Occupational Diseases and Environmental Medicine, 2024, 12, 49-57
https://www.scirp.org/journal/odem
ISSN Online: 2333-357X
ISSN Print: 2333-3561

Work Ability Index and Work Ability Score: A Comparation between both Scores in a Persistent COVID-19 Cohort

Carmen Muñoz-Ruiperez[1,2*], Diego Alvaredo Rodrigo[2], Daniel Arroyo-Sánchez[2], Juan Francisco Álvarez Zarallo[3], Ignacio Sánchez-Arcilla Conejo[4], José Lorenzo Bravo Grande[5]

[1]Department of Occupational Health, Hospital Universitario 12 de Octubre, Madrid, Spain
[2]Instituto de Investigación Biomédica Hospital 12 de Octubre (Imas12), Madrid, Spain
[3]Department of Occupational Health, Hospital Universitario Virgen Macarena, Andalucía, Sevilla, Spain
[4]Department of Occupational Health, Hospital Universitario Gregorio Marañón, Madrid, Spain
[5]Department of Occupational Health, Complejo Asistencial Universitario de Salamanca, Castilla y León, Salamanca, Spain
Email: *carmenmzrz@gmail.com

How to cite this paper: Muñoz-Ruiperez, C., Rodrigo, D.A., Arroyo-Sánchez, D., Zarallo, J.F.Á., Conejo, I.S.-A. and Grande, J.L.B. (2024) Work Ability Index and Work Ability Score: A Comparation between both Scores in a Persistent COVID-19 Cohort. *Occupational Diseases and Environmental Medicine*, **12**, 49-57.
https://doi.org/10.4236/odem.2024.121006

Received: January 16, 2024
Accepted: February 18, 2024
Published: February 21, 2024

Abstract

Aims: The present study aims to compare the assessment of work ability based on the use of the Work Ability Index (WAI) with another questionnaire base only on the use of WAI's first item, termed as the "Work Ability Score" (WAS). Study design: A cohort of 384 Spanish workers included in a Post COVID-19 condition or persistent COVID-19 multicenter research was utilized. Place and Duration of Study: This cohort was enlisted in four hospitals (Hospital Universitario 12 de Octubre, Madrid; Hospital Universitario Virgen Macarena, Sevilla, Andalucía; Hospital Universitario Gregorio Marañón, Madrid and Complejo Asistencial Universitario de Salamanca, Castilla y León), since 2021 until 2022. Methodology: 384 Spanish workers (176 men and 208 women; aged 20 to 70 years) with Post COVID-19 condition or persistent COVID-19 were included. Descriptive analysis of primary scores was conducted. Given the non-normal distribution of data, the Mann-Whitney and Kruskal-Wallis tests were employed. Spearman and Kendall correlations were employed to assess the relationship between WAI and WAS, also used weighted Kappa to estimate the degree agreement between WAI and WAS. Logistic regression models were utilized to study determinants influencing WAI and WAS, categorized as poor or moderate. Results: WAI had an average score of 32.98 (SD = 10.28), whereas WAS had an average of 5.95 (SD = 2.77). Significant differences were observed in both WAI and WAS across the same variables. Strong and statistically significant correlations were evident between WAI and WAS ($rs = 0.83$, $p < 0.001$). All the variables used in the logistic re-

gression model (gender, the sector employment, and previous chronic diseases) were statistically significant in both questionnaires. Conclusion: WAS questionnaire could be used as a tool for reliable assessment of work ability among Spanish workers with Post COVID-19 condition or Persistent COVID-19.

Keywords

Work Ability Index, Work Ability Score, Post COVID-19 Condition, Occupational Health, Occupational Medicine

1. Introduction

The Work Ability Index (WAI) is a test designed by the Finnish Institute of Occupational Health during the decade of 1980. It has helped to estimate the self-perception of a worker situation in both work and global health [1] [2]. It has been used worldwide and has been validated on a wide range of issues, including stress, psychosocial factors, musculoskeletal pathologies and general labor effects [3] [4] [5] [6].

It consists of seven dimensions: current work ability compared with the lifetime best; work ability in relation to the demands of the job; number of current diseases diagnosed by a physician; estimated work impairment due to diseases; sick leave during the past year; own prognosis of work ability two years from now; and mental resources. These dimensions give a punctuation, which must be added. The final punctuation can be categorized as: deficient, moderate, good or excellent.

One of the most controversial matter about WAI is the implication of each dimension. Not all the dimensions express the same aspect of the worker, and some of them can produce redundant information already recorded in another. Due of this problem, several teams have tried to shorten the test and validating the result in order to improve both: the time of the procedure (WAI questionnaire lasts around an hour) and also to limit confusion factors of not so relevant dimensions [7] [8] [9].

This paper will test the validity of the Work Ability Score (WAS), an abridged WAI which only consists of the first WAI question (Current work ability compared with the lifetime best) as some other teams have also done with diverse outcomes [10]-[16]. This paper will test the validity of de Work Ability Score (WAS) in a cohort of workers with post COVID-19 condition or persistent COVID-19 [17], a fact that had not even been done, at least, in the reviewed scientific literature.

2. Material and Methods

2.1. Study Design and Participants

This is an observational multicenter study, that prospectively follow-up an his-

torical cohort, representative of workers who have been diagnosed or treated for POST-COVID19 Condition. To calculate the sample, we used the epidemiological report No. 90 of the National Epidemiological Surveillance Network of Spain until August 4, 2021 [18].

The following were specified as inclusion criteria: workers from any professional sector who were working at the time of the diagnosis of SARS-CoV-2 infection by PDIA or specific IgG against SARS-CoV-2, carried out between March 1, 2020 and July 31, 2021 of the pandemic who needed specialized medical assistance for POST-COVID19 symptoms, 3 months after the diagnosis of COVID-19.

This cohort was enlisted in four hospitals (Hospital Universitario 12 de Octubre, Madrid; Hospital Universitario Virgen Macarena, Sevilla, Andalucía; Hospital Universitario Gregorio Marañón, Madrid and Complejo Asistencial Universitario de Salamanca, Castilla y León) since 2021 until 2022. Those patients had a condition of persistent COVID-19, whose diagnose could be previous to the start of the research.

WAI questionnaire was used at least at the beginning and at the end of the study (one year of time between both points approximately). In addition, if a patient was on sick leave during the follow-up and returned to work, was an additional WAI check-up performed upon return to work, before medical cite to the ending of the study.

2.2. Variables

This study considers the WAI and WAS scores as dependent variables. Additionally, various explanatory variables have been considered, including age, gender, type of occupation (physical or mentally demanding), industry sector, sector employment and the presence of previous chronic diseases.

The WAI and WAS scores have been classified in four categories based on recommendations from previous authors [12]. WAI scores are interpreted so that work ability is: poor (7 - 27); moderate (28 - 36); good (37 - 43) or excellent (44 - 49). Similarly, WAS score is classified according to the same four categories: poor (0 - 5); moderate (6 - 7); good (8 - 9) or excellent (10).

2.3. Statistical Analysis

To assess the validity of WAS as a substitute for WAI, various steps were undertaken using different methodologies. Data analysis was performed using R version 4.2.1.

Initially, a descriptive analysis of the two primary scores was conducted in relation to the remaining explanatory variables. Given the non-normal distribution of the data, the presence of significant differences was examined using the Mann-Whitney test for explanatory variables with two categories and the Kruskal-Wallis test for variables with more than two categories. The agreement of their categories was examined through a cross-tabulation. Subsequently, the association between the WAI and WAS categories was explored, calculating Spear-

man and Kendal correlations.

The degree of agreement between WAI y WAS was estimated using weighted Kappa for ordered categories.

Two logistic regression models were estimated in order to study the determinants that influence WAI and WAS. Both scores were categorized into two groups (poor and moderate). The cutoff points were set at 36 for WAI and 7 for WAS. Independent variables were included in the multivariate model if they yielded significance in the univariate analysis ($P \leq 0.15$). Variables with a $P < 0.05$ were considered statistically significant.

3. Results

3.1. Descriptive Analysis

In order to test our premise, we have been used the data from a 384 cohort of patients recruited in the persistent COVID-19 multicenter research.

The mean scores of WAI and WAS, with respect to the explanatory variables, are presented in Table 1. Significant differences were observed in the mean WAI scores when comparing sector employment ($P = 0.003$) and chronic diseases ($P < 0.001$). Similarly, significant differences were found in the WAS scores for the same variables: sector employment ($P < 0.001$) and chronic diseases ($P = 0.039$).

After conduction the cross-tabulation of categories for both variables, as presented in Table 2, it was observed that, in most of the cases, the grouping performed, whether considering WAI or WAS scores, exhibited significant similarity. The overall mean WAI score is 32.98 (SD = 10.28), and for WAS, it is 5.95 (SD = 2.77). A substantial portion of the subjects (63.8%) falls along the main diagonal of the table, what means that the category in which they have been classified remains consistent when either of the two scores is considered. Approximately 34.1% of the subjects were classified into adjacent categories. Notably, the most significant discrepancies were evident in five subjects whose WAI classification was labeled as "good", yet their WAS scores indicated "poor", and in three other subjects whose WAI scores were classified as "excellent", but their categorization based on WAS scores was deemed "moderate".

The correlations between WAI and WAS scores were statistically significant, both when utilizing Spearman's rank correlation ($rs = 0.83$, $P < 0.001$) and Kendall's tau ($\tau = 0.76$, $P < 0.001$). These values indicate a strong correlation.

The degree of agreement between WAI and WAS scores was 0.66 with 95% CI [0.61; 0.71] utilizing weighted kappa for ordered categories. This value indicates a good strength of agreement [19] [20]. 245 (61.6%) participants had equal categorization, 131 (32.9%) participants had adjacent categories, and only 8 participants (2.08%) who had a poor or moderate WAS, were classified as good or excellent WAI, respectively.

3.2. Determinants of WAI and WAS

Table 3 presents the results of the two multivariate analyses conducted to examine

Table 1. Participants' sociodemographic and work-related factor and their associations with the work ability index and work ability score (n = 384).

Variable	N	WAI		WAS	
		Mean (SD)	P	Mean (SD)	P
Gender					
Male	176	33.6 (10.8)	0.13	6.0 (3.0)	0.31
Female	208	32.5 (9.8)		5.9 (2.6)	
Age groups (years)					
20 - 30	1	23 (0.0)		4 (0.0)	
30 - 45	58	33.1 (10.9)	0.75	5.8 (2.9)	0.71
45 - 60	237	33.1 (10.2)		5.9 (2.7)	
60 - 70	88	32.6 (10.3)		6.1 (2.9)	
Type of position					
Physical	79	31.6 (11.5)		5.6 (3.1)	
Mental	93	31.6 (11.2)	0.25	5.7 (3.0)	0.41
Mixed	212	34.1 (9.3)		6.2 (2.5)	
Economic Sector					
Primary	10	26.7 (11.8)		4.2 (3.0)	
Secondary	44	33.2 (11.0)		5.9 (2.9)	
Tertiary	170	32.1 (10.9)	0.22	5.8 (3.0)	0.28
Quaternary	39	33.1 (10.5)		6.1 (3.0)	
Quinary	121	34.6 (8.7)		6.3 (2.4)	
Sector Employment					
Private	208	31.4 (11.1)	<0.01	5.5 (2.9)	<0.01
Public	176	34.9 (8.9)		6.5 (2.5)	
Monitoring					
Homecare	144	34.0 (9.4)		6.2 (2.6)	
Hospital ward	131	32.7 (10.6)	0.44	5.9 (2.8)	0.38
ICU (UCI)	109	32.0 (10.9)		5.7 (2.9)	
Chronic diseases					
Yes	222	31.6 (10.1)	<0.01	5.7 (2.7)	<0.01
No	162	34.8 (10.3)		6.2 (2.9)	

Table 2. Cross-categorization of work ability assessment categories based on WAI and WAS.

WAI \ WAS	Poor	Moderate	Good	Excellent
Poor	103	6	0	0
Moderate	31	59	11	0
Good	5	52	59	7
Excellent	0	3	24	24

Table 3. Odds ratio (OR) and 95% confidence intervals (95% CI) for individual and professional factor associated with Work Ability Index (WAI) and with Work Ability Score (WAS)—[moderate-poor] vs [excellent-good].

	Dependent variable					
	WAI			WAS		
	OR	95% CI	P	OR	95% CI	P
Gender (female)	0.65	(0.42, 0.99)	0.049	0.52	(0.33, 0.82)	0.005
Sector (public)	1.87	(1.22, 2.88)	0.004	1.68	(1.07, 2.66)	0.025
Chronic diseases (yes)	0.49	(0.32, 0.74)	<0.001	0.53	(0.33, 0.81)	0.004

the likelihood of having a "moderate" or "poor" work ability. In the multivariate model, all variables that were found to be significant (P = 0.15) in the univariate models were included. After testing the significance of different second-order interactions, significant variables with a P = 0.05 were retained in the model.

The results obtained for both WAI and WAS are analogous: the significant variables included gender, the sector employment and the chronic diseases. No variable emerged as significant exclusively in one of the two models. Furthermore, the estimated coefficients were similar:

Women have a 35% lower probability of exhibiting "moderate" rather than "poor" work ability when considering WAI and 48% lower probability when considering WAS.

Public sector employees have a 87% higher probability of exhibiting "moderate" rather than "poor" work ability when taking WAI into account and a 68% higher probability when considering WAS.

Individual with presence of chronic diseases have a 51% lower probability of demonstrating "moderate" rather than "poor" work ability when considering WAI and a 47% lower probability when considering WAS.

4. Discussions and Conclusion

The findings of this study reveal a notable concordance when employing WAS scores a substitute for the traditional WAI questionnaire. This research represents the first attempt to compare these scores in a specific sample of Spanish workers with post-COVID-19 condition or persistent COVID-19.

Variables in which significant discrepancies are identified regarding WAI and WAS scores are consistent in both groups: the type of employment, public or private, and the presence or absence of previous chronic diseases. In most cases, categories related to work ability align, considering both WAI and WAS scores.

The results obtained demonstrate a substantial correlation between the measures of both scores and their respective categories. This correlation has been previously documented by other groups [12].

Logistic regression models have revealed that the variables that have a statistically significant effect on the probability of presenting a "poor" or "moderate" work ability are the same in both WAI and WAS. These variables include gend-

er, sector employment (public or private), and the presence of chronic diseases. Furthermore, the effect generated by both scores on the probability of presenting a "moderate" work ability was similar. There are some studies that have been carried out in line with ours, and their results resemble those obtained in this study, although with the presence of some variables that were only significant in one of the two models [12] [13].

It is important to highlight that, although both WAI and WAS explained a significant proportion of the variability in these questionnaires, WAI showed a slightly superior ability to explain this variability. These results might indicate subtle differences in predictive ability between WAI and WAS, although these differences are not significantly wide.

Moreover, the justification for considering WAS as a suitable substitute for WAI lies in its consistent alignment with WAI on several variables and categories that are keys in their relationship to work ability. The substantial correlation observed between both measures, along with their similar impact on predicting work ability categories, strengthens the argument for the reliability of WAS as a similar tool when compared with WAI.

WAS is an effective surrogate questionnaire for WAI and could be used for reliable assessment of work ability among Spanish workers and specifically workers with post COVID-19 condition.

Ethics Approval Statement

The human data were performed in accordance with the Declaration of Helsinki. This manuscript has been approved by the Ethical Committee from "Instituto de Investigación del Hospital Universitario 12 de Octubre" (Nº CEIm: 21/666).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

Funding Statement and Acknowledgements

This article has been prepared thanks to the funding of the study "RETURN TO WORK: ADAPTATION AND EMPLOYABILITY NEEDS IN POST-COVID19 WORKERS" funded after the evaluation of competitive projects published by the National Institute of Safety and Health at Work O.A.M.P. (INSST), file: 5175-21, on 20th December 2021 and granted to the i + 12 Research Foundation of the 12 de Octubre University Hospital.

We would like to thank all the patients' participants and their families who dedicated time for the participation in this study.

References

[1] Tuomi, K., Ilmarinen, J., Jahkola, A., Katajarinne, L. and Tulkki, A. (1998) Work Ability Index. 2nd Edition. Finnish Institute of Occupational Health, Helsinki.

[2] Ilmarinen, J. (2019) From Work Ability Research to Implementation. *International Journal of Environmental Research and Public Health*, **16**, 2882. https://doi.org/10.3390/ijerph16162882

[3] Gharibi, V., Mokarami, H., Taban, A., Yazdani Aval, M., Samimi, K. and Salesi, M. (2016) Effects of Work-Related Stress on Work Ability Index among Iranian Workers. *Safety and Health at Work*, **7**, 43-48. https://doi.org/10.1016/j.shaw.2015.10.005

[4] Rashid, M., Heiden, M., Nilsson, A. and Kristofferzon, M.L. (2021) Do Work Ability and Life Satisfaction Matter for Return to Work? Predictive Ability of the Work Ability Index and Life Satisfaction Questionnaire among Women with Long-Term Musculoskeletal Pain. *BMC Public Health*, **21**, 584. https://doi.org/10.1186/s12889-021-10510-8

[5] Kaleta, D., Makowiec-Dabrowska, T. and Jegier, A. (2006) Lifestyle Index and Work Ability. *International Journal of Occupational Medicine and Environmental Health*, **19**, 170-177. https://doi.org/10.2478/v10001-006-0021-x

[6] Padula, R.S., Comper, M.L., Moraes, S.A., Sabbagh, C., Pagliato, W.J. and Perracini, M.R. (2013) The Work Ability Index and Functional Capacity among Older Workers. *Brazilian Journal of Physical Therapy*, **17**, 382-391. https://doi.org/10.1590/S1413-35552013005000107

[7] Schouten, L.S., Bültmann, U., Heymans, M.W., Joling, C.I., Twisk, J.W. and Roelen, C.A. (2016) Shortened Version of the Work Ability Index to Identify Workers at Risk of Long-Term Sickness Absence. *European Journal of Public Health*, **26**, 301-305. https://doi.org/10.1093/eurpub/ckv198

[8] Hetzel, C., Baumann, R., Bilhuber, H. and Mozdzanowski, M. (2014) Determination of Work Ability by a Work Ability Index Short Form ("WAI-r"). *ASU International*, **10**, 01-03. https://doi.org/10.17147/ASUI.2014-10-01-03

[9] Ebener, M. and Hasselhorn, H.M. (2019) Validation of Short Measures of Work Ability for Research and Employee Surveys. *International Journal of Environmental Research and Public Health*, **16**, 3386. https://doi.org/10.3390/ijerph16183386

[10] Gould, R., Ilmarinen, J., Jarvisalo, J. and Koskinen, S. (2008) Dimensions of Work Ability. Results of the Health 2000 Survey. Helsinki, Finnish Centre for Pensions, The Social Insurance Institution, National Public Health Institute, Finnish Institute of Occuptional Health. https://www.julkari.fi/bitstream/handle/10024/78055/dimensions_of_work_ability_7.pdf

[11] Radkiewich, P. and Widerszal-Bazyl, M. (2005) Psychometric Properties of Work Ability Index in the Light of Comparative Survey Study. In: *International Congress Series*1280, Elsevier, Amsterdam, 304-309. https://doi.org/10.1016/j.ics.2005.02.089

[12] El Fassi, M., Bocquet, V., Majery, N., Lair, M.L., Couffignal, S. and Mairiaux, P. (2013) Work Ability Assessment in a Worker Population: Comparison and Determinants of Work Ability Index and Work Ability Score. *BMC Public Health*, **13**, 305. https://doi.org/10.1186/1471-2458-13-305

[13] Mokarami, H., Cousins, R. and Kalteh, H.O. (2022) Comparison of the Work Ability Index and the Work Ability Score for Predicting Health-Related Quality of Life. *International Archives of Occupational and Environmental Health*, **95**, 213-221. https://doi.org/10.1007/s00420-021-01740-9

[14] Roelen, C.A., van Rhenen, W., Groothoff, J.W., van der Klink, J.J., Twisk, J.W. and Heymans, M.W. (2014) Work Ability as Prognostic Risk Marker of Disability Pension: Sigle-Item Work Ability Score versus Multi-Item Work Ability Index. *Scandinavian Journal of Work, Environment & Health*, **40**, 428-431.

https://doi.org/10.5271/sjweh.3428

[15] Boekel, I., Dutmer, A.L., Schiphorst Preuper, H.R. and Reneman, M.F. (2022) Validation of the Work Ability Index-Single Item and the Pain Disability Index-Work Item in Patients with Chronic Low Back Pain. *European Spine Journal: Official Publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society*, **31**, 943-952. https://doi.org/10.1007/s00586-022-07109-x

[16] Mokarami, H., Mortazavi, S.B., Asgari, A. and Choobineh, A. (2017) Work Ability Score (WAS) as a Suitable Instrument to Assess Work Ability among Iranian Workers. *Health Scope*, **6**, e42014. https://doi.org/10.17795/jhealthscope-42014

[17] Soriano, J.B., Murthy, S., Marshall, J.C., Relan, P., Diaz, J.V. and WHO Clinical Case Definition Working Group on Post-COVID-19 Condition (2022) A Clinical Case Definition of Post-COVID-19 Condition by a Delphi Consensus. *The Lancet, Infectious Diseases*, **22**, e102-e107. https://doi.org/10.1016/S1473-3099(21)00703-9

[18] Equipo COVID-19 (2021) Situación de COVID-19 en España a 04 de agosto de 2021 (Vol. 90). RENAVE. CNE. CNM (ISCIII). https://www.isciii.es/QueHacemos/Servicios/VigilanciaSaludPublicaRENAVE/EnfermedadesTransmisibles/Documents/INFORMES/Informes%20COVID-19/INFORMES%20COVID-19%202021/Informe%20n%C2%BA%2090%20Situaci%C3%B3n%20de%20COVID-19%20en%20Espa%C3%B1a%20a%2004%20de%20agosto%20de%202021.pdf

[19] Landis, J.R. and Koch, G.G. (1977) The Measurement of Observer Agreement for Categorical Data. *Biometrics*, **33**, 159-174. https://doi.org/10.2307/2529310

[20] Wit, E. and McClure, J.D. (2004) Statistics for Microarrays Design, Analysis, and Inference. John Wiley & Sons, Hoboken. https://doi.org/10.1002/0470011084