

Work Ability and Quality of Life in Metal Industry Workers: A Cross-Sectional Study

Yasser Labbafinejad ¹, Sepideh Lamei Haghighat ², Tahereh Babajani Roshan², Omid Asghari ¹, Negin Kassiri ^{1,2 *}

¹ Occupational Medicine Research Center, Iran University of Medical Sciences, Tehran, Iran.

² Department of Occupational Medicine, School of Medicine, Iran University of Medical Sciences, Tehran, Iran.

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ABSTRACT

Introduction: Cardiovascular diseases are one of the leading causes of mortality and disability, as well as a major public health burden worldwide.

Methods: This study is a cross-sectional, descriptive-analytical study conducted in 2023 on all workers of a metal industry factory. The inclusion criteria for the study were a work history of over one year and an age above 40 years. Exclusion criteria included unwillingness to participate and a diagnosed history of coronary disease, stroke, or transient ischemic attack. The quality of life (QoL) of the participants was assessed using the SF-12 Quality of Life Questionnaire, the Work Ability Index was measured through the Work Ability Index questionnaire, and the ten-year cardiovascular disease risk was determined using the WHO/ISH chart. Finally, the relationship between the QoL and work ability indices with the ten-year cardiovascular risk was examined.

Results: A survey of 187 employees in a metal industry revealed a significant relationship between the QoL index and job title (p value: 0.001) as well as smoking history (p value: 0.024). Regarding the work ability index, significant relationships were found with variables such as job type (p value: 0.000), education (p value: 0.000), physical activity (p value: 0.006), age (p value: 0.023), work history (p value: 0.000), and ten-year cardiovascular risk (p value: 0.003). In linear regression analysis, physical activity and work history showed a significant relationship with the work ability index, while job type remained significantly associated with quality of life (p value<0.05).

Conclusion: The results of our study demonstrate a significant relationship between job type and QoL, as well as physical activity and work history with the work ability index. Individuals with less work history and those engaging in regular physical activity reported a higher work ability index. Production workers, assemblers, and welders had a lower quality of life compared to warehouse workers and forklift drivers.

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Introduction

Cardiovascular disease (CVD) is a leading cause of death, disability, and a significant public health burden worldwide (1). In 2016, it was responsible for an annual mortality rate of approximately 17.9 million people globally, making it one of the most common

causes of death worldwide, accounting for 20% of global deaths and 35% of deaths in Iran (2). To address this, a comprehensive approach to managing CVD risk factors is essential, including lifestyle counseling, weight management, cholesterol-lowering medications, and blood pressure monitoring (2, 1).

* Corresponding authors: Negin Kassiri, Occupational Medicine Research Center - Iran University of Medical Sciences- Tehran- Iran. Tel: +982186703170; Fax: +982188622682; E-mail: neginkassiri@gmail.com

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Health-related quality of life (QoL) is a multidimensional concept that focuses on patients' subjective experience of their physical, mental, emotional, and social functioning (3, 4). It has a negative correlation with valuable outcomes in patients with CVD. QoL decreases in cardiovascular diseases (5), and previous research has shown that QoL is not only a predictor of mortality and readmission (6,7) but also suggested that it can be useful as an option to improve risk classification among patients with CVD (7,8).

In many countries, including Iran, the workforce is rapidly aging. If the physical and mental capabilities of workers do not align with the demands of their jobs, it leads to safety and health problems, reduced productivity, and increased costs related to worker turnover. Assessing and maintaining work ability is a critical issue (9, 10). Furthermore, previous studies have shown that a mismatch between a worker's ability and the physical and mental demands of their job can lead to consequences such as safety and health issues, musculoskeletal disorders, CVD, behavioral disorders, sleep problems, fatigue, decreased QoL, reduced motivation, increased absenteeism, and higher employee turnover and lower productivity (11-13).

Therefore, the present study aims to evaluate the quality of life and work ability indices and their relationship with the ten-year cardiovascular risk in workers employed in a metal industry factory.

Method

This study is a cross-sectional, descriptive-analytical research conducted in 2023 among all workers of a metal industry factory in Markazi Province. Participants were voluntarily recruited based on a research call. The inclusion criteria were a work history of over one year and an age above 40 years. The exclusion criteria included unwillingness to participate and a diagnosed history of coronary disease, stroke, or transient ischemic attack. The sampling method was a census. After applying the inclusion and exclusion criteria, 187 participants were enrolled in the study. During the periodic occupational health examinations of the factory workers, after obtaining informed consent, providing a detailed explanation of

the study's objectives, and ensuring confidentiality of the information, initial data such as age, gender, work history, smoking history, job title, physical activity, education, and marital status were collected through a checklist. Subsequently, participants' QoL was assessed using the SF-12 Quality of Life Questionnaire, and their work ability was measured using the Work Ability Index (WAI).

Work Ability Index (WAI) Questionnaire

This tool was designed to assess individuals' work ability in occupational environments and was developed by the Finnish Institute of Occupational Health (14). The WAI score is derived from the sum of the scores on seven domains, including current work ability compared to the best period of life, work ability in relation to the physical and mental demands of the job, number of current diseases diagnosed by a doctor, personal assessment of the impairment caused by disease in performing work, sick leave taken in the last 12 months, prediction of work ability over the next two years, and mental and cognitive capabilities. The WAI score ranges from 7 to 49, with the best possible score being 49 and the worst being 7.

SF-12 Quality of Life Questionnaire(15)

The SF-12 is a shorter form of the 36-item Quality of Life Questionnaire, which is widely used in various studies. This questionnaire contains 8 subscales and assesses QoL in terms of self-perceived overall health, physical functioning, physical health, emotional problems, bodily pain, social functioning, vitality, and mental health. Higher scores on this questionnaire indicate better quality of life.

CVD 10-Year Risk Assessment:

The 10-year CVD risk was determined using the WHO/ISH risk prediction algorithm for the EMR B region, based on factors such as age, gender, systolic blood pressure, diabetes history, smoking history, and blood cholesterol levels (16).

Finally, the quality of life and work ability indices were determined according to the objectives of the study, and the relationship

between these indices and the 10-year cardiovascular risk was examined.

Data Analysis

The data were analyzed using SPSS software version 26. Descriptive statistics, including means and standard deviations, were used for quantitative variables, and frequencies and percentages were used for categorical variables. The t-test was employed To compare quantitative variables, and the chi-square test was used for categorical variables. Logistic regression analysis was applied to adjust for potential confounding factors.

Ethical Considerations

Participation in this study was entirely voluntary, and no costs were incurred by individuals for participating. Professional confidentiality principles were strictly adhered to. In cases where individuals were unwilling to respond to questions, further interviews were avoided to ensure they were not disturbed. The study received ethical approval with the code (IR.IUMS.FMD.REC.1402.218) on July 11, 2023.

Result

A total of 187 employees participated in the study, of whom 176 (94.1%) were male and 11 (5.1%) were female. The occupational distribution was as follows: 30 (16%) were production workers, 60 (32.1%) were welders, 39 (20.9%) were assemblers, 47 (25.1%) were warehouse workers and 11 (5.9%) were forklift drivers. Notably, 174 (93%) of the participants were married. A minority of the employees (150, 83.9%) reported engaging in high levels of physical activity (at least 150 minutes per week). Among participants, 100 (53.5%) had less than a diploma, 59 (32.6%) held a diploma, 26 (13.9%) had an associate or bachelor's degree, and 2 (1.1%) had higher education levels such as master's and doctorate degrees. The average age of participants was 46.5 ± 5.7 years (ranging from 40-60). Additionally, the mean work experience of employees was 13.9 ± 8.2 years (ranging from

1-31). The average BMI was 26.94 ± 4.3 (ranging from 18.9-41.5), and the mean cigarette consumption was 2.59 ± 2.5 pack/years (ranging from 0-8) .

Moreover, the range of the WAI was observed to be between 31 and 49, with a mean value of 44.08 ± 3.6 . Likewise, the SF-12 score ranged from 12 to 48, with a mean value of 39.28 ± 7.1 . In terms of WAI, 62% (116) of participants exhibited excellent WAI, while 34.2% (64) fell into the good category, and 3.7% (7) were classified as average. Regarding the SF-12 score, 71.7% (134) of individuals reported a good status, 24.6% (46) fell into the average category, and 3.7% (7) experienced a poor QoL. These findings indicate that a significant proportion of the population maintains favorable conditions in both WAI and QoL .

According to the 10-year CVD risk, 55.6% (104) of individuals had a risk of less than 10% for developing CVD. 31.6% (59) fell within the 10-20% risk category, while 12.8% (24) were classified in the 20-30% risk range. This finding indicates that the majority of the study population falls within the low-risk category for CVD over a 10-year period. The association of the 10-year CVD risk, Work Ability Index, and QoL across different groups of participants is provided in Tables 1 and 2. In the initial analysis, it was found that the WAI had a significant relationship with job title, education level, physical activity, 10-year cardiovascular disease risk, age, and work experience (p-value < 0.05). Additionally, there was a significant relationship between smoking consumption and job title with QoL (p-value < 0.05). The 10-year CVD risk was significantly associated with gender, job title, age, and smoking status (p-value < 0.05).

To account for the impact of confounding variables, linear regression analysis was utilized (Tables 3 and 4). The significant correlation between QoL and job title was maintained (p-value: 0.02). Likewise, for the WAI, variables that exhibited a significant correlation in the initial analysis were incorporated into the linear regression analysis. The significant correlation of physical activity and work experience with the WAI remained (p-value < 0.05).

Table 1. The relationship between the WAI and QoL and variables.

Variables		WAI (mean±SD)	P-value	QoL (mean±SD)	P-value
Gender	Male	43.99±3.7	0.167	39.17±7.33	0.416
	Female	45.54±1.8		41±4.17	
Occupation	Production workers, welders, assemblers	43.23±3.4	0.000	37.91±8.6	0.001
	Warehouse workers, forklift drivers	45.43±2.8		42.28±3.8	
Marital status	Single	45.34±2.03	0.194	39±3.87	0.883
	Married	43.98±3.71		39.3±7.38	
Physical activity	Yes	45.55±3.48	0.006	40.54±9.31	0.236
	No	43.71±3.59		38.97±6.56	
Education	Diploma and under diploma	43.56±3.84	0.000	37.97±7.58	0.087
	Associated degree and higher	46.86±1.9		41.76±3.85	
10-year CVD risk	<10%	44.87±3.45	0.003	41.29±4.05	0.092
	10-20%	42.22±4.07		39.21±8.68	
	20-30%	40.18±2.17		38.74±4.74	
		Pearson correlation coefficient	p-value	Pearson correlation coefficient	p-value
Age (year)		-1.67	0.023	-0.23	0.753
Work experience (year)		-0.263	0.000	-0.32	0.664
BMI (kg/m ²)		-0.39	0.599	-0.74	0.312
Smoking consumption (pack / year)		-1.23	0.072	-0.165	0.024

Table 2. The relationship 10 years Cardio vascular risk and variables.

Variables		10 years Cardio vascular risk			P-value
		Less than 10%	10-20%	20-30%	
Gender	Male	93 (89.4%)	59 (100%)	24 (100%)	0.009
	Female	11 (10.6%)	0 (0%)	0 (0%)	
Occupation	Production workers, welders, assemblers	63 (90.6%)	46 (78%)	20 (83.4%)	0.04
	Warehouse workers, forklift drivers	41 (9.4%)	13 (22%)	4 (16.6%)	
Marital status	Single	8 (7.7%)	5 (8.5%)	0 (0%)	0.35
	Married	96 (92.3%)	54 (91.5%)	24 (100%)	
Physical activity	Yes	25 (24%)	9 (15.3%)	3 (12.5%)	0.25
	No	79 (76%)	50 (84.7%)	21 (87.5%)	
Education	Diploma and under diploma	87 (83.7%)	50 (84.7%)	22 (91.7%)	0.41
	Associated degree and higher	17 (16.3%)	9 (15.3%)	2 (8.32%)	
Age (year)		44.91 (5.1)	46.32 (4.7)	53.83 (5.1)	0.000
Work experience (year)		12.09 (7.5)	14.88 (8.0)	15.83 (10.9)	0.10
BMI (kg/m ²)		26.51 (4.4)	27.98 (4.1)	29.08 (4.3)	0.08
Smoking consumption (pack / year)		2.22 (2.6)	3.24 (2.6)	5.59 (1.3)	0.04

Table 3. Linear regression analysis of QoL and variables.

	B	Std. Error	Beta	P-value
Smoking consumption	-0.259	0.224	-0.090	0.250
Occupation	1.124	0.479	0.184	0.020

Table 4. Linear regression analysis of WAI and variables.

	B	Std. Error	Beta	P-value
Occupation	0.352	0.239	0.114	0.142
Education level	-0.427	0.401	-0.090	0.288
Physical activity	1.402	0.668	0.154	0.037
Age	-0.017	0.054	-0.026	0.756
Work experience	-0.079	0.035	-0.179	0.026
CVD risk	-0.611	0.364	-0.135	0.095

Discussion

Our findings indicate a significant relationship between job title and QoL, with production, assembly, and welding workers reporting lower QoL compared to warehouse workers and forklift drivers. These results align with the study by Qin et al. (17), who found that various aspects of quality of life were worse among welders compared to non-welders. The potential reasons for the differences in QoL among the jobs examined in the present study are as follows:

- Production, assembly, and welding workers typically work in more physically demanding and hazardous environments. These roles often involve prolonged exposure to noise, fumes, and intense physical activity, which can lead to lower QoL (18). In contrast, warehouse workers and forklift drivers may experience more controlled and less hazardous working conditions, resulting in higher QoL.
- Higher levels of job stress and lower job satisfaction are common among production, assembly, and welding workers due to the monotony and repetitiveness of their tasks (19). These factors can negatively affect mental health and overall QoL. Warehouse workers and forklift drivers may have more varied tasks and experience less physical strain, which can contribute to higher job

satisfaction and better mental well-being.

- Production, assembly, and welding workers may face longer and more irregular working hours, disrupting their work-life balance (18). This imbalance can lead to higher stress and lower QoL. In contrast, warehouse workers and forklift drivers may have more regular hours, allowing for a better work-life balance and, consequently, a higher QoL.

Additionally, our findings revealed a significant correlation between the WAI, physical activity, and work history. Workers with less work experience and regular daily physical activity reported higher WAI. Regular physical activity is well-known for its numerous health benefits, including improved cardiovascular health, enhanced mood, and increased energy levels (20). Workers who engage in at least 150 minutes of physical activity per week are likely to experience these benefits, contributing to a higher WAI. Physical activity also improves muscular strength and endurance, which is crucial for performing physically demanding tasks in metalworking (21). As a result, workers with an active lifestyle may have better physical capacity to meet their job demands.

Workers with less work experience may report higher WAI due to a combination of factors, including greater physical resilience and adaptability. Younger or less experienced workers may suffer less from accumulated physical stress and injuries. Furthermore,

less experienced workers may be more open to adopting healthy lifestyle habits, such as regular physical activity, which can positively influence their WAI (22). They may also be more motivated to prove their abilities and advance in their roles, resulting in higher self-reported WAI.(23)

Our study found a significant relationship between the 10-year CVD risk and gender, job title, age, and smoking habits. These findings align with previous research that emphasizes the importance of these variables as key determinants of cardiovascular health.

Consistent with existing literature (24), gender was found to be significantly associated with cardiovascular risk. Men generally face a higher risk of CVD compared to women, a difference that has been attributed to both biological factors, such as hormonal differences, and lifestyle factors. Testosterone, for example, has been shown to influence lipid metabolism and vascular health, contributing to an elevated risk in men (25). Furthermore, men tend to engage in behaviors that increase the risk of cardiovascular disease, such as smoking and higher alcohol consumption (24).

Age is a well-known risk factor for cardiovascular disease. As individuals age, the likelihood of developing risk factors such as hypertension, diabetes, and dyslipidemia increases, all of which contribute to a higher CVD risk (26). Our study supports this, showing that older workers are more likely to have higher cardiovascular risk. This is particularly concerning in industrial settings where workers may be exposed to various physical and environmental stressors over time.

Our study also revealed a significant association between occupation and cardiovascular risk, highlighting the impact of work-related factors on heart health. Occupational stress, physical workload, and environmental exposures such as noise, chemicals, and physical strain are well-documented contributors to cardiovascular diseases (27). The nature of an individual's job can influence their health through stress, irregular working hours, and limited opportunities for physical activity. Workers in more physically demanding roles, such as manual labor, may experience higher levels of

stress and physical exertion, which can lead to increased cardiovascular risk (28).

Smoking remains one of the most significant modifiable risk factors for cardiovascular disease. It has been consistently shown that smoking accelerates the process of atherosclerosis, raises blood pressure, and increases the risk of heart attack and stroke (29). Our findings support this, showing a strong association between smoking and elevated CVD risk, which emphasizes the need for workplace interventions targeting smoking cessation.

Our findings emphasize the importance of promoting physical activity and supporting workers, especially those with longer work histories, to maintain their WAI. Interventions are needed to improve working conditions and QoL for production, assembly, and welding workers. Employers and policymakers should consider measures such as:

- Encouraging and facilitating physical activity programs in the workplace, such as offering fitness classes, providing on-site gym facilities, or organizing group activities.
- Educating workers about the benefits of regular physical activity and providing resources to help them integrate it into their daily routines.
- Implementing ergonomic interventions and job rotation schemes to reduce the risk of physical strain and injuries among more experienced workers.
- Improving workplace safety standards to reduce exposure to hazardous conditions.
- Providing psychological support and resources to cope with job stress.
- Promoting flexible working hours and work-life balance initiatives.

This study, by examining the relationship between job title, QoL, and the WAI among metal industry workers, has several strengths. One of the key strengths of this study is the identification of significant differences in QoL and WAI based on job type, physical activity, and work history, which can serve as a basis for targeted interventions. Additionally, the use of validated and well-established tools to assess QoL and WAI enhances the reliability of the findings.

However, this study also has limitations. The sample was limited to workers from a specific industry, and the results may not be generalizable to other industries. Furthermore, as this is a cross-sectional study, causal inferences cannot be drawn. Longitudinal studies are needed to confirm the stability of the findings.

Suggestions for Future Research

Further research is needed to explore additional factors that may influence WAI among metal industry workers, including:

- The role of mental health and stress management in maintaining work ability.
- The impact of workplace culture and social support on physical activity levels and overall health.
- Longitudinal studies to track changes in WAI and quality of life over time and assess the effectiveness of interventions.

Conclusion

This study is the first in Iran to investigate QoL and WAI and their relationship with the 10-year CVD risk among workers. Our results demonstrate a significant relationship between job type, QoL, and work ability. Workers with less work experience and regular physical activity reported higher WAI scores. Production, assembly, and welding workers had lower QoL compared to warehouse workers and forklift drivers. Consequently, our study highlights the importance of addressing the specific needs of different job titles in the metalworking industry to improve overall QoL and work ability. By focusing on targeted interventions and supportive policies, a healthier and more productive workforce can be created.

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