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Work Ability Index: Validation of the Greek Version and Descriptive Data in Heavy Industry Employees

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Authors' contributions

This work was carried out in collaboration between all authors. The conception and design of the study was made by author ECA. For data editing and descriptive statistics, GM was responsible. Authors ECA and CG performed the statistical analysis. All authors contributed to the interpretation process. Authors ECA and GM wrote the draft. All authors contributed to the revision and approved the manuscript for release. All authors read and approved the final manuscript.

Research Article

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ABSTRACT

Aims: Validation of the Greek version of Work Ability Index (WAI).
Study Design: A cross sectional survey of 943 workers from a shipyard industry.
Place and Duration of Study: University of Patras, Medical School, Public Health Department, HSY occupational health department, Greece in 2006-07.
Methodology: The translation and cultural adaptation of the questionnaire was performed according to the international standards. The following aspects of the questionnaire were evaluated: construct validity, using factorial analysis, and discriminant capacity, by comparing Work Ability Index scores across variables likely to be related with work ability, like absenteeism; criterion validity, by determining the correlation between self-reported health and Work Ability Index score; and reliability, using Kendall's tau b coefficient to determine the internal consistency of the

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questionnaire.
Results: A two-dimensional structure model, interpreted as "subjectively estimated work ability" and "ill-health related ability" of the instrument fits better our study population with some of the subscales load on both dimensions. Good discriminating properties of the tool with sickness absence, education level and high criterion validity using dimensions of health status, were evident. High inter-item Kendall's tau b coefficients were indicative of satisfactory reliability.
Conclusions: The Greek version of the WAI showed satisfactory psychometric properties thus constituting an appropriate option for evaluating work ability in both individual and population-based settings.

Keywords: Occupational health; WAI; validation; work ability; medical fitness for work.

1. INTRODUCTION

Work ability can be defined as the ability of a worker to perform his job, taking into account the specific work demands, individual health conditions and mental resources [1]. Extensive research on this field has been initiated by members of the Finnish Institute of Occupational Health [1–4] and gave birth to the Work Ability Index (WAI) questionnaire, which is a self-administered tool evaluating the individual's work ability. The questionnaire has been translated in many languages and has been used extensively by researchers in the last two decades [5–9]. The WAI address seven dimensions (items) which allows the evaluation of work ability from the perspective of the worker's own perception. The workers' own perception should be taken into account (by the occupational health physician and other stakeholders) since the work ability is conceptualized in multifactorial way and is influenced by factors such as the personal values and needs, the culture and, the social context. In Greece, the use of validated tools evaluating the subjective estimates of employees in occupational field research is limited [10,11] and hardly there is any published study concerning the work ability domain for monitoring, prevention, intervention and recovery. The WAI could be useful both in occupational health practice (e.g. certification of medical fitness for work) and in academic research especially in a country where the employees report the most unfavourable conditions among other EU countries, and which is under extra burden due to the socioeconomic climate and the rapidly changing working conditions [12,13]. The purpose of this study was to validate the Greek translation of Work Ability Index.

2. MATERIALS AND METHODS

2.1 The Work Ability Index

The 2nd revised edition of the WAI (FIOH, 1998) [1], which consists of 7 items, was used in this study. The index was calculated as follows: (1) the "*current work ability compared with the lifetime best*" with a score ranging from 0 to 10 points;(2) the "*work ability in relation to the demands of the job*" based on two questions on the nature of work (physical, mental, or mixed) that, when weighted, yield a score ranging from 2 to 10 points; (3) the "*number of current diseases diagnosed by physician*" based on a list of 51 diseases that defines a score ranging from1 to 7 points; (4) the "*estimated work impairment due to diseases*" based on a question with a score ranging from 1 to 6 points; (5) the "*sick leave during the past year (12 months)*" based on a question (5-categories) on the number of absences with score ranging from 1 to 5 points; (6) the "*own prognosis of work ability two years from now*" based on a

question with a score of either 1, 4 or 7 points; and (7) "*mental resources*" based on a score ranging from 1 to 4 points obtained by weighting the answers to three questions. The results of these seven dimensions provide a measure of work ability that ranges from 7 to 49 points. Higher scores indicate better work ability. Based on the WAI score employees could be classified to four categories: poor, moderate, good and excellent work ability. The relevant points were 7-27, 28-36, 37-43 and 44-49 respectively. The 15^{th}, 50^{th} and 85^{th} percentiles of scoring distribution are also presented as alternate cut-off points between categories.

Cross-cultural translation guidelines recommended by International Quality of Life Assessment Project [14] in order to translate the 7 items of WAI was used. Forward translation (English to Greek) was done independently by three bilingual translators and minor differences were solved by the research team. The forward version was then back translated by two other bilingual translators. In a pilot testing, the Greek version of the WAI was given to 10 people, who were encouraged to make comments and suggestions on the clarity of the wording, difficulties during completion and on the layout and style of the tool. An agreement signed between the Finnish Institute of Occupational Health (FIOH) and one of the authors (ECA) for the translation and the scientific use (the license rights) of the Work Ability Index Questionnaire. Basic demographic data such as age, gender, family, job title, educational and employment status were also collected. Additionally, retrospective data on absenteeism (occurrence, duration and diagnosis) in the past 12 months were available by the sickness absence register kept in occupational health department.

2.2 Study Population and Study Design

The self-administered questionnaires (including the translated Greek version of the WAI) were handed over by the occupational health department personnel in employees and briefly introduced its purpose and clearly stating that the answers would be confidentially treated. Employees were asked during the routine bi-annual checkup to participate in the study by giving their written informed consent. Workers were eligible for the current study when they had at least 1 year of work experience in the current position. The response rate was 97.8% (949 out of 970 eligible employees) and the final valid questionnaires analyzed were 943 (6 with missing values).

In addition to the WAI the validated Greek version of *Medical Outcomes Study 36 – Item short form health* survey (SF-36) questionnaire was also administered [11]. The SF-36 evaluates eight health concepts: physical functioning, bodily pain, role limitations due to physical health problems, role limitations due to personal or emotional problems, general mental health, social functioning, energy/fatigue (vitality) and general health perceptions. It also includes a single item that provides an indication of perceived change in health. As WAI includes health-related variables and is a predictor of medium and long-term worker health [1], SF-36 was chosen as the standard criterion because of its ability to evaluate the overall health based on the subject's own perception and to generate scores representing concepts most frequently measured in health surveys [15]. For scoring each item responses were coded, summed and transformed into a scale from 0 to 100 so as scores represent the percentage of total possible score achieved. A higher score defines a more favorable health state. Then item scores in the same scale are averaged together to create the 8 scale scores with missing data not taken into account when calculating the scale scores [15]. All SF-36 sub-scales exhibited acceptable internal consistency with Cronbach's alpha ranging from 0.71 (vitality and general health) up to 0.90 (physical functioning).

2.3 Validation and Statistics

The following aspects of the Greek version of the Work Ability Index were examined: (i) discriminant and concurrent validity by comparing WAI scores across the variables under study such as morbidity/comorbidity, gender, age, sick leave duration and self-reported health (SF36); (ii) construct validity, using factorial analysis; and (iii) reliability, using Kendall's tau b coefficient, and multivariate analysis. Statistical analysis was performed using SPSS software version 17.0. Adherence of the scores to normal distribution was determined by Kolmogorov-Smirnov analysis, and subsequent statistical tests included Mann-Whitney, Kruskal-Wallis test and Spearman correlation coefficient, which were chosen based on the result of this analysis. For all analyses, the 5% significance level was adopted.

The sick-leave duration during last year was treated by using the cutoffs pre-determined on the questionnaire (i.e. 0, 1-9, 10-24, 25-99, and 100-365 days) in factor analysis, while for other analysis it was dichotomized (cut-off ten or more days). Similarly low morbidity/comorbidity was considered the presence of up to one diagnosed disease.

Initially exploratory factor analysis was employed through both principal axis factoring and principal component analysis, selecting factors with eigenvalues greater than 1 and correlation coefficients greater than 0.50, using different method for matrix rotation. To further investigate the controversial question of whether the WAI may be treated as a one-dimensional or as a two or more dimensional instrument confirmatory factor analysis was used. Comparative Fit Index (CFI) was used to assess fit quality of the possible models. This index, introduced by Bentler, compares the model under investigation to the model assuming independent subscales. It ranges between zero and one and values 0.90 or 0.95 indicate a satisfactory fit [16]. In order to estimate the best models the values of CFI and the results of exploratory factor analysis were taken into account.

WAI reliability was determined by analysis of internal consistency among its items using Kendall's tau b coefficient to verify correlations between them, since it has been argued that the use of Cronbach's alpha might be misleading if the underlying factor structure contains more than one dimension and especially if the number of subscales influencing each factor is different [17].

3. RESULTS

The basic characteristics of the study population and the corresponding WAI scores are presented in Table 1. Blue collars mainly consisted of metal workers (33%) (i.e. platters, fitters, pipe fitters), welders (25%), drivers/crane operators (9%), carpenters (6%), electricians (7%), sandblasters/painters (5%), security (4%) and a variety of other jobs. White collars consisted mainly of office employees like accountants, designers, secretaries, telephone operators, computer experts, managers, and construction engineers. The total mean WAI score in the studied population was 42.6 (SD 3.6) ranging from 28 to 49 points, and with a median of 43 points. Table 1 also presents the categorization of work ability index with regard to education, sex and age, using as cut off points the 15^{th}, 50^{th} and 85^{th} percentiles. According to the Finnish Institute of Occupational Health recommended cut-off points of 27^{th}, 36^{th} and 42^{nd} point score, most in our study population would score good (49.8%) or excellent (43.7%), and all the rest (6.5%) assigned in the moderate ability (score 27-35).

Table 1. Epidemiological characteristics of the study population (943 shipyard employees) and corresponding WAI scores (the 15th, 50th, and 85th percentiles were used as cut offs)

	Employees		Work ability index					
	N	%	Mean	SD	%	%	%	%
SEX					7-39	40-43	44-46	47-49
Male	895	94.9	42.6	3.7	17	38	33	12
Female	48	5.1	42.9	3.4	6	48	35	11
Employment								
Blue collar workers	804	85.2	42.5	3.6	17	39	33	11
white collar workers	139	14.8	43.2	3.6	12	36	35	17
Age (in years)								
<30	237	25.2	42.6	3.7	16	39	34	11
30-40	254	26.9	43.5	3.3	10	35	36	19
41-50	327	34.7	42	3.5	20	43	29	8
>50	125	13.2	41.9	4.2	22	36	34	8
Family status								
With children	533	56.5	42.4	3.7	17	40	32	11
Without children	410	43.5	42.7	3.6	15	38	35	12
Educational Level (Years of education)								
Up to 9	153	16.2	42	3.9	18	44	30	8
9-12	96	10.2	42.4	3.9	16	45	30	9
Technical school	564	59.8	42.6	3.5	18	38	32	12
> 12 (higher education)	130	13.8	43.4	3.6	10	32	40	18

3.1 Morbidity and Comorbidity

The morbidity-comorbidity pattern and the corresponding WAI scores are shown in Table 2. The percentage of employees reporting more than one disease diagnosed by a physician (60%) rose to 72% when including self-reported diseases. Employees suffered mostly musculoskeletal diseases, injuries (trauma) and respiratory diseases. While sciatic pain syndrome, upper limb and leg injury exceeded 20%, hypertension and obesity were close to 10%. There was a huge difference between cases of anxiety, sleep disorder and minor depression diagnosed by a physician and the self-reported ones (Table 2). Cardiovascular and mental disorders seem to have the greatest impact on work ability.

Table 2. Morbidity, comorbidity and corresponding WAI score in shipyard employees in Greece (n=943) (selective disease categories and subcategories)

	Diseases diagnosed by a physician*						Diseases diagnosed by a physician or subjects' own opinion					
	Age		Employees		WAI score		Age		Employees		WAI score	
	Mean	SD	n	%	Mean	SD	Mean	SD	n	%	Mean	SD
No disease			131	13.9	46.7	2			82	8.7	46.9	2
Musculoskeletal disease	**41.4**	**9.4**	**357**	**37.9**	**40.7**	**3.6**	**40.3**	**9.6**	**531**	**56.3**	**40.5**	**3.3**
Sciatic pain syndrome	42.9	9.1	201	21.3	40.2	3.7	40.8	9.8	358	37.9	40.1	3.4
Limb affecting diseases	42.1	9.2	117	12.4	39.9	4.1	42.2	8.9	155	16.4	39.7	3.7
No comorbidity	*37.8*	*8.6*	*63*	*6.7*	*42.8*	*2.9*	*36.5*	*8.1*	*64*	*6.8*	*43.2*	*2.9*
At least one more disease	*41.9*	*9.4*	*294*	*31.2*	*40.3*	*3.5*	*40.8*	*9.7*	*467*	*49.5*	*40.2*	*3.2*
Trauma	**38.3**	**10**	**387**	**41**	**41.4**	**3.6**	**38.3**	**10**	**387**	**41**	**40.8**	**3.5**
Leg injury	38.1	9.8	206	21.8	41.1	3.7	38	9.8	211	22.3	40.5	3.7
Upper limb injury	38.3	10.5	180	19.1	41.2	3.7	38.4	10.6	189	20.1	40.4	3.6
No comorbidity	*34.8*	*9.5*	*104*	*11*	*43.6*	*2.5*	*33.9*	*8.5*	*60*	*6.3*	*43.7*	*2.6*
At least one more disease	*39.6*	*9.9*	*283*	*30*	*40.6*	*3.6*	*39.2*	*10*	*327*	*34.7*	*40.2*	*3.4*
Respiratory disease	**37.6**	**10**	**210**	**22.3**	**41**	**3.6**	**38.1**	**9.9**	**240**	**25.4**	**40.3**	**3.6**
Sinusitis	37	9.5	78	8.3	40.5	3.4	37.2	9.3	91	9.7	40.1	3.6
Chronic bronchitis	38.4	10	35	3.7	40.2	3.7	40	9.4	51	5.4	39.6	3.4
Recurrent upper respiratory tract infections	37.2	10.5	25	2.7	40.8	3.5	36.9	10.5	28	3	40.2	3.4
No comorbidity	*34.8*	*10.4*	*29*	*3.1*	*43.8*	*3.4*	*36.4*	*10.2*	*21*	*2.2*	*44.4*	*2.6*
At least one more disease	*38.1*	*9.9*	*181*	*19.2*	*40.6*	*3.5*	*38.3*	*9.9*	*219*	*23.2*	*40*	*3.4*
Neurological and sensory diseases	**43.2**	**9.6**	**154**	**16.3**	**40.5**	**3.8**	**42.9**	**9.6**	**230**	**24.4**	**40.1**	**3.5**
Hearing problems/injury	44.8	8.6	66	7	40.6	3.5	44.2	8.9	124	13.2	40.2	3.1
Visual disease/ injury	42.1	10	66	7	40.3	4.3	41.4	10.3	74	7.8	39.6	4.2
Stroke, neuralgia, migraine, epilepsy	42.2	9.9	25	2.7	39.6	3.5	41.4	10	43	4.6	39.3	3.2
No comorbidity	*41.9*	*12.3*	*16*	*1.7*	*44.7*	*2.1*	*43.7*	*11.5*	*10*	*1.1*	*44.9*	*1.8*
At least one more disease	*43.8*	*9.2*	*138*	*14.6*	*40*	*3.7*	*42.8*	*9.5*	*220*	*23.3*	*39.9*	*3.4*
Digestive disease	**43.1**	**9**	**165**	**17.5**	**40.6**	**3.4**	**42.9**	**9.3**	**188**	**19.9**	**40**	**3.2**
No comorbidity	*39.2*	*10.8*	*16*	*1.7*	*42.7*	*2.3*	*38.3*	*10.9*	*10*	*1.1*	*42.3*	*2.5*

At least one more disease	*43.5*	*8.8*	*149*	*15.8*	*40.4*	*3.4*	*43.1*	*9.1*	*178*	*18.8*	*39.9*	*3.2*
Skin disease	**37.5**	**9.8**	**131**	**13.9**	**40.8**	**3.4**	**37**	**10.1**	**181**	**19.2**	**40.3**	**3.3**
No comorbidity	*36*	*10.3*	*21*	*2.2*	*44.2*	*3.2*	*31.5*	*7.2*	*15*	*1.6*	*44.7*	*3.3*
At least one more disease	*37.8*	*9.7*	*110*	*11.7*	*40.2*	*3*	*37.5*	*10.2*	*166*	*17.6*	*39.9*	*3*
Genitourinary disease	**42.9**	**9.3**	**138**	**14.6**	**40.8**	**3.1**	**42.5**	**9.5**	**145**	**15.4**	**40.2**	**2.9**
No comorbidity	*38.4*	*9.5*	*11*	*1.2*	*43.9*	*2.5*	*48*	*7*	*3*	*0.3*	*44*	*5.2*
At least one more disease	*43.3*	*9.2*	*127*	*13.5*	*40.6*	*3*	*42.4*	*9.5*	*142*	*15.1*	*40.1*	*2.8*
Mental disorders	**44.9**	**8**	**22**	**2.3**	**36.9**	**4.5**	**40**	**10.2**	**155**	**16.4**	**39**	**3.8**
Depression	45.3	7.5	16	1.7	36.9	5	44.7	8.7	26	2.8	38	4.4
Anxiety, sleep disorder, minor depression	44.4	7.6	14	1.5	37.3	3.7	39.3	10	140	14.9	39.2	3.6
No comorbidity			*0*	*0*	*na*	*na*	*35.5*	*7.8*	*6*	*0.6*	*45.7*	*1.8*
At least one more disease	*44.9*	*8*	*22*	*2.3*	*36.9*	*4.5*	*40.2*	*10.2*	*149*	*15.8*	*38.8*	*3.6*
Cardiovascular disease	**45**	**8.7**	**126**	**13.4**	**40.2**	**3.9**	**44.3**	**9**	**154**	**16.3**	**39.7**	**3.6**
Hypertension	48.1	5.9	68	7.2	39.9	4	47.3	6.8	86	9.1	39.6	3.8
Angina pectoris	50.3	4.3	8	0.8	37.1	5.5	47.4	8.8	10	1.1	36.7	4.5
Myocardial infarction	49	4.4	6	0.6	39.3	3.5	49	4.4	6	0.6	38.5	4
No comorbidity	*42.1*	*9.6*	*13*	*1.4*	*43.5*	*3*	*43.2*	*9.7*	*9*	*0.9*	*44.2*	*2.7*
At least one more disease	*45.4*	*8.6*	*113*	*12*	*39.9*	*3.8*	*44.4*	*9*	*145*	*15.4*	*39.4*	*3.5*
Endocrine and metabolic diseases	**43.6**	**9.2**	**72**	**7.6**	**40.8**	**4**	**42.7**	**9.2**	**139**	**14.7**	**40.2**	**3.7**
Obesity	42.4	9.9	26	2.8	40.5	4.2	42.1	9.4	92	9.8	40	3.7
Diabetes	49.5	3.5	19	2	40.3	4.3	49.4	3.6	24	2.5	38.6	4.8
No comorbidity	*37.8*	*12.4*	*12*	*1.3*	*44.7*	*2*	*39.8*	*11*	*14*	*1.5*	*44.9*	*1.3*
At least one more disease	*44.8*	*8*	*60*	*6.3*	*40*	*3.8*	*43.1*	*9*	*125*	*13.2*	*39.7*	*3.5*

**only the diagnosed diseases (by a physician) scored to the index (WAI)*

3.2 Regression Analysis on Total WAI Score

Significantly, lower WAI scores were calculated in employees reported long sick leaves (>10 days) (40.1 vs. 43.1), in elderly workers (>45years; 42 points vs. 42.9) and those with higher comorbidity (>1 diseases; 40.4 vs. 44.1 points). In linear regression analysis, WAI score was associated significantly with morbidity and comorbidity frequency (b-coefficient = -3.74; 95% CI -4.16 to -3.32, p<.001); with sick-leave duration (b-coefficient= -3.06; 95% CI -2.49 to -3.62, p<.001); and with age in a lower extend (b-coefficient= -0.81; 95% CI -1.30 to -0.32, p<.001). Multivariate analysis showed that additional factors associated with work ability, were having children and obesity. Having children decreased the possibility to report worst current work ability compared to lifetime best (OR: 0.46, 95%CI: 0.24 - 0.87, p<.001). Also the possibility of reporting moderate rather than very good work ability (in relation to the demands of the job) increases up to 2 (95%CI: 1.15-3.46) with obesity.

3.3 Correlations with SF-36

WAI total score showed statistically significant and positive correlations (p<.001) with all eight items of health status derived from the SF-36 questionnaire (data not shown in table). The Spearman correlation coefficients (r) reached 0.40 for physical functioning, 0.37 for general health, 0.33 for vitality, 0.31for mental health, 0.29 for bodily pain, 0.25 for social functioning, physical role and emotional-role subscales. This pattern of correlations underlines the higher impact of physical capability as it was expected in this mostly male blue collar population.

Table 3. Factor analysis of the Greek version of the Work Ability Index

Items	Principal axis factoring*		Principal component Analysis**	
	Factor		Factor	
	1	2	1	2
1 Current work ability compared with the lifetime best	0.508		0.747	
2 Current work ability in relation to its demands	0.722		0.759	
3 Number of current diseases diagnosed by physician		0.451		0.671
4 Estimated work impairment due to diseases		0.554		0.608
5 Sick leave during the past year (12 months)		0.208		0.638
6 Own prognosis regarding of work ability two years from now	0.289	0.322	0.325	0.347
7 Mental resources (feelings of joy, activeness or optimism lately)	0.373	0.341	0.565	0.139
Variance of the component (%)	28.1	15.7	28.1	15.8

*Rotation Method: *Oblimin with Kaiser Normalization; **Varimax with Kaiser Normalization*

3.4 Factor Analysis

Both exploratory and confirmatory factor analysis favored a two-dimensional structure. There was a clear grouping of five of the seven subscales of the WAI in the two-dimensional rotated model: items 1 and 2 constituted a factor that could be described as “subjectively

estimated work ability" and items 3, 4 and 5 as "ill-health-related ability". For items 6 and 7, the situation was less clear (Tables 3 and 4).

The confirmatory analysis supported the use of a two-factor model and the special role of items 6 and 7. For the total population and almost all subpopulation groups, the best fitting models were those where items 6 or 7 loaded on both factors (models C and E; Table 4).

Table 4. Results of confirmatory analysis, seven subscales, fit of models in various subpopulations

	All employees n=943	Age (≤45) n=637	Age (>45) n=306	White collar workers n=137	Blue collar workers		
					All n=806	Fitters n=299	Welders n=122
One factor							
p	.000	.000	.000	.000	.000	.009	.063
CFI	0.828	0.792	0.861	0.721	0.835	0.841	0.843
Two factor, correlated factors							
A							
p	.001	.000	.056	.235	.006	.043	.258
CFI	0.953	0.909	0.951	0.964	0.958	0.900	0.950
B							
p	.001	.002	.022	.129	.005	.343	.365
CFI	0.953	0.935	0.934	0.935	0.956	0.985	0.980
C							
p	.036	.006	.105	.289	.133	.285	.412
CFI	0.970	0.948	0.965	0.976	0.986	0.977	0.992
D							
p	.000	.003	.036	.034	.003	.954	.395
CFI	0.948	0.942	0.943	0.880	0.954	1.000	0.988
E							
p	.011	.020	.047	.146	.035	.934	.356
CFI	0.971	0.961	0.950	0.943	0.974	1.000	0.979
F							
p	.010	.020	.089	.159	.029	.899	.319
CFI	0.972	0.963	0.964	0.949	0.973	1.000	0.971

Fitters and welders are subgroups of blue collar workers. CFI: Comparative Fit Index(higher values indicate a better fit).

Structure of models A-F: A) Items 1,2 vs. 3,4,5,6,7; B) Items 1,2,7 vs. 3,4,5,6; C) Items 1,2,7 vs. 3,4,5,6,7 (item 7 loading on both factors); D) Items 1,2,6,7 vs. 3,4,5; E) Items 1,2,6,7 vs. 3,4,5,6 (Item 6 loading on both factors); F) Items 12467 vs. 3456 (Item 4 and 6 loading on both factors)

The best models are highlighted (C and E; see also relative text in 2.3 section)

3.5 Internal Consistency

Internal consistency among the items was satisfactory as verified by Kendall's tau b correlation coefficients (Table 5).

Table 5. Inter-item correlations using Kendall's tau-b coefficient

Item	2	2a	2b	3d	3t	4	5	6	7	7a	7b	7c
1	0.314	0.312	0.29	0.044	0.086	0.121	0.014	0.039	0.139	0.072	0.115	0.141
	p<.001	p<.001	p<.001	p=.067	p<.001	p<.001	p=.621	p=.021	p<.001	p=.011	p<.001	p<.001
2a			0.466	0.112	0.125	0.204	0.046	0.188	0.209	0.155	0.212	0.193
			p<.001	p<.001	p<.001	p<.001	p=.138	p<.001	p<.001	p<.001	p<.001	p<.001
2b				0.049	0.054	0.132	0.089	0.094	0.169	0.122	0.158	0.129
				p=.086	p=.058	p<.001	p=.003	p=.003	p<.001	p<.001	p<.001	p<.001
2				0.107	0.113	0.195	0.07	0.168	0.216	0.167	0.217	0.179
				p<.001	p<.001	p<.001	p=0.014	p<.001	p<.001	p<.001	p<.001	p<.001
3d					0.783	0.271	0.090	0.106	0.080	0.006	0.077	0.064
					p<.001	p<.001	p<.001	p<.001	p=.001	p=.836	p=0.002	p=.002
3t						0.293	0.090	0.109	0.117	0.017	0.086	0.073
						p<.001	p<.001	p<.001	p<.001	p=.549	p=.002	p=0.008
4							0.114	0.178	0.162	0.117	0.111	0.106
							p<.001	p<.001	p<.001	p<.001	p<.001	p<.001
5								0.063	0.017	0.006	0.014	0.01
								p=.052	p=0.56	p=.836	p=.635	p=.737
6									0.146	0.105	0.164	0.087
									p<.001	p=.001	p<.001	p=0.005
7a											0.362	0.279
											p<.001	p<.001
7b												0.337
												p<.001

WAI items: 1) Current work ability compared with the lifetime best, 2a) Current work ability in relation to physical demands, 2b) Current work ability in relation to mental demands, 2) Current work ability in relation to work demands, 3d) Number of current diseases diagnosed by physician, 3t)Number of total current diagnosed by physician and self-reported diseases, 4) Estimated work impairment due to diseases, 5) Sick leave during the past year (12 months), 6) Own prognosis regarding of work ability two years from now, 7a) Enjoying daily tasks, 7b) Activity and life spirit, 7c) Optimistic about the future, 7) mental resources.

4. DISCUSSION

We validated the Greek version of Work Ability Index, a tool largely contribute to the study of work ability and its individual, social, and economic implications in the field of public health [4]. Our results based on confirmatory analysis were consistent with studies supported a two-factor structure.

In a cross-sectional study, various aspects of WAI validity were examined in a population of shipyards employees with significant variety in respect to age, gender, education, and job titles. WAI score was significantly related with age, sick leave duration and morbidity/co-morbidity pattern showing good prognostic properties and discriminant validity. In accordance to previous studies, WAI score was related positively to educational level and inversely to age though an increase in elders (healthy worker effect) was evident [6,18,19]. The finding of Gould and colleagues that the presence of children in the family was positively related to work ability [18] was also found but in the presence of high morbidity/comorbidity the relation was reversed in our study. Cardiovascular and mental disorders seem to hold the greater impact in work ability in our study as well [18]. The fact that many diseases, especially mental disorders, are exclusively self-reported in our sample, may suggest a high prevalence of sickness 'presenteeism' and/or a low level of seeking care either by choice or by limited access [13].

All dimensions of health (status) measured by the SF-36 questionnaire were significantly and positively related with WAI scores, as an evidence of criterion validity. This is consistent with the theoretical framework of work ability, which is represented as health based on functional ability and presence of diseases. Though significant, the weaker correlations may be justified by the fact that each dimension in itself has not the same impact in forming the overall WAI score.

The internal consistency as a measure of reliability was tested by inter-item correlations and the results showed that the items fit together satisfactorily. However, low correlation coefficients found with sick leave duration the previous year, although may be attributed to particularities in the specific setting, indicate that the cause and the frequency of sick leaves may be more informative [20–22]. Based on the lack of substantial relationship between the level of sick leave the previous year and total WAI score, it has been proposed the exclusion of this item from the questionnaire [23].

Factor analysis in our sample showed that the WAI was not fit as a one-dimensional construct. Consistently in total and subgroup analysis the results favored a two-dimensional structure. The one factor model was inadequate in all cases tested. Similarly – although not identically – with other researchers, we found a clear grouping of five of the seven subscales of the WAI in the two-dimensional rotated model: subscales 1, 2 constituted a factor named as “subjectively estimated work ability” and subscales 3, 4 and 5 could be constituted an “ill-health-related ability” named factor, differentiating for the terminology of “objective work ability” used by other researchers [23]. As far as it concerns, items 6 and 7 may load on both factors in equally well fitted models. We proposed as more preferable the model where item 6 loads in both factors and item 7 loads in the factor of “subjectively estimated work ability” (first). This model was stable in all groups tested and is supported by recent research [17]. Similarly to Radkiewicz and Widerszal-Bazyl [23], we also found that subscales 1 and 2 had the highest discriminant power, although factor loadings differed largely among the various settings [7,9].

As far as it concerns our descriptive data the WAI scores in our study was found slightly higher compared with other studies in industry [24,25]. This could be explained by the age distribution in our cohort (younger population), organizational factors (increased job insecurity), cultural factors and possibly a stronger healthy worker effect.

Our study had a very high statistical power, low female participation (common in heavy industry) and a relatively limited number of job titles, so further research with more homogeneous samples and the appropriate statistical power is needed in order to test the tool in various sectors and employment settings. Sociocultural, political and economic environment may affect the pattern of functional (healthy) ageing [13] and the differences in working and living conditions may excuse the large variation in WAI scores among countries [7,9,13,18]. Since the cutoff points proposed in the Finnish study may not be valid, its use as a categorical scored instrument is not warranted, and we suggest to use WAI as a "linear scored" tool both in occupational health practice and academic research. A slightly lower level of explained variance may be attributed to the specific cohort and/or setting effects.

5. CONCLUSION

The Greek version of the Work Ability Index showed satisfactory psychometric properties and consistency and therefore stands as an appropriate option for evaluating work ability in both individual and population-based settings.

CONSENT

Not applicable. (As we stated in the method section, participants gave their informed consent)

ETHICAL APPROVAL

Not applicable.

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COMPETING INTERESTS

The authors declare no conflict of interest. ECA, who act as guarantor of the study, was affiliated with the HSY Company during the study period.

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