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Original Articles

WORK ABILITY OF MACHINERY MANUFACTURING EMPLOYEES

Gergana N. Sandeva,
Rositsa P. Deliradeva,
Pavlina L. Gidikova

Department of Hygiene,
Epidemiology and Infectious
Diseases,
Medical Faculty,
Trakia University,
Stara Zagora,
Bulgaria

Corresponding Author:
Gergana N. Sandeva,
Medical Faculty,
Trakia University
11, Armeyska Str.
Stara Zagora, 6000
Bulgaria
e-mail: geri_sandeva@yahoo.com

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Summary

Assessment of work ability is an important aspect of occupational medical services, the main goal being to maintain employees' health, well-being and efficiency. The aim of the study was to evaluate and compare the work ability of workers employed by two machinery factories. We used the Work Ability Index (WAI) questionnaire to assess 165 workers of an iron casting factory A and 166 workers in a press-forging plant B. The data obtained were evaluated and compared based on gender, age, length of service and occupation. Mean WAI for the two factories were almost identical (43.3±4.9 for Factory A and 43.3±4.6 for Factory B), both indicating good overall work ability. The lowest mean WAI (37.7) was registered for the crane operators from Factory B, and the highest (47.2) – for the molders in Factory A. The female production workers in Factory A had a significantly lower WAI as compared to their male counterparts (p=0.001). WAI also varied significantly between different age groups and occupations in the two plants. Significant negative correlations were found between work ability and length of service, as well as between psychological resources and gender (Factory A) and the length of service (Factory B). WAI is a useful tool in finding vulnerable workers who need more attention from occupational health specialists.

Key words: work ability, Work Ability Index, iron casting, press-forging

Introduction

Work ability is an important evidence-based concept in occupational medicine [1]. It is defined as the balance between human resources and the demands of work with several major determinants, consisting of individual and work-related factors, and the environment outside of work. This encompassing idea of work ability is best illustrated by the so called "Work Ability House" (Figure 1) [2]. The core of work ability consists of individual factors such as health, professional expertise, knowledge and motivation. Second come work-related factors like work demands, work environment and organization. Surrounding the work ability house are organizations that support work (e.g., occupational health care and safety), as well as personal support units – family and friends. The outermost layer is society, whose infrastructure and social, health, and occupational policies and services form the macro environment of work ability [3].

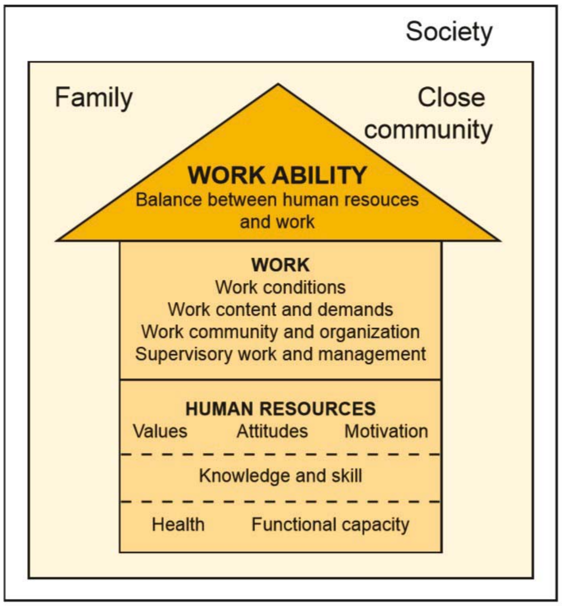


Figure 1. Dimensions of work ability – the work ability house (after Ilmarinen, 2006)

Assessing work ability is an important aspect of occupational medical service with the main goal of maintaining workers' health, well-being and productivity. It is quite a difficult task, however, because of the complexity of work ability and the large number of factors that influence it. After years of research, the Finnish Institute of Occupational Health proposed a tool for measuring work ability that was both reliable and easy to use in different work environments – the Work Ability Index (WAI) [4, 5]. Besides being able to determine work ability with significant accuracy, WAI has been found to be a valid indicator of sickness absence from work, work disability, and early retirement from the labor market [6, 7]. WAI is widely used by occupational health professionals for finding vulnerable workers who need more attention, especially in countries with significant investments in occupational health and safety [8]. WAI has been implemented in Bulgaria for at least ten years, but mainly for evaluating professions with predominantly mental work – administration, teaching, healthcare [9-11].

Machinery manufacturing is one of the leading industries in Bulgaria with over 28 000 workers and annual export revenues of more than four billion euros [12]. Production is characterized with working conditions that can cause significant health damage and reduce work ability: heavy workload, shift work, exposure to dust and toxic chemicals, electromagnetic radiation, excessive noise and vibrations, unfavorable microclimate, etc [13]. Additional negative effects on overall work ability in the sector could pose ageing of the working population and low motivation of workers to be involved in physically demanding and often dangerous jobs. Protecting production workers from occupational health risks is paramount in order to preserve their work ability at optimal levels. Unfortunately, there is insufficient data on work ability of factory workers in Bulgaria. Therefore, our aim in this study was to evaluate and compare work ability of workers of two large Bulgarian machinery factories.

Materials and Methods

The study encompassed 331 workers from production, maintenance and production management in two factories: Factory A (iron casting) – 105 men and 60 women, and Factory B (press forging) – 148 men and 18 women. The age of workers in Factory A was between 22 and 64 years (mean 42.7), and in Factory B 20-67 years (mean 47.4). In the iron casting production the following professions were studied: production managers (N=7), quality controllers (N=10), sand mixers (N=6), furnace operators (N=10), core makers (N=24), molders (N=16), iron casters (N=12), emery workers (N=36), furnace masons (N=17), crane operators (N=18) and forklift operators (N=7). The group studied in the press forging Factory B included production managers (N=14), quality controllers (N=10), press tuners (N=15), cold (N=8) and hot press operators (N=32), heat treatment workers (N=6), machine tool workers (N=35), emery workers (N=10), welders (N=5), maintenance workers (N=25), crane operators (N=3) and forklift operators (N=3).

To evaluate the factory workers' work ability, we used the WAI Questionnaire [14], officially adapted by L. Mincheva and K. Vangelova for use in Bulgaria [15]. WAI is based on a series of questions, which take into consideration the demands of work, the worker's health status and resources. The main items comprising the questionnaire are presented in Table 1.

Table 1. Items of the Work Ability Index

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

Based on the overall score, four levels of work ability are possible: excellent (44-49 points), good (37-43 points), moderate (28-36 points), and poor (7-27 points). To compare the work ability of workers of different ages we used WAI, devised for evaluating workers over 45 years. For younger workers, we used the revised scale by Kujala et al.(2005): excellent (45-49 points), good (41-44 points), moderate (37-40 points), and poor (7-36 points) work ability [16].

All workers filled out the questionnaire, receiving comprehensive guidance from an occupational health expert. WAI scores were calculated according to the authors' instructions. The data obtained was analyzed and compared, using Student's t-test and correlation analysis with Statsoft Statistica v.12.

Results

The mean WAI score for Factory A was 43.3±4.9, and for Factory B it was 43.3±4.6. The distribution of WAI scores for workers by occupation is presented on Figure 2 (Factory A) and Figure 3 (Factory B). The highest mean WAI score in Factory A was that of mold makers (47.2±1.7), and the lowest – that of core makers, who were all women (39.2±5.7). The highest mean WAI score in Factory B was found with forklift operators (45.2±2.6), and the lowest was the one of the all-female crane operators (37.7±10.7). The majority of workers in both factories had either good or excellent work ability.

Several significant differences in mean WAI

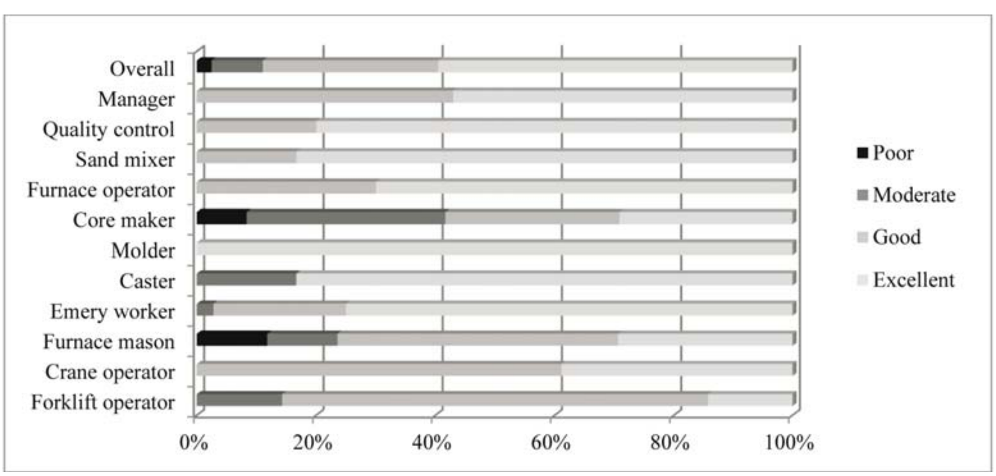
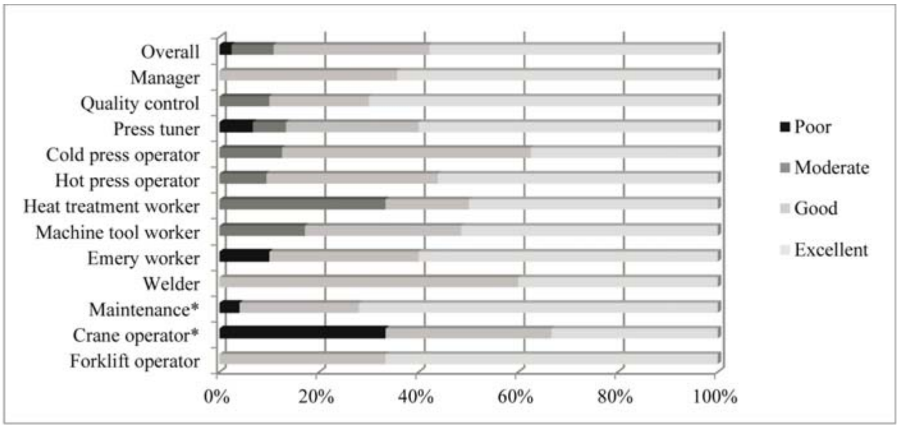


Figure 2. Distribution of WAI score for workers in factory A (%)



*p=0.026

Figure 3. Distribution of WAI score for workers in factory B (%)

scores were seen between different groups of workers in Factory A, especially between the lower scoring core makers and furnace masons, and the higher scoring molders, casters and sand mixers. In Factory B, the only significant difference between professions was found for maintenance workers and crane operators (p=0.026).

Table 2 shows mean WAI scores in the studied factories based on gender, age and length of service in years. WAI for female workers form Factory A was significantly lower than the corresponding score of the male workers (p=0.001). Work ability gradually decreased

Table 2. WAI score (Mean±SD) in the two factories based on gender, age and length of service

Indicator	Factory A		Factory B	
	Mean	SD	Mean	SD
Gender				
Male	44.48*	4.5	43.39	4.5
Female	41.36*	4.9	42.56	5.5
Age (years)				
20-29	44.33	4.8	44.68	4.5
30-39	43.92	4.9	43.81	4.0
40-49	43.21	4.3	43.18	5.2
50-59	42.78	5.7	43.2	4.5
60+	41.36	5.4	42.11	4.8
Length of service (years)				
<5	43.13*	5.0	43.67*	4.3
5-9	44.98*	3.2	43.04	4.8
10-14	44.03*	3.5	43.4	2.7
15-19	38.83*	7.8	43.5	3.0
20+	41.71	5.4	38.55*	7.3

*p < 0.05

with workers' age in both factories, although non-significantly. Significant decrease of WAI was present only in workers with longer tenure (length of service), as compared with their less experienced colleagues.

Correlation analysis showed significant positive correlations between WAI score and health status (Item 4 of the questionnaire, r=0.53; p<0.001), and WAI and mental resources (Item 7, r=0.603; p<0.001) in Factory A. Significant negative correlations were found between length of service and WAI (r= –0.158; p=0.043), age and length of service and health status (r= –0.281; p=0.001 and r= –0.265; p=0.001 respectively). Significant correlation between WAI and gender was also present, confirming the results on Table 2.

In Factory B, WAI also correlated significantly with health status (r=0.542; p=<0.001), mental resources (r=0.596, p=<0.001) and tenure (r= –0.196, p=0.012), but not with workers' age or gender.

Discussion

Mean WAI scores in the studied factories indicated good overall work ability, consistent with reports from other European countries [3]. Furthermore, the proportion of poor and moderate WAI scores was close to the results observed in Finnish metalworking industry, but the percentage of excellent scores was higher in our study [3]. Still, data on WAI for European industrial workers is insufficient, which limits the possibility for a European-wide comparative study of the metalworking industry.

Lower WAI scores in our study were mostly due to low results on Items 1, 2, 3, and, to some extent, Item 7 of the questionnaire, which signifies the importance of subjective health and mental status for the personal perception of work ability. Most authors agree that individual health status is the most significant predictor not only of work ability, but also of possible sick-leave and future disability [6, 7, 17].

The presence of significant differences in WAI scores of the studied professions could be linked to working conditions, but also gender and age of different groups of workers. Most striking was the large proportion of poor and moderate WAI scores for the core makers in Factory A. These workers were all female. Nevertheless, many of them performed highly physically demanding tasks, including lifting of heavy objects, and also working nightly shifts – all factors that are linked to lower work ability [18-21]. Another profession with heavy workload was that of the furnace mason. This profession also showed lower overall work ability in our study. Other jobs with predominantly mental stress and neurosensory load, such as production managers, quality controllers, sand mixers and furnace operators expressed higher work ability. The molders from Factory A, who showed the best WAI scores despite their significant physical workload, were a notable exception from this pattern. Their results (only good and excellent work ability) could be due to the fact that most of them were young, physically fit workers.

Mean WAI scores of women in production jobs from both factories were lower than those of their male counterparts – an outcome suggesting that women might not be suitable for the increased requirements of production work in machinery manufacturing.

Age of workers is usually linked to a decrease of work ability [20, 22, 23] with very few exceptions [24]. Our results also showed a decrease in mean WAI scores with age, though non-significant. A significant decrease in WAI was more obvious when comparing workers with different lengths of service, proving that working in machinery production in particular can have a negative effect on work ability that was not dependent of workers' age.

The observed significant correlations showed the importance of physical and mental resources for achieving better work ability.

Conclusions

Work ability of production workers in machinery manufacturing was at a good level, but present occupational risk factors (heavy workload, exposure to dust, noise, vibrations, unfavorable microclimate, and electromagnetic fields) could lead to decreased work ability in the future. Investments should be made to promote work ability in Bulgarian machinery factories. Follow-up studies could be performed in both factories to detect future changes in work ability, especially for older and female workers.

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