

## The effect of sleep disorder on the work ability of workers in a car accessories manufacturing plant

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### Abstract

**Background:** Work ability assessment and its affecting factors are important in the field of occupational health. One of the factors affecting work ability is sleep disorder, which is very common among workers. Therefore, the present study aimed to assess work ability and its relationship with sleep disorder in workers of a manufacturing plant.

**Methods:** This cross-sectional study was conducted in a manufacturing plant in Tehran in 2013. All the 931 male workers of this plant were enrolled in the study, and their work ability was assessed using the Work Ability Index (WAI). The scores of this index range from 7 to 49, and the higher work ability score indicates a better work ability status. In this study, sleep disorder was assessed using the MUSIC-Norrtalje Questionnaire.

**Results:** The average score of WAI was 42.81, ranging from 22 to 49. This score was significantly lower in the group with sleep disorder (41.28) than in the group without sleep disorder (44.10) ( $p < 0.001$ ). The results of the logistic regression analysis revealed a significant relationship between work ability and sleep disorder even after adjustment for the confounding variables (OR= 2.52, 95% CI= 1.07 – 5.93,  $p = 0.033$ ).

**Conclusion:** The results of this study found a relationship between sleep disorder and work ability. Therefore, it is recommended to identify workers with sleep disorder and attend to their problem in order to increase their work ability.

**Keywords:** Work Ability, Sleep disorder, Worker.

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### Introduction

Since the first half of the twentieth century, the average age of the population has increased around the world and this also includes Iran (1,2). This increase may have some consequences such as lack of enough workforce entering work environments at the right time and the disability of a large number of the workers at work environ-

ments. Analyzing and predicting the work ability of the workers in each category is significant in terms of management policies. Work ability in a working population could be a predictive factor for disability and duration of absenteeism in the future (3,4).

Work ability means how much a worker can work now and in the near future, and

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considering such factors as the job demands, personal health status and mental resources how he/she will do the work (5).

The Work Ability Index Questionnaire, which analyzes the work ability status, is extensively used in the field of occupational health and in the studies associated with it. This questionnaire also determines the work ability of workers based on their job requirements and level of physical and mental health.

The workers at risk of work-related disabilities could be identified using the WAI. This index also helps identify the workers at risk of prolonged sick leave and early exit from work.

On the other hand, sleep disorder is common among workers, and this can lead to undesirable working consequences such as absenteeism and work accidents. The quality of sleep affects the quality of life and productivity. The frequency of chronic sleep disorder has been estimated as nearly 10% in the U.S. (6).

In Iran, the prevalence of sleep disorder has been increasing since the last decade (7). In their study, Ghalichi et al. reported the prevalence of sleep disorder among the health care workers in Iran as 43.1% (8). In a study on 1100 individuals in Kerman (southeast of Iran) the frequency of sleepiness in the general population was reported as 34.3% (9).

In a study investigating the relationship between occupational accidents and shift work, sleepiness and fatigue in Iranian miners, it was found that the average score of sleep disorder in shift workers with occupational accidents was higher; however, the difference was not significant ( $p=0.126$ ) (10).

In a study by Camerino et al. on shift and non-shift nursing personnel in seven European countries, it was found that the nurses with better sleep quality and quantity enjoyed a better work ability (11).

The study of Swanson et al. on 1000 workers working for 30 hours or more per week in the U.S. showed that long working hours and shorter sleep duration were asso-

ciated with shorter sleep duration and more work impairments, respectively (12).

In a historical cohort study by Sivertsen et al., it was found that sleep disorder can be considered as a predictive factor for disability and may lead to increased disability in workers with such disorder (OR = 3.90, 95% CI = 3.20 – 4.76). In a study on petrochemical industry in Iran, there was also an association between the WAI and sleep problems (14).

The frequency of sleep disorder in Iran has been mostly studied on health care workers, and fewer studies have been conducted on workers of other industries. Moreover, most of the studies in Iran have only investigated sleep disorder among shift workers, neglecting the relationship between sleep disorder and work ability. Identifying the influential variables on work ability and enhancing their status could be of prime importance in preventing early disability. The present study aimed to investigate the relationship between sleep disorder and the Work Ability Index (WAI) among the workers of a manufacturing plant.

## Methods

### *Study design and population*

This cross-sectional study was conducted on the male workers of a car accessories manufacturing plant in Tehran in 2013. All the male workers of the plant were enrolled in the study. Of the 931 production line workers, 728 consented to participate in the study. The participants' demographic characteristics including age, education level, marital status and cigarette smoking, their medical history and occupational information were collected using direct interviews. The participants' duration of leave of absence was obtained through the Administrative Affairs Department in the relevant plant. Moreover, the participants' weight and height were measured and their Body Mass Index (BMI) was calculated in  $\text{kg}/\text{m}^2$ . This study was approved by the Ethics Committee of Tehran University of Medical Sciences.

### *Work ability measurement*

The participants' work ability was assessed using the Work Ability Index questionnaire (15). The Persian version of this questionnaire, whose reliability and validity have been identified, was used in this study (16). This questionnaire consists of 7 items, each of which having a different score range. The first item is "the current work ability compared to the lifetime best", ranging from 0 to 10 scores; the second item is "work ability in relation to job demands", ranging from 2 to 10 scores; the third item is "the number of current diseases diagnosed by a physician", ranging from 1 to 7 scores; the fourth item is "the estimated work impairment due to diseases", ranging from 1 to 6 scores; the fifth item is "sick leave during the past year", ranging from 1 to 5 scores; the sixth item is "the prognosis of work ability within the past two years" with 1, 4, or 7 scores; and the seventh item is "mental resources", ranging from 1 to 4 scores. In all the items mentioned above, the best status belongs to those with highest scores. The WAI is calculated by the sum of the scores of these seven items. Higher WAI scores are indicative of better work ability. The scores of this index range from 7 to 49. Moreover, the participants can be classified into four work ability groups, including poor (score 7-27), average (score 28-36), good (score 37-43), or excellent (score 44-49) (15).

### *Sleep disorder assessment*

In this study, sleep disorder was assessed using the Persian version of the MUSIC-Norrtalje questionnaire (17). The reliability and validity of this questionnaire have been investigated by Alipour et al. ( $\kappa > 0.7$ ) (17). The sleep section of this questionnaire consists of 6 questions with Likert-type answers in 5 options, including never, rarely, sometimes a year, sometimes a month, several times a week and every day. A score of 1 to 4 was respectively assigned to the above-mentioned options for the participants, and higher scores indicated poorer sleep quality. Moreover, the participants

were classified into two groups (with and without sleep disorder) based on the median score of the questionnaire (score 12).

### *Statistical analyses*

The mean, standard deviation (SD) and ranges of the quantitative variables were calculated. The independent T-test was used to compare these variables among the groups. Also, the Chi-square test was used to compare the qualitative variables. In addition, logistic regression analysis was performed to identify the risk of moderate or low work ability. Logistic regression analysis with eliminating the confounding variables was used to investigate the correlation between work ability and sleep disorder. P values were two-sided, and p values of less than 0.05 were considered statistically significant. The results of statistical analyses were expressed as odds ratio (OR) with 95% confidence interval (95 %CI). All the mentioned calculations were performed using SPSS version 12 software.

### **Results**

The present study investigated 727 male production line workers in an automobile plant. The results revealed that the participants' average age was 34.88, ranging from 21 to 63, and their average work experience was 10.37, ranging from 1 to 35. The participants' average BMI was 27.59, ranging from 19.32 to 41.40 kg/m<sup>2</sup>. Of the participants, 135 (18.5%), 639 (87.85%) and 520 (71.4%) were cigarette smokers, married and shift workers, respectively. Moreover, 543 (74.6%) and 258 (35.4%) had a high-school diploma or higher education and regular physical activity, respectively. The average score of sleep disorder was 12.10, ranging from 4 to 22.

The average WAI score was 42.81, ranging from 22 to 49. In terms of the rate of WAI, 5 (0.7%), 66 (9.1%), 289 (39.7%) and 368 (50.5%) were in the poor, average, good and excellent groups, respectively. Therefore, 9.8% of the participants were in the poor or average group and 90.2% of them were in the good or excellent group.

Table 1. Descriptive analysis of the Work Ability Index items

Item	Mean of score	SD	Min-Max
1- Current work ability compared with the lifetime best	8.71	1.35	1-10
2- Work ability in relation to the demands of the job	8.46	1.60	2-10
3- Number of current diseases diagnosed by a physician	5.97	1.72	2-7
4- Estimated work impairment due to diseases	5.49	0.86	1-6
5- Sick leave during the past year (12 months)	4.51	0.71	1-5
6- Own prognosis of work ability 2 years from now	6.37	1.48	1-7
7- Mental resources	3.31	0.73	1-4
Total score	42.81	4.68	22-49

Table 2. Comparison of the mean of work ability index in terms of study variables

Variable	Status	WAI		
		Mean	S.D	p
Sleep disorder (score)	> 12 (n= 334)	41.28	5.05	< 0.001
	≤12 (n= 394)	44.10	3.89	
Age (year)	≥ 33 (n= 368)	42.27	4.53	0.031
	< 33 (n= 360)	43.14	4.80	
Work experience (year)	≥ 10 (n= 352)	42.66	4.98	0.040
	< 10 (n= 376)	43.01	4.37	
Education	≥ diploma (n= 543)	42.69	6.64	0.253
	< diploma (n= 185)	43.15	4.68	
Work shift	Day work (n= 208)	43.21	4.03	0.144
	Shift work (n= 520)	42.65	4.90	
Body mass index (kg/m <sup>2</sup> )	< 25 (n= 282)	44.23	3.78	< 0.001
	≥ 25 (n= 446)	41.90	4.96	
Smoking	Yes (n= 135)	41.19	5.17	< 0.001
	No (n= 593)	43.17	4.48	
Physical activity	Yes (n= 258)	43.00	6.80	0.008
	No (n= 470)	42.73	5.71	

Table 1 demonstrates the average scores of various WAI items.

Table 2 compares the average WAI score in terms of the study variables such as sleep disorder. As indicated by the results, the average WAI score of the group with a BMI of less than 25 kg/m<sup>2</sup> was significantly higher than that of the group with a BMI equal to or greater than 25 kg/m<sup>2</sup>. It was also found that the average WAI score of the non-smoker group and the group with physical activity was significantly higher than that of the smoker group and the group with no physical activity, respectively (p<0.005). Moreover, the average WAI score of the group of workers under the age of 33, the group with less than 10 years of work experience and the group with sleep disorder was higher than that of the group aged equal to or older than 33, the group with equal to or more than 10 years of work experience and the group with no sleep disorder, respectively (p< 0.005).

The average rate of absenteeism in the past year in the groups with and without sleep disorder was 1.62 and 2.89 days. This

difference was statistically significant (p<0.029).

Table 3 compares the frequency of the study population with good or excellent work ability in terms of the study variables such as sleep disorder. The frequency of those with good or excellent work ability in the group with a BMI of less than 25 kg/m<sup>2</sup> was significantly higher than that of the group with a BMI equal to or higher than 25 kg/m<sup>2</sup>. It was also found that the frequency of those with good or excellent work ability in the non-smoker group and the group with physical activity was significantly higher than that of the smoker group and the group with no physical activity, respectively (p< 0.001). Moreover, the frequency of those with good or excellent work ability in the group of workers under 33 years of age, the group with less than 10 years of work experience and the group with no sleep disorder was higher than that of the group aged equal to or older than 33, the group with equal to or more than 10 years of work experience and the group with sleep disorder, respectively (p<0.001).

Table 3. Comparison of the frequency of understudy workers with excellent or good work ability index in terms of study variables

Variable	N-(%)	OR	95% C.I	p
Sleep disorder (score)		3.63	2.10-6.29	<0.001
> 12	282 (84.42)			
≤ 12	375 (95.11)			
Age (year)		3.51	1.88-6.01	<0.001
≥ 33	317 (86.14)			
< 33	375 (94.44)			
Work experience (year)		3.28	1.46-5.86	<0.001
≥ 10	301 (85.51)			
< 10	351 (93.35)			
Body mass index (kg/m <sup>2</sup> )		3.43	1.80-6.50	<0.001
≥ 25	387 (86.77)			
< 25	270 (95.74)			
Smoking		3.11	1.85-5.25	<0.001
Yes	490 (82.63)			
No	125 (92.59)			
Physical activity		3.01	1.74-5.83	<0.001
No	401 (85.31)			
Yes	241 (93.41)			

Table 4. Association between sleep disorder and work ability index using logistic regression analysis

Variable	Status	Adjusted OR	95% C.I	p
Sleep disorder (score)	≤ 12	1.00	-----	0.033
	> 12	2.52	1.07-5.93	
Age (year)	≥ 33	1.00	-----	0.025
	< 33	2.66	1.11-8.32	
Work experience (year)	≥ 10	1.00	-----	0.001
	< 10	3.05	1.43-10.82	
Body mass index (kg/m <sup>2</sup> )	< 25	1.00	-----	0.045
	≥ 25	2.83	1.17-6.01	
Smoking	No	1.00	-----	0.001
	Yes	2.67	1.51-4.70	
Physical activity	Yes	1.00	-----	0.042
	No	2.81	1.08-6.16	

Logistic Regression Analysis was used for a deeper investigation of the relationship between work ability and sleep disorder. In this analysis, work ability was considered as a dependent variable, and the participants were classified into two groups (with poor and average, and good or excellent work ability) based on the scoring of the Work Ability Index questionnaire. Moreover, the participants were classified into two groups (with and without sleep disorder) based on the median sleep disorder scores of the MUSIC-Norrtalje questionnaire. In this analysis, age, marital status, education level, BMI, cigarette smoking, physical activity, work experience, work shift and occupational factors (physical factors by the MUSIC-Norrtalje questionnaire and psychosocial factors by the Copenhagen Psychosocial Questionnaire) were considered as confounding variables.

The results of this analysis revealed a significant relationship between work ability and sleep disorder even after adjustment for the confounding variables ( $p < 0.05$ ) (Table 4). Moreover a significant relationship was found between work ability and age, BMI, cigarette smoking, physical activity and work experience ( $p < 0.05$ ). However, no such relationship was observed between work ability and marital status, education level and work shift ( $p > 0.05$ ).

### Discussion

Stability and promotion of optimal work ability will be possible through physical and mental health and favorable working conditions. On the other hand, identifying workers at risk of early exit from work will be, to a great extent, possible by investigating the WAI. The present study investigated the WAI and its relationship with sleep

disorder. In this study, the average score of the WAI was 42.8. Furthermore, 50.5%, 39.7% and 9.1% of the participants were in the groups with excellent, good and average WAI, respectively. This average was slightly higher than what was found by the results of some previous studies (11, 14). This difference could be due to the participants' age difference, occupation type and gender (all the subjects of this study were male).

In this study, the average rate of absenteeism in those with poorer sleep quality was higher than those having better sleep quality ( $p < 0.05$ ).

In previous studies, poor sleep quality was accompanied by lower work capacity (18), lack of job satisfaction and high level of work stress (19) and absenteeism due to illness (20-21).

The results of the present study showed a significant relationship between work ability and sleep disorder even after adjustment for the confounding variables (OR= 2.52, 95%CI= 1.07 – 5.93,  $p = 0.033$ ).

The study of Kyle et al. showed that sleeplessness had a negative effect on different aspects of quality of life such as individual performance (22). Also, the study of Leger et al. showed that occupational accidents are more prevalent in French workers suffering from severe sleep disorder than in those sleeping properly (23).

In their cross-sectional study, Halvani et al. investigated the frequency of fatigue and sleepiness and their relationship with occupational accidents in Iranian miners. The study was conducted on 137 shift workers and 130 non-shift workers in terms of the above-mentioned relationship. The average score of the fatigue questionnaire for the shift workers reporting occupational accidents was significantly higher compared to those experiencing no accidents ( $p < 0.001$ ). However, no significant relationship was found between the two groups in terms of the difference in the number of occupational accidents and sleepiness score ( $p < 0.05$ ) (10). In their prospective longitudinal study, Fischer et al. found that proper sleep

was associated with the WAI (24).

A study in the U.S. investigated the effect of sleep disorder on the performance of 1000 workers aged 18 and above. In this study, 37% of the workers were at risk of a kind of sleep disorder. The results showed that the amount of sleep in people working more than 60 hours a week is significantly lower than in those with less working hours. The participants with poor sleep quality suffered from work performance problems such as poorer concentration (OR= 3.32, 95%CI= 2.08 – 5.29,  $p = 0.001$ ), more avoidance of interacting with colleagues (OR= 2.24, 95%CI= 1.30 – 3.85,  $p = 0.004$ ), more fatigue (OR= 1.57, 95%CI= 1.09 – 2.26,  $p = 0.016$ ), presenteeism, further reduction of work productivity (OR= 3.26, 95%CI= 1.83 – 5.81,  $p < 0.001$ ) and further absenteeism (OR= 3.54, 95%CI= 1.35 – 9.28,  $p = 0.001$ ). Overall, it was found that the workers with poor sleep quality and quantity suffered from such consequences as poorer work performance (12).

In a historical cohort study in Norway, 37308 working-age individuals who did not claim for compensation due to disability were investigated. In this study, sleepiness was the most important predictive factor for disability during 18 to 48 months follow-up. Moreover, there was a significant relationship between sleepiness and disability after adjustment for different confounding factors (OR= 2.02, 95%CI= 1.61 – 2.53) (13).

In a study by Camerino et al., work ability status and the factors affecting it among the nurses of several European countries (between 2002 and 2004) were investigated. The results showed that better sleep quality and quantity could significantly increase the work ability among these nurses. In this study, the nurses' average WAI score was 39.0, and the WAI score for the nurses younger than the age of 45 was significantly higher than those aged greater than or equal to 45. In addition, multiple analyses also showed an association between sleep disorder and the WAI (11).

In a cross-sectional study on 420 workers in a petrochemical complex in Iran, Mazloumi et al. investigated the WAI and the factors affecting it. In this study, the average WAI score was 39.1. Furthermore, using linear regression analysis, the association between age, work experience, education level and sleep status was determined (14).

In the present study, a significant relationship was found between work ability and age, BMI, cigarette smoking, physical activity and work experience ( $p < 0.05$ ). The results were consistent with those of previous studies in terms of the relationship between the WAI and age (5, 11, 14), work experience (14) and lifestyle (BMI, cigarette smoking, physical activity) (25).

Very few studies on the relationship between sleep disorder and work ability have been conducted in Iran. Moreover, other studies have indirectly investigated sleep disorder among shift workers. The present study, however, aimed to directly investigate sleep disorder (not shift work) and use the Work Ability Index questionnaire.

The cross-sectionality of this study and uncertainty about commenting on its causality might be regarded as its limitations. Moreover, all the participants were male and no study was conducted on females. Therefore, it could be more helpful to use the Sleep Disorder Questionnaire with more questions and details that could better deal with sleep quality and quantity.

### Conclusion

The results of the present study revealed a relationship between sleep disorder and work ability. Therefore, in order to increase and improve the workers' performance, it is recommended to identify and screen those with sleep disorder and help to improve their sleep status through medical involvement and management decisions.

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