Analyzing the Influence of Work Demands and Work Organization on Workability Based on Age

Camila A. Ribeiro[1(✉)], Teresa P. Cotrim[1,2], Vítor Reis[3], Maria João Guerreiro[3], Susana Candeias[3], Ana Sofia Janicas[3], and Margarida Costa[3]

[1] Ergonomics Laboratory, FMH, Universidade de Lisboa, Lisbon, Portugal
tcotrim@fmh.lisboa.pt
[2] CIAUD, Faculdade de Arquitetura, Universidade de Lisboa, Lisbon, Portugal
[3] Health and Safety Department, Municipality of Sintra, Sintra, Portugal

Abstract. The reduction in work ability over the years is due to the imbalance between the work demands and individual resources and is strongly affected by a set of factors. This study aims at analyzing the influence of work demands and work organization on work ability based on age. The results were extracted from a prospective study that accomplishes three time periods. Was used a self-administered questionnaire composed of sociodemographic questions, the Portuguese version of the Work Ability Index (WAI) and the scales related to work demands and work organization from the Portuguese medium version of Copenhagen Psychosocial Questionnaire (COPSOQ II). In 2015 the sample included 885 participants, in 2017, 1167 participants, and in 2019, 1331 participants. The results pointed out that the ability to work decreased over the years. Also, workers over 50 years old, from the operational assistant category, with a degree in basic education presented lower WAI, representing a more vulnerable group. Regarding the COPSOQ II, the scales of "quantitative demands", "work pace" and "cognitive demands" showed better results as age increases. Better values in the scales "meaning of work", "workplace commitment" and "cognitive demands" determined better results in WAI, playing a protective role on the work ability. To conclude, psychosocial factors affect differently workers from different age groups and professional categories and has an important role on work ability. This must be taken into consideration to propose intervention measures.

Keywords: Work ability · Work demands · Cognitive demands · Work organization · Workplace commitment

1 Introduction

To better understand the concept of work ability, we first reflect on the concept of disability established by the International Classification of Functionality, Disability and Health: a person's functionality and disability are conceived as a dynamic interaction between health conditions and contextual factors; disability is not an attribute of the

N. L. Black et al. (Eds.): IEA 2021, LNNS 220, pp. 33–40, 2021.
https://doi.org/10.1007/978-3-030-74605-6_5

person, but a complex set of conditions that results from the interaction between person and environment (OMS 2004).

Disability is the generic term for disabilities, activity limitations and participation restrictions. It corresponds to the negative aspects of the interaction between an individual (with a health condition) and its contextual factors (environmental and personal) (OMS 2004). The work ability can be defined, therefore, by a sustainable balance between factors of work and human resources (physical and mental) (Ilmarinen 2012).

Maintaining the work ability of workers has been the focus of many studies, since professional life has been prolonged over the past decades and there is a concern to reduce occupational risks and promote quality of life and health among the aging workforce (Ilmarinen 2012; Oakman et al. 2016). In the European Union, it is estimated that by 2030, workers aged between 55 and 64 will make up the majority of the workforce in many countries (EU-OSHA 2016; Ilmarinen 2012).

The current changes in working life, increase the challenges for everybody, especially aging workers, since these changes are not accompanied by the pace of biological aging (Ilmarinen 2019).

Several studies have sought to understand how the emergent risk factors of psychosocial origin affects workers life and how they interfere on mental health for older workers (Collins and O'Sullivan 2015; Leijten et al. 2015). Among the results obtained, it was possible to identify that high physical, emotional demands and less autonomy at work were associated with reduced health among older workers. On the other hand, the promotion of commitment at work was a favorable factor and could be beneficial to health, especially the mental health of the older group (Leijten et al. 2015). The work demands also influence the risk of musculoskeletal injuries what can reduce the ability to work over the years (Collins and O'Sullivan 2015; Oakman et al. 2016).

Therefore, it is justified to develop a study that contemplates the analysis of the ability to work over the years and the characterization of the factors that influence this variation, regarding sociodemographic characteristics, work demands and work organization, aiming to contribute to the promotion of the permanence of workers in their workplace and improve health.

2 Methodology

2.1 Study Design

The study is cross-sectional but has a longitudinal design in which it seeks to analyze the aspects related to time and the changes that occur in individuals, integrating three time periods.

2.2 Methods

The analysis was done using a self-administered questionnaire composed by questions related to the sociodemographic variables, the Portuguese version of the Work Ability Index (WAI) (Silva et al. 2011) and the scales related to work demands and work organization from the Portuguese medium version of Copenhagen Psychosocial Questionnaire (COPSOQ II) (Silva et al. 2012).

The Work Ability Index is a self-administered instrument developed in Finland, which evaluates the worker's perception on how well they can perform work in function of work demands, health, physical and mental resources. Seven dimensions compose the WAI, with a final score ranging from 7 to 49 (better score). The results are classified as poor, moderate, good or excellent (Silva et al. 2011).

The COPSOQ is an instrument developed by the National Occupational Institute of Denmark, and tested in several studies, in order to standardize and monitor different psychosocial aspects in the workplaces (Silva et al. 2012). The scales from the Work demands, Work organization of the Portuguese medium version of COPSOQ II, regarding Quantitative demands, Work pace, Emotional demands, Cognitive demands, meaning of work, Commitment to the workplace, were used in this study. The scales are scored with a 5-point Likert scale and classified as critical, intermediate and favourable, based on two cut-off points.

2.3 Population and Sample

The population of this study included 1,667 workers of a Portuguese municipality. In 2015 the response rate was of 54%, with a total of 888 participants. In 2017, the sample comprised 1167 participants, corresponding to a response rate of 70%. In 2019, the global sample of workers in the Municipality was higher than in previous years, comprising 1997 workers. From this sample, we obtained 1325 valid questionnaires, making an overall response rate of 66.3%.

2.4 Procedures

The questionnaire was self-administered during the years 2015, 2017 and 2019. The inclusion criteria were to have a valid WAI and be a municipality worker for at least one year. 20 questionnaires were excluded from the analysis in 2015, 14 questionnaires in 2017 and 6 questionnaires in 2019. Missing values were excluded. The confidence level assumed for the statistical analysis was 95%.

At the end of the study, focus groups will be held to evaluate measures that can be implemented in the workplace.

3 Results

3.1 Sociodemographic Characterization

The sample showed an average age of 46.9 years (sd = 8.3) in 2015, 48.4 years (sd = 8.7) in 2017, and 49.5 years (sd = 9.2) in 2019. The mean age had an increase in both follow ups and the differences were statistically significant (F(2): 22,217; $p \leq 0{,}001$). Looking at the age groups, it's clear that in 2019, the group aged 50 years and more had a high percentage (Table 1).

The largest part of our sample has an undergraduate level and belong to a lower hierarchical level (Table 1). In the first two moments, workers in the technical assistant category had a higher percentage, and in 2019 we obtained a higher participation of workers in the operational assistant category (Table 1).

Table 1. Sociodemographic characterization

		2015		2017		2019	
		N	%	N	%	N	%
Age groups	<50	521	61,2%	593	52,8%	589	46,7%
	≥50	330	38,8%	530	47,2%	671	53,3%
Qualifications	Basic level	242	28,2%	314	27,9%	397	31,4%
	Secondary level	324	37,8%	411	36,5%	474	37,5%
	Graduated/post graduated	291	34,0%	402	35,7%	392	31,0%
Professional category	Operational assistant	287	33,7%	370	32,7%	468	37,6%
	Technical assistant	336	39,4%	431	38,1%	445	35,7%
	White collars	229	26,9%	330	29,2%	333	26,7%

Looking at the occupational category and age, workers in the Operational Assistant category are mostly aged 50 and over, and, comparing with the other occupational categories, the differences were statically significant [2015: F(2): 25,808; $p \leq 0{,}001$; 2017: F(2): 25,538; $p \leq 0{,}001$; 2019: F(2): 21,327 $p \leq 0{,}001$].

The qualifications also correlate with age [2015: F(2): 50.090; $p \leq 0{,}001$; 2017: F(2): 81,924; $p \leq 0{,}001$; 2019: F(2): 73,876; $p \leq 0{,}001$]. Workers with a Basic level of education are mostly aged 50 and over.

3.2 COPSOQ II Dimensions

The scales belonging to the Work demands of COPSOQ II, correspond to those in which the highest value is the most critical result: "Cognitive demands", "Emotional demands", and "Work Pace". These scales had the worst results. Comparing the three years of research the Work demands scales that had significant differences were the "Work pace" ($F(2) = 6{,}199$; $p = 0{,}002$) and "Emotional demands" ($F(2) = 4{,}663$; $p = 0{,}009$). The results were worse in 2015 comparing with the subsequent moments (Table 2).

Concerning the scales from the Work Organization and Content dimensions, from those whose lower value corresponds to the most critical result: "Commitment to the workplace" and "Meaning of work"; the scale "Commitment to the workplace" had the lowest values. Comparing the years of research, we found that the "Meaning of work" ($F(2) = 4{,}760$; $p = 0{,}014$) had statistically significant differences, presenting worse results in 2015 (Table 2).

Regarding the analysis comparing the COPSOQ II Scales between professional categories, declining scores in the scales "meaning of work" [F(2): 16,002; $p \leq 0{,}001$] and "workplace commitment" [F(2): 11,723; $p \leq 0{,}001$] were found in 2019 among the technical assistants.

Table 2. COPSOQ II dimensions characterization

Year		2015		2017		2019	
N		888		1167		1313	
		Mean	S.D.	Mean	S.D.	Mean	S.D.
Work demands	Quantitative demands	2,3	0,9	2,3	0,8	2,2	0,9
	Work pace*	3,0	1,0	2,9	1,0	2,9	1,1
	Cognitive demands	3,5	0,8	3,6	0,7	3,5	0,8
	Emotional demands*	3,3	1,2	3,1	1,2	3,1	1,2
Work organization and content	Meaning of work*	3,9	0,8	4,0	0,7	4,0	0,7
	Commitment to the workplace	3,2	0,9	3,3	0,9	3,3	0,9

* $p \leq 0{,}050$;

The White collar workers presented worst results on a greater number of scales: "quantitative demands" [2015: F(2): 37,780; $p \leq 0{,}001$; 2017: F(2): 45,775; $p \leq 0{,}001$; 2019: F(2): 57,678; $p \leq 0{,}001$], "work pace" [2015: F(2): 22,553; $p \leq 0{,}001$; 2017: F(2): 38,846; $p \leq 0{,}001$; 2019: F(2): 31,550; $p \leq 0{,}001$] "cognitive demands" [2017: F(2): 40,020; $p \leq 0{,}001$; 2019: F(2): 26,207; $p \leq 0{,}001$], "emotional demands" [2017: F(2): 8,438; $p \leq 0{,}001$; 2019: F(2): 4,628; $p = 0{,}010$].

Analysing the COPSOQ II scales and age, the scales of "quantitative demands" (2015: $r = -0{,}17$; $p \leq 0{,}001$; 2017: $r = -0{,}12$; $p \leq 0{,}001$; 2019: $r = -0{,}18$; $p \leq 0{,}001$), "work pace" (2015: $r = -0{,}09$; $p \leq 0{,}001$; 2017: $r = -0{,}09$; $p \leq 0{,}001$; 2019: $r = -0{,}13$; $p \leq 0{,}001$) and "cognitive demands" (2015: $r = -0{,}18$; $p \leq 0{,}001$; 2019: $r = -0{,}12$; $p \leq 0{,}001$) correlated with age, showing better results as age increases.

3.3 Work Ability Index

The WAI of the municipal workers showed, in 2015, an average of 40.7 points (s.d = 5,1), in 2017, 40.2 points (s.d = 5,1) and in 2019, 39.9 points (s.d = 5,5). In the three time periods, the average value obtained corresponds to a classification of "good" work ability. The differences in the mean WAI values between 2015, 2017 and 2019 were statistically significant ($F(2) = 6{,}366$; $p = 0{,}002$), indicating a decrease in the ability to work in recent years (Table 3).

Age was negatively correlated with WAI (2015: $r = -0.15$; $p \leq 0.001$; 2017: $r = -0.18$; $p \leq 0.001$; 2019: $r = -0.15$; $p \leq 0.001$), that means when age increases, the ability to work decreases.

Workers over 50 years old (2015: $t = 4{,}266$; $p \leq 0{,}001$; 2017: t:5,541: $p \leq 0{,}001$; 2019: t: 4,775: $p \leq 0{,}001$), from the operational assistant category [2015: $F(2) = 5{,}519$; $p \leq 0{,}001$; 2017: $F(2) = 18{,}301$; $p \leq 0{,}001$; 2019: $F(2) = 9{,}576$; $p \leq 0{,}001$], with a

Table 3. WAI scores

Year	N	Mean	Min.	Max.	S.D.
2015	885	40,7	14	49	5,1
2017	1167	40,2	7	49	5,1
2019	1331	39,9	12	49	5,5

degree in basic education [2015: F(2): 11,494; $p \leq 0{,}001$; 2017: F(2): 26,005; $p \leq 0{,}001$; 2019: F(2): 9,972; $p \leq 0{,}001$] presented lower WAI (Table 4).

Table 4. WAI and sociodemographic characterization

WAI		2015			2017			2019		
		N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
Age groups	<50	521	41,3	4,7	593	41,0	4,5	589	40,7	5,4
	≥50	330	39,8	5,6	530	39,3	5,6	671	39,2	5,6
Qualifications	Basic level	242	39,6	5,6	314	38,6	5,7	397	39,2	5,8
	Secondary level	324	40,8	5,2	411	40,2	4,8	474	39,7	5,7
	Graduated/post graduated	291	41,7	4,3	402	41,3	4,6	392	40,9	5,0
Professional category	Operational assistant	287	40,3	5,6	370	38,9	5,6	468	39,5	6,0
	Technical assistant	336	40,6	5,1	431	40,4	4,9	445	39,6	5,2
	White collars	229	41,7	4,1	330	41,2	4,6	333	41,1	4,8

WAI also correlates with the scales of COPSOQ II. Better values in the scales "meaning of work" (2015: $r = 0{,}27$; $p \leq 0{,}001$; 2017: $r = 0{,}25$; $p \leq 0{,}001$; 2019: $r = 0{,}27$; $p \leq 0{,}001$), "workplace commitment" (2015: $r = 0{,}13$; $p \leq 0{,}001$; 2017: $r = 0{,}16$; $p \leq 0{,}001$; 2019: $r = 0{,}16$; $p \leq 0{,}001$) determined better results in WAI.

4 Discussion

The average age of the samples was higher in the follow up, what corresponds to the ageing process of the working population.

The samples presented a majority of workers in the Technical assistant category in 2015 and 2017. In 2019 the number of workers in the Operational assistant category increased and these workers were mostly aged 50 and over, with a degree in basic education, belonging operational assistant category, in all moments of the research,

representing a more vulnerable group. The hierarchical level and the nature of work activities is correlated, the lower the hierarchical level, the greater the physical demands of the activity, which may affect workers' health (Rugulies et al. 2010).

The COPSOQ II scales, in this study, presented worse results in 2015, what can be explained by the changes made in public administration on the last years. The psychosocial risks also affected professional categories in a different way, similar to other studies (Metzler and Bellingrath 2017), making it important to assess specific groups to better understand how psychosocial risks are present and affect the health of these groups. While lower hierarchical levels have more physical demands, higher levels have higher cognitive demands (Rugulies et al. 2010). Furthermore, high qualification at work is related to reduced risk of work exit generally and health-related exit specifically (Fleischmann et al. 2017).

The scales of "quantitative demands", "work pace" and "cognitive demands" correlated with age, showing better results as age increases. There is a longitudinal association between changes in exposure to psychosocial work factors and health, what needs to be considered deploying measures to improve the psychosocial work environment of aging workers (Havermans et al. 2018). With advancing age, although workers are less physically fit, they can be mentally capable, therefore, their work should be less physically demanding and more demanding in terms of mental abilities, which were developed throughout their professional career (Tuomi et al. 2001).

Regarding the WAI, results confirmed that work ability has a complex structure that includes the interactions between skills, individual and work characteristics. In line with other studies, there was a negative correlation between age and work ability (Ilmarinen et al. 1997). Aging is associated with a decrease in physical aptitudes and an increase in musculoskeletal injuries what can reduce the individual's ability to work at the same rhythm and requirements for productivity (Oakman et al. 2016). On the other hand, higher results at scales meaning of work and workplace commitment were correlated with better results on work ability, similar to other studies where, regarding psychosocial factors, the development of opportunities and the meaning of work are characteristics that contribute to the maintenance of work ability (Ilmarinen 2012).

5 Conclusion

To conclude, psychosocial factors that play a protective role on work ability must be taken into consideration in order to be included in intervention measures, especially knowing that cognitive demands tend to decrease over the years.

In this way, companies should promote the possibility of training and acquiring new skills over the years, developing strategies that improve the workplace commitment, the meaning of work and optimize other organizational aspects, considering that it seems to be a good way to maintain work ability.

In the future, studies with focused groups will be conducted to identify the specific group requirements in order to propose interventions that seek to promote healthier workplaces for all workers.

References

Collins, J.D., O'Sullivan, L.W.: Musculoskeletal disorder prevalence and psychosocial risk exposures by age and gender in a cohort of office based employees in two academic institutions. Int. J. Ind. Ergon. **46**, 85–97 (2015). https://doi.org/10.1016/j.ergon.2014.12.013

EU-OSHA: Healthy Workplaces for All Ages Promoting a sustainable working life (2016). https://www.healthy-workplaces.eu/

Fleischmann, M., Carr, E., Stansfeld, S.A., Xue, B., Head, J.: Can favourable psychosocial working conditions in midlife moderate the risk of work exit for chronically ill workers? A 20-year follow-up of the Whitehall II study. Occup. Environ. Med. (2017). https://doi.org/10.1136/oemed-2017-104452

Havermans, B.M., Boot, C.R.L., Hoekstra, T., Houtman, I.L.D., Brouwers, E.P.M., Anema, J.R., van der Beek, A.J.: The association between exposure to psychosocial work factors and mental health in older employees, a 3-year follow-up study. Int. Arch. Occup. Environ. Health **91**(1), 57–66 (2018). https://doi.org/10.1007/s00420-017-1261-8

Ilmarinen, J., Tuomi, K., Klockars, M.: Changes in the work ability of active employees over an 11-year period. Scand. J. Work Environ. Health **23**, 49–57 (1997)

Ilmarinen, J.: Promover o envelhecimento ativo no local de trabalho. Agencia Europeia de Saúde e Segurança No Trabalho. Bruxelas: OSHA, 1–9 (2012)

Ilmarinen, J.: From work ability research to implementation. Int. J. Environ. Res. Public Health **16**(16) (2019). https://doi.org/10.3390/ijerph16162882

Leijten, F.R.M., van den Heuvel, S.G., van der Beek, A.J., Ybema, J.F., Robroek, S.J.W., Burdorf, A.: Associations of work-related factors and work engagement with mental and physical health: a 1-year follow-up study among older workers. J. Occup. Rehabil. **25**(1), 86–95 (2015). https://doi.org/10.1007/s10926-014-9525-6

Metzler, Y.A., Bellingrath, S.: Psychosocial hazard analysis in a heterogeneous workforce: determinants of work stress in blue- and white-collar workers of the European steel industry. Front. Public Health **5** (2017). https://doi.org/10.3389/fpubh.2017.00210

Oakman, J., Neupane, S., Nygård, C.H.: Does age matter in predicting musculoskeletal disorder risk? An analysis of workplace predictors over 4 years. Int. Arch. Occup. Environ. Health **89**(7), 1127–1136 (2016). https://doi.org/10.1007/s00420-016-1149-z

OMS, O.M. de S.: CIF: Classificação Internacional de Funcionalidade. Calssificação Internacional de Funcionalidade, Incapacidade e Saude, 238 (2004). https://doi.org/10.1590/S1415-790X2005000200011

Rugulies, R., Aust, B., Pejtersen, J.H.: Do psychosocial work environment factors measured with scales from the Copenhagen psychosocial questionnaire predict register-based sickness absence of 3 weeks or more in Denmark? Scand. J. Public Health **38**(3 Suppl), 42–50 (2010). https://doi.org/10.1177/1403494809346873

Silva, C., Rodrigues, V., Pereira, A., Cotrim, T., Silvério, J., Rodrigues, P., Sousa, C.: Índice de Capacidade para o Trabalho-Portugal e Países Africanos de Língua Oficial Portuguesa. FCT - Fundação Para a Ciência e Tecnologia, pp. 1–6 (2011)

Silva, C., Amaral, V., Pereira, A., Bem-Haja, P., Pereira, A., Rodrigues, V., Nossa, P.: Copenhagen Psychosocial Questionnaire - COPSOQ - Portugal e países africanos de língua oficial portuguesa, pp. 1–46 (2012)

Tuomi, K., Huuhtanen, P., Nykyri, E., Ilmarinen, J.: Promotion of work ability, the quality of work and retirement. Occup. Med. **51**(5), 318–324 (2001)