Variables measured at different scales will result in different variance, in a way that the particles measured on the scales with a larger range generally have a larger variance and consequently larger covariates; e.g. a variable measured on a scale from 0 to 10 has a larger range and thus a larger variance of the same variable measured on a scale of 1-5. Since the input data in the factor analysis are variances and covariances, it is important to ensure that the results of the factor analysis don't arise from the methodological characteristics of the questionnaire such as the type

of scale that was used. In the case of the WAIQ, Item-1, measured on an 11-degree scale (0-10), would almost certainly have a greater variance than Item-7, measured on a scale 1-4, and consequently have greater importance in factor analysis. Thus the outcome of factor analysis is somewhat predictable before the implementation of the analysis itself. Previous verification of WAIQ factor structure did not take into account these characteristics of the questionnaire. It is important to note that the result that would be consistent with previous findings does not justify the implementation of factor analysis on crude results (without transformation of all variables on the same scale) - factor saturation will almost certainly not be the same although the factor analysis on transformed and untransformed results would find an equal number of factors (e.g. one common factor). Next, one could argue that no method of measurement of stability of the instrument over time, e.g. the test-retest method, was used in the present study. However, the reliability of any self-reported outcome measure can be evaluated using measurement stability and/or measurement equivalence methods. The latter were developed for situations in which it is not possible to perform repeated measurements reliably because the measured phenomenon could change over time (39). Since we assumed, based on the results of previous studies (28-30), that the phenomenon measured in our study could change over time, due to specifics of the workplace of the observed group, only the measures of equivalence were used (39). Finally, one could argue the low response rate, however, there is no agreed-upon standard for acceptable response rates (40). According to Babbie, cited by Draugalis et al., 50% is regarded as an acceptable response rate in social research postal surveys (40). Consequently, we assumed that the response rate achieved in our study still permits reliable conclusions.

The study has also some important strengths. First, implementation of transformed scores for factor analysis could be seen as a very important strength since it makes the study results more reliable, with greater power of applicability. Next, the study offers to our knowledge the first published psychometric properties of WAIQ-CRO. Finally, the results of this study could be applicable not only in Croatia but much wider - in several countries of former Yugoslavia where WAIQ-CRO could be used due to similarity of languages, all of them also facing the similar transition in departing from a common healthcare system.

Basing on the results of our study we can already draw some rough implications for public health in Croatia. The results in WAI scoring are not in accordance with our expectations. According to the relative means of transformed scores, the highest result was shown for Factor-1, then Factor-2, while the least mean was for Factor-3. This could imply that nurses in our study had the best result in self-assessment of WA and worst in general

mental state. However, taking into account that our participants were mostly middle-aged nurses this result is understandable - in this age group major health problems are not present yet. However, the results of Factor-2 and Factor-3 indicate that the problems exist, but are not so influential as to reflect on their WA. On the other hand, the question is how long employees in such a demanding profession as clinical nursing can compensate for potential physical and/or mental disabilities in carrying out their work. This means that if certain interventions are not taken, these difficulties will, in time, affect their WA. According to the study of Milošević et al. Croatian nurses are faced with inadequate resources to work with, an inadequate working environment, complex administration and patients' waiting lists, insufficient funds for normal everyday work, a shortage of registered nurses and high workload (41). Similar was also confirmed by the study of Golubic et al. which highlighted that Croatian healthcare workers were exposed to poor organisation of work, insufficient financial resources and inadequate working environment (28). These factors can contribute to a worsening of nurses' health and decreased WA. Therefore, permanent monitoring of WA with a valid and reliable instrument is of enormous importance. According to Carel et al., the WAI instrument enables early identification of poor WA and consequently identification of nurses needing intervention for prevention of unfavourable consequences, including early retirement (42).

Further in-depth examination of the structure of the questionnaire is required in order to more firmly confirm whether it is better to take into account the total WAI score or evaluate each factor separately. Also, it would be necessary to conduct similar studies in other occupational groups within the population of Croatian workers.

5 CONCLUSION

The WAIQ-CRO demonstrated satisfactory psychometric properties and can therefore be used in the assessment of WA among the Croatian nurse population. From the results of our study it is evident that it would be better to consider a three-factor than single-factor structure, as a three-factor structure can direct decision makers to which segment to locate interventions - in motivation for work, in improving working conditions, or in improving health through workplace health-promotion programmes.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

FUNDING

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ETHICAL APPROVAL

The study was carried out in accordance with the ethical principles of the Helsinki Declaration. All respondents gave their informed consent to participate in the study, which was approved by the UHCSM (code EP-7811/16-19).

REFERENCES

- Gould R, Ilmarinen J, Järvisalo J, Koskinen S, editors. Dimensions of work ability. Helsinki: Finnish Centre for Pensions, 2008.
- Tuomi K, Ilmarinen J, Klockars M, Nygard CH, Seitsamo J, Huuhtanen P, et al. Finnish research project on aging workers in 1981-1992. *Scand J Work Environ Health*. 1997;23(Suppl 1):7-11.
- Ilmarinen J, von Bonsdorff M. Work Ability. In: The encyclopedia of adulthood and aging. doi: 10.1002/9781118521373.wbeaa254.
- Rostamabadi A, Zamanian Z, Sedaghat Z. Factors associated with work ability index (WAI) among intensive care units' (ICUs) nurses. *J Occup Health*. 2017;59:147-55. doi: 10.1539/joh.16-0060-OA.
- Cherry B, Jacob SR. Contemporary nursing: issues, trends & management. St. Louis: Elsevier/Mosby, 2005.
- Fisekovic Kremic MB, Terzic-Supic ZJ, Santric-Milicevic MM, Trajkovic GZ. Encouraging employees to report verbal violence in primary health care in Serbia: a cross-sectional study. *Zdr Varst*. 2017;56:11-7. doi: 10.1515/sjph-2017-0002.
- Drnovšček Hafner N, Miklič Milek D, Dodič Fikfak M. Hospital staff's risk of developing musculoskeletal disorders, especially low back pain. *Zdr Varst*. 2018;57:133-9. doi: 10.2478/sjph-2018-0017.
- Labrague LJ, McEnroe-Petitte DM, Leocadio MC, Van Bogaert P, Cummings GG. Stress and ways of coping among nurse managers: an integrative review. *J Clin Nurs*. 2018;27:1346-59. doi: 10.1111/jocn.14165.
- Luan X, Wang P, Hou W, Chen L, Lou F. Job stress and burnout: a comparative study of senior and head nurses in China. *Nurs Health Sci*. 2017;19:163-9. doi: 10.1111/nhs.12328.
- Su SF, Boore J, Jenkins M, Liu PE, Yang MJ. Nurses' perceptions of environmental pressures in relation to their occupational stress. *J Clin Nurs*. 2009;18:3172-80. doi: 10.1111/j.1365-2702.2008.02771.x.
- Dobnik M, Maletič M, Skela-Savič B. Work-related stress factors in nurses at Slovenian hospitals - a cross-sectional study. *Zdr Varst*. 2018;57:192-200. doi: 10.2478/sjph-2018-0024.
- Sell L, Bultmann U, Rugulies R, Villadsen E, Faber A, Sogaard K. Predicting long-term sickness absence and early retirement pension from self-reported work ability. *Int Arch Occup Environ Health*. 2009;82:1133-8. doi: 10.1007/s00420-009-0417-6.

13. Roelen CA, Heymans MW, Twisk JW, van der Klink JJ, Groothoff JW, van Rhenen W. Work ability index as tool to identify workers at risk of premature work exit. *J Occup Rehabil.* 2014;24:747-54. doi: 10.1007/s10926-014-9505-x.
14. Ilmarinen J, Tuomi K, Eskelinen L, Nygard CH, Huuhtanen P, Klockars M. Background and objectives of the Finnish research project on aging workers in municipal occupations. *Scand J Work Environ Health.* 1991;17(Suppl 1):7-11.
15. Tuomi K, Ilmarinen J, Jahkola A, Katajarinne L, Tulkki A. *Work Ability Index.* 2nd ed. Helsinki: Finnish Institute of Occupational Health, 1998.
16. de Zwart B, Frings-Dresen M. Test-retest reliability of the Work Ability Index questionnaire. *Occup Med (Lond).* 2002;52:177-81. doi: 10.1093/ocmed/52.4.177.
17. Radkiewicz P, Widerszal-Bazyl M. Psychometric properties of work ability index in the light of comparative survey study. *Int Congr Ser.* 2005;1280:304-9. doi: 10.1016/j.ics.2005.02.089.
18. Martinez MC, do Rosario Dias de Oliveira Latorre M, Fischer FM. Validity and reliability of WAI. *Rev Saude Publica.* 2009;43:1-7.
19. Silva Junior SH, Godoi Vasconcelos AG, Harter Griep R, Rotenberg L. Validity and reliability of the work ability index (WAI) in nurses' work. *Cad Saude Publica.* 2011;27:1077-87.
20. Peralta N, Godoi Vasconcelos AG, Harter Griep R, Miller L. Validity and reliability of the Work Ability Index in primary care workers in Argentina. *Salud Colect.* 2012;8:163-73. doi: 10.1590/S1851-82652012000200005.
21. Abdolalizadeh M, Arastoo AA, Ghsemzadeh R, Montazeri A, Ahmadi K, Azizi A. The psychometric properties of an Iranian translation of the Work Ability Index (WAI) questionnaire. *J Occup Rehabil.* 2012;22:401-8. doi: 10.1007/s10926-012-9355-3.
22. Alexopoulos EC, Merekoulis G, Gnardellis C, Jelastopulu E. Work ability index: validation of the Greek version and descriptive data in heavy industry employees. *Br J Med Med Res.* 2013;3:608-21. doi: 10.9734/BJMMR/2013/2552.
23. Silva Junior SH, Godoi Vasconcelos AG, Harter Griep R, Rotenberg L. Test-retest reliability of the Work Ability Index (WAI) in nursing workers. *Rev Bras Epidemiol.* 2013;16:202-9.
24. Lavasani S, Abdul Wahat NW. Work ability index: validation and model comparison of the Malaysian work ability index (WAI). *DCIDJ.* 2016;27:37-56. doi: 10.5463/DCID.v27i2.427.
25. Mazloumi A, Rostamabadi A, Garosi E. Validity and reliability of work ability index (WAI) questionnaire among Iranian workers: a study in petrochemical and car manufacturing industries. *J Occup Health.* 2019;61:165-74. doi: 10.1002/1348-9585.12028.
26. Freyer M, Formazin Maren, Rose U. Factorial validity of the work ability index among employees in Germany. *J Occup Rehabil.* 2019;29:433-42. doi: 10.1007/s10926-018-9803-9.
27. Pranjić N, Garcia Gonzales JM, Cvejanov-Kezunović L. Perceived Work Ability Index of public service employees in relation to ageing and gender: a comparison in three European countries. *Zdr Varst.* 2019;58:179-88. doi: 10.2478/sjph-2019-0023.
28. Golubic R, Milosevic M, Knezevic B, Mustajbegovic J. Work-related stress, education and work ability among hospital nurses. *J Adv Nurs.* 2009;65:2056-66. doi: 10.1111/j.1365-2648.2009.05057.x.
29. Hudek-Knezević J, Kalebić Maglica B, Krapić N. Personality, organizational stress, and attitudes toward work as prospective predictors of professional burnout in hospital nurses. *Croat Med J.* 2011;52:538-49. doi: 10.3325/cmj.2011.52.538.
30. Knezević B, Golubić R, Belosević L, Milosević M, Mustajbegović J. Maintenance of work ability among hospital health care professionals. *Acta Med Croat.* 2010;64:391-5.
31. University of Zagreb, School of Medicine, Andrija Stampar School of Public Health. Health at work and healthy environment project (code 108-1080316-0300). Accessed December 3, 2019 at: <http://zprojekti.mzos.hr/page.aspx?pid=6&tid=1>.
32. Pranjić N, Maleš-Bilić LJ, Beganlić A, Mustajbegović J. Mobbing, stress, and work ability index among physicians in Bosnia and Herzegovina: survey study. *Croat Med J.* 2006;47:750-8.
33. Sorić M, Golubić R, Milošević M, Juras K, Mustajbegović J. Shift work, quality of life and work ability among Croatian hospital nurses. *Coll Antropol.* 2013;37:379-84.
34. Tabachnick BG, Fidell LS. *Using multivariate statistics.* 5th ed. Boston: Pearson, 2007.
35. Hu L, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct Equ Modeling.* 1999;6:1-55. doi: 10.1080/10705519909540118.
36. Hooper D, Coughlan J, Mullen MR. Structural equation modelling: guidelines for determining model fit. *EJBRM.* 2008;6:53-60.
37. Shevlin M, Miles JNV. Effects of sample size, model specification and factor loadings on the GFI in confirmatory factor analysis. *Pers Individ Dif.* 1998;25:85-90.
38. Yong AG, Pearce S. A beginner's guide to factor analysis: focusing on exploratory factor analysis. *Tutor Quant Methods Psychol.* 2013;9:79-94. doi: 10.20982/tqmp.09.2.p079.
39. Ferligoj A, Leskošek K, Kogovšek T. *Methodological notes 10. Reliability and validity of measurement.* Ljubljana: University of Ljubljana, FDV, 1995.
40. Draugalis JR, Coons SJ, Plaza CM. Best practices for survey research reports: a synopsis for authors and reviewers. *Am J Pharm Educ.* 2008;72:1-6. doi: 10.5688/aj720111.
41. Milosevic M, Brborovic H, Mustajbegovic J, Montgomery A. Patients and health care professionals: partners in health care in Croatia? *Br J Health Psychol.* 2014;19:670-82. doi: 10.1111/bjhp.12062.
42. Carel RS, Zusman M, Karakis I. Work Ability Index in Israeli hospital nurses: applicability of the adapted questionnaire. *Exp Aging Res.* 2013;39:579-90. doi: 10.1080/0361073X.2013.839316.