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Factors associated with work ability index (WAI) among intensive care units' (ICUs') nurses

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Abstract: Objectives: Work ability is a crucial occupational health issue in health care settings where a high physical and psychosocial work capacity is required and a high risk of disabling injuries and illnesses is predictable. This study aims to examine the association between the work ability index (WAI) and individual characterizations, workload, fatigue, and diseases among intensive care units' (ICUs') nurses. **Methods:** The study sample included 214 nurses selected by a random sampling method from a target population consisting of 321 registered nurses working in eight ICUs. Multiple linear regression analysis was used to test the association between WAI scores and each of the independent variables. **Results:** Results of multivariate analysis revealed a strong and negative association between WAI scores and diseases (B=-5.82, 95% CI=-7.16, -4.48, P<0.001). Among the studied individual characterizations, body mass index (BMI) was significantly and inversely associated with WAI scores. A significant and negative association was also found between WAI scores and dimensions of MFI-20, such as general fatigue (B=-0.31, 95% CI=-0.53, -0.09, P=0.005) and physical fatigue (B=-0.44, 95% CI=-0.65, -0.23, P<0.001). From dimensions of workload, frustration (B=-0.04, 95% CI=-0.07, -0.02, P<0.001) and temporary demand (B=-0.04, 95% CI=-0.08, -0.0001, P=0.04) showed a negative and significant association with WAI scores, while performance showed a positive and significant association (B=0.04, 95% CI=0.01, 0.07, P=0.005). **Conclusions:** Based on the study findings, development of health care programs with the aim of setting up a healthy work environment characterized by a well-structured preventive attitude toward controlling diseases, and a well-designed organizational framework toward increasing the level of performance and motivation, reducing the level of fatigue, as well as reducing the workload, is necessary to promote work ability among ICUs' nurses.
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Key words: Intensive Care Units (ICUs), Nurses, Work Ability Index (WAI)

Introduction

Work ability is defined as how physically and mentally able is a worker to cope with his/her mental work and physical demands[1]. Work ability has been widely assessed by the work ability index (WAI), an instrument developed by the Finnish Institute of Occupational Health (FIOH)[2]. Studies showed that WAI is a helpful tool in predicting long-term sickness absence[3,4], early retirement[3,5], and identifying prognostic factors for mortality and work disability[6,7].

In recent years, there has been a growing interest in conducting studies on work ability in health care settings. Health care workers (HCWs), especially nurses working in intensive care units (ICUs), often operate in job settings where a high physical and psychosocial work capacity is required and a high risk of disabling injuries and illnesses is predictable.

ICUs' nurses often perform heavy physical activities, such as lifting and transferring patients, working in poor postures, standing for long hours, which can lead to de-

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velopment of a wide range of disabling injuries, such as musculoskeletal disorders (MSDs)[8]. Nursing also increases the risk of long-term exposures to biological, chemical, and toxic substances that trigger disabling chronic diseases, such as occupational asthma, allergy, liver diseases, skin dermatitis, and kidney ailments[9]. Furthermore, from the viewpoint of mental dimension of work, it is inevitable for ICUs' nurses to perform complex tasks in critical situations, such as confronting unpredictable events, decision-making under time pressure, and dealing with aggressive relatives[10]. Based on the stress-strain concept, these situations impose a high mental load on nurses and brining long-run excessive job strain.

New studies have suggested that fatigue is one of the immediate consequences of job strain, particularly in occupations in which job tasks require both intense physical and mental efforts simultaneously[11,12], such as those found in health care settings. Job strain and fatigue have been recognized as important risk factors for impairing job performance and work ability[12-14].

Given these conditions along with other factors related to organizational characteristics, such as shift working and long and irregular working hours, have caused nurses to be exposed to a high risk of health attenuating determinants and increasingly affected their work ability.

A previous study on work ability of health care professionals found a lower level of work ability among nurses as compared with other medical staff[15]. This condition may be more critical among ICUs' nurses who may experience higher levels of workload and health-related stressors. Literature review shows that little information is available on work ability and its associated factors in a particular group of health care staff, such as ICUs' nurses.

Nurses constitute a majority of the HCWs' force in Iran. Although, in recent years, establishment of occupational safety and health services within the Iranian hospital health system has led to a better management of health-related stressors and caused an increased protection of HCWs from exposure to workplace safety and health hazards[16], factors related to work ability among nurses still remain widely unknown. This study aims to determine the association between WAI and individual characterizations, workload, fatigue, and diseases among nurses working in ICUs of the hospitals affiliated to Shiraz University of Medical Sciences (SUMS).

Materials and Methods

This is a descriptive and cross-sectional survey design.

Subject and study design

The study subjects included nurses working in ICUs of the hospitals affiliated to SUMS. Based on a random sampling method, 250 individuals were randomly selected from a target population consisting of 321 registered nurses working in 8 ICUs.

The required data were obtained through questionnaire. Data collection was performed during the working hours of the nurses and the head nurses helped the researchers in informing participants about the study purpose and the distribution and collection of questionnaires. A total of 222 questionnaires was returned of which 8 questionnaires were not completed and excluded from the analyses. Therefore, the study was performed among 214 nurses, corresponding to a sample of 85.60% of the population. The mean age of participants was 28.88 (SD= 4.10), which ranged from 22 to 39 years. All nurses were asked to provide written consent prior to starting the study.

Measurement of variables

Work Ability

In this study, work ability was measured by the WAI questionnaire[2], which is calculated by summing the points of 7 items, including current work ability compared with the lifetime best (0-10 points), subjective work ability with regard to physical and mental demands of work (2-10 points), current number of diagnosed diseases by the physician (1-7 points), subjective estimated work impairment due to diseases (1-6 points), sickness absenteeism during the past year (1-5 points), personal prognosis for work ability 2 years from now (1, 4, or 7 points), and mental resources (1-4 points). The index score ranged from 7 to 49 points and the scores were categorized as poor, moderate, good, and excellent. In the original version, reference limits used to categorize WAI into 4 groups (including poor; 7-27 points, moderate; 28-36 points, good; 37-43 points, and excellent; 44-49 points) were based on the distribution of scores for workers aged from 45 to 58 years. Since the nurses in this study had a mean age of 28.88 years, therefore, to prevent an overestimation of work ability, according to previous studies conducted by Kujala et al. based on the distribution of scores, three cut-off points, including the 15th percentile, median, and 85th percentile, were used among the categories[17,18].

The validity and reliability of the Persian version of WAI have been explored in a previous study among Iranian nurses, indicating satisfactory psychometric properties of the questionnaire[19].

Workload

The NASA task-load index (NASA-TLX) was used to examine workload. NASA-TLX is one of the most sensitive and applicable instruments to assess subjective workload[20,21]. This index consists of 6 sub-scales with 21 gradations each. The sub-scales include mental demand, physical demand, temporal demand, performance, effort, and frustration. The first 3 sub-scales are related to demands imposed on an individual and the last 3 ones are related to interaction between an individual with his/her

task. A score ranging from 0 to 100 is obtained on each scale. The overall workload (OW) score is calculated based on the weighted average of rating on the 6 subscales. To simplify, it has been suggested to eliminate the weighting process all together or weighting the subscales and then analyzing them individually[20]. Many researchers have eliminated the weighting procedure and instead use the raw test scores[22]. Therefore, in this study, the mean of the raw test scores (sum of scores of all 6 sub-scales divided by 6, the number of sub-scales) was considered as OW. The face validity and reliability of the Persian version of NASA-TLX among ICUs' nurses was confirmed by Mohammadi et al.[23].

Fatigue

Multi-dimensional Fatigue Inventory (MFI) was used to assess fatigue. MFI consists of 20 items grouped in 5 dimensions, including general fatigue, physical fatigue, mental fatigue, reduced activity, and reduced motivation. Each dimension consists of 4 items scored on a 5-point scale. The possible range of the total score for each dimension is 4 to 20; higher scores indicate higher levels of fatigue. MFI has been recently translated and validated into Persian language[24].

Diseases

Information on the prevalence and type of diseases was obtained based on the nurses' responses to item 3 of the WAI questionnaire, number of diagnosed diseases by the physician. The third item of the WAI questionnaire consists of a detailed list of diseases as follows:

- Trauma/injury from accident
- Musculoskeletal diseases (e.g., chronic disorders of the musculoskeletal system)
- Cardiovascular disease (e.g., hypertension, coronary heart disease, and myocardial infarction)
- Respiratory disease (e.g., chronic bronchitis and sinusitis, bronchial asthma, and emphysema)
- Mental disorder (e.g., slight/severe mental diseases, such as depression, tension, anxiety, and insomnia)
- Neurological and sensory diseases (e.g., problems or injuries related to hearing, visual diseases, neurological diseases, such as stroke, neuralgia, and migraine)
- Digestive disease (e.g., gall bladder stones, liver or pancreatic disease, and gastric or duodenal ulcer)
- Genitourinary disease (e.g., urinary tract infection, kidney disease, and genital disease)
- Skin diseases (e.g., allergic rash/eczema and other skin diseases)
- Tumors (malignant or benign)
- Endocrine and Metabolic diseases (e.g., obesity, diabetes, goiter, or other thyroid diseases)
- Blood diseases (e.g., anemia and other blood disorders)
- Birth defects

Statistical Analysis

Data was analyzed using SPSS software (version 21). The main study variables included both quantitative (BMI, WAI, general fatigue, mental fatigue, reduced activity, reduced motivation, mental demand, physical demand, temporal demand, performance, effort, frustration, and OW) and qualitative measures (gender, education, marital status, physical exercise, type of diseases, work experience, and smoking).

Univariate analysis was used as the primary analysis strategy to determine the unadjusted association between the study variables and WAI. Multivariate linear regression was used to measure the adjusted association between the study variables and WAI. All variables (MFI-20, NASA-TLX, and diseases) were entered into the 3 different models adjusted by BMI, age, and job experience. The modeling procedure was started after collinearity between independent variables was measured using the variance inflation factor index (VIF). The cut-off point of VIF was set at 10.

Results

The demographic characteristic of participants and their associations with the mean WAI score are shown in Table 1. Participants were predominantly females (80.37%, P=0.49) younger than 30 years (60.28%, P=0.02), with a bachelor's degree (91.59%, P=0.93), were non-smokers (98.60%, P=0.52), and had a mean job experience of 6.11 (SD=4.68) years.

The mean WAI score was 39.80 (SD=5; range 24-49) and based on the distribution of the scores, the 15th percentile was 35 points, median was 40 points, and 85th percentile was 45 points. Therefore, 35 points was selected as the cut-off point between poor and moderate work ability, 39 points as that between moderate and good work ability, and 44 points as that between good and excellent work ability, and WAI scores between 7-35, 36-39, 40-44, and 45-49 points were considered to be in the poor, moderate, good, and excellent categories, respectively. After the above-mentioned categorization, 17.8% of the studied population was in the poor, 25.7% in the moderate, 37.4% in the good, and 19.2% in the excellent category.

The results of univariate analysis revealed statistically and inversely significant associations between age (B=-1.59, 95% CI: -2.96, -0.22, P=0.02), BMI (B=-2.17, 95% CI: -3.65, -0.69, P=0.004), and job experience (B=-1.65, 95% CI: -2.99, -0.30, P=0.01) with WAI scores, while other individual characterizations, such as gender, marital status, education, physical exercise, and smoking, did not show a significant association (Table 1).

The mean of WAI scores was not significantly different

Table 1. Individual characterizations of participants in the study and their association with mean WAI score

Characterizations		N (%)	B**	CI	P-value
Age	30<*	129 (60.28)	-	-	-
	30-39	85 (39.72)	–1.59	–2.96, –0.22	0.02
BMI	25<*	150 (70.09)	-	-	-
	25-30	61 (28.50)	–2.17	–3.65, –0.69	0.004
	30>	3 (1.40)	–4.15	–9.81, 1.51	0.15
Education	Diploma*	13 (6.07)	-	-	-
	B.Sc.	196 (91.59)	–0.12	–2.96, 2.72	0.93
	M.Sc.	5 (2.34)	–0.12	–5.35, 5.10	0.96
Gender	Male*	42 (19.63)	-	-	-
	Female	172 (80.37)	0.59	–2.29, –1.11	0.49
Marital status	Single*	99 (46.26)	-	-	-
	Marriage	115 (53.74)	–0.73	–2.08, –0.62	0.28
Physical Exercise	No*	162 (75.70)	-	-	-
	Yes	52 (24.30)	0.05	–1.52, 1.63	0.94
Smoking	No*	211 (98.60)	-	-	-
	Yes	3 (1.40)	1.88	–3.87, 7.64	0.52
Job Experience	<5*	120 (56.07)	-	-	-
	>5	94 (43.93)	–1.65	–2.99, –0.30	0.01

* Selected as reference group
**Un standard regression coefficient

among different hospitals (P > 0.05). However, the mean of workload and age was significantly different among different hospitals (P<0.05).

In this study, more than one quarter of the participants reported a chronic disease diagnosed by a physician. Musculoskeletal problems, digestive disease, and skin disease accounted for the most prevalent diseases (Table 2). Based on the results from Table 2, 57.14% of the participants with trauma were at the poor level of WAI and 14.29% were at the moderate level. Those with musculoskeletal disease (67.76%), mental disorder (62.50%), digestive disease (52.94%), skin disease (60%), and genitourinary disease (87.50%) were at the poor level of WAI. Furthermore, those with a history of trauma (71.43%), musculoskeletal disease (20.00%), and digestive disease (10.59%) were more than 30 years. According to WAI scores, it was observed that the mean WAI score of nurses with diseases diagnosed by a physician was lower than those without diseases, a poor work ability level (WAI=35.42) as compared with a good work ability level (WAI=41.47).

With regard to the results from Table 3, the mean of general fatigue was (X=10.92, SD=2.63, P<0.001) and that of reduced activity was (X=11.81, SD=3.39, P=0.007). In addition, the mean of physical demand was (X=82.92, SD=21.32, P=0.98) and that of frustration was (X=57.37, SD=30.72, P<0.001).

Based on the results of univariate analysis (Table 3), significant and inverse associations were found between general fatigue (B=-0.71, 95% CI: -0.91, -0.51, P<0.001), physical fatigue (B=-0.76, 95% CI: -0.93, -0.59, P<0.001), mental fatigue (B=-0.54, 95% CI: -0.73, -0.35, P<0.001), reduced activity (B=-0.22, 95% CI: -0.38, -0.05, P=0.007), reduced motivation (B=-0.60, 95% CI: -0.79, -0.40, P<0.001), and frustration (B=-0.05, 95% CI: -0.07, -0.03, P<0.001) with WAI. However, physical demand, temporal demand, effort, and OW did not show significant associations with WAI (P > 0.05 for all).

Multivariate analysis of the data was performed using linear regression with WAI scores (Table 4). Among the studied individual characterizations, BMI was significantly and inversely associated with WAI scores. On the other hand, age and job experience showed no significant association with WAI scores. Some dimensions of MFI-20, such as general fatigue (B=-0.31, 95% CI=-0.53, -0.09, P=0.005) and physical fatigue (B=-0.44, 95% CI=-0.65, -0.23, P<0.001), showed negative and significant associations with WAI scores. The association between NASA-TLX subscales and WAI scores are also shown in Table 4. In this study, due to collinearity between OW and NASA-TLX subscales, OW was not entered into the final model. Hence, frustration (B=-0.04, 95% CI=-0.07, -0.02, P<0.001) and temporary demand (B=-0.04, 95% CI=-0.08, -0.0001, P=0.04) showed negative and significant associations with WAI scores, while performance showed a positive and significant association (B=0.04, 95%CI=

Table 2. WAI scores according to presence and type of diagnosed diseases by physician for mean and WAI categories (n=214)

		Age groups				WAI categories			
		<30 N (%)	30-39 N (%)	Total N (%)	WAI X (SD)	Poor N (%)	Moderate N (%)	Good N (%)	Excellent N (%)
Diseases	Yes	24 (11.21)	35 (16.35)	59 (27.57)	35.42 (4.77)	26 (12.14)	22 (10.28)	9 (4.20)	2 (0.93)
	No	105 (49.06)	50 (23.36)	155 (72.42)	41.47 (4.01)	12 (5.60)	33 (15.42)	71 (33.17)	39 (18.22)
Type of disease									
Trauma	Yes	2 (28.57)	5 (71.43)	7 (3.3)	34.28 (7.15)	4 (57.14)	1 (14.29)	1 (14.29)	1 (14.29)
	No	127 (61.35)	80 (38.65)	-		34 (16.43)	54 (26.09)	79 (38.16)	40 (19.32)
Musculoskeletal disease	Yes	11 (39.29)	17 (60.71)	28 (13.1)	33.46 (4.84)	19 (67.76)	6 (21.43)	3 (10.71)	0
	No	118 (91.47)	68 (36.56)	-		19 (10.22)	49 (26.34)	77 (41.40)	41 (22.04)
Cardiovascular disease	Yes	4 (66.67)	2 (33.33)	6 (2.8)	35.50 (3.27)	4 (66.67)	2 (33.33)	0	0
	No	125 (60.10)	83 (39.90)	-		34 (16.35)	53 (25.48)	80 (38.46)	41 (19.71)
Respiratory disease	Yes	2 (28.57)	5 (71.43)	7 (3.3)	30.85 (3.28)	7 (100.00)	0	0	0
	No	127 (61.35)	80 (38.65)	-		31 (14.98)	55 (26.57)	80 (38.65)	41 (19.81)
Mental disorder	Yes	1 (12.50)	7 (87.50)	8 (3.7)	31.37 (4.98)	5 (62.50)	3 (37.50)	0	0
	No	128 (62.14)	78 (37.86)	-		33 (16.02)	52 (25.24)	80 (38.83)	41 (19.90)
Neurological and sensory diseases	Yes	1 (14.29)	6 (85.71)	7 (3.3)	33.57 (3.45)	4 (57.14)	3 (42.86)	0	0
	No	128 (61.84)	79 (38.16)	-		34 (16.43)	52 (25.12)	80 (38.65)	41 (19.81)
Digestive disease	Yes	8 (47.06)	9 (52.94)	17 (7.9)	33.82 (5.25)	9 (52.94)	5 (29.41)	3 (17.65)	0
	No	121 (61.42)	76 (38.58)	-		29 (14.72)	50 (25.38)	77 (39.09)	41 (20.81)
Genitourinary disease	Yes	2 (25.00)	6 (75.00)	8 (3.7)	31.87 (5.27)	7 (87.50)	0	1 (12.50)	0
	No	127 (61.65)	79 (38.35)	-		31 (15.05)	55 (26.70)	79 (38.35)	41 (19.90)
Skin disease	Yes	7 (46.67)	8 (53.33)	15 (7)	34.00 (5.15)	9 (60.00)	5 (33.33)	0	1 (6.67)
	No	122 (61.31)	77 (38.69)	-		29 (14.57)	50 (25.13)	80 (40.20)	40 (20.10)
Endocrine and Metabolic	Yes	2 (22.22)	7 (77.78)	9 (4.2)	34.66 (5.93)	4 (44.44)	4 (44.44)	0	1 (0.46)
	No	127 (61.95)	78 (38.05)	-		34 (15.59)	51 (24.88)	80 (39.02)	40 (19.51)
Tumor	Yes	0	1 (100)	1 (0.46)	40.00 (-)	0	0	1 (100)	0
	No	129 (60.56)	84 (39.44)	-		38 (17.84)	55 (25.82)	79 (37.09)	41 (19.25)

Table 3. Unadjusted association between study variables and WAI

Dimensions	Min	Max	Mean (SD)	B	CI	P-value
MFI-20						
General fatigue	4	20	10.92 (2.63)	–0.71	–0.91, –0.51	<0.001
Physical fatigue	4	20	11.56 (2.78)	–0.76	–0.93, –0.59	<0.001
Mental fatigue	4	20	11.22 (2.57)	–0.54	–0.73, –0.35	<0.001
Reduced activity	4	20	11.81 (3.39)	–0.22	–0.38, –0.05	0.007
Reduced motivation	4	20	11.11 (2.62)	–0.60	–0.79, –0.40	<0.001
NASA-TLX						
Mental demand	0	100	72.95 (25.41)	0.03	0.004, 0.05	0.02
Physical demand	5	100	82.92 (21.32)	–0.0003	–0.03, 0.03	0.98
Temporal demand	5	100	83.61 (17.51)	–0.03	–0.07, 0.003	0.07
Performance	0	100	77.86 (20.66)	0.05	0.02, 0.08	0.001
Effort	10	100	84.07 (16.90)	0.0006	–0.03, 0.04	0.97
Frustration	0	100	57.37 (30.72)	–0.05	–0.07, –0.03	<0.001
Overall workload (OW)	43.33	100	76.46 (12.17)	–0.02	–0.08, 0.03	0.36

0.01, 0.07, p=0.005).

Discussion

This cross-sectional study examined the association between a wide range of demographic and clinical characteristics with work ability among ICUs' nurses. In this study, a low mean WAI score was found among ICUs' nurses, especially among those with a history of diseases. WAI was influenced by individual characterizations, diseases, fatigue, and workload.

The findings of this study showed a lower mean WAI score for ICUs' nurses when compared with values reported from other studies for general hospitals' nurses. In this study, because the studied population included young adults, the mean age of 28.88 (SD=4.10) ranged from 22 to 39 years, WAI categorization was conducted by three cut-off points (15th percentile, median, and 85th percentile), based on the classification suggested by Kujala et al. for young employees[17,18]. The mean WAI score for ICUs' nurses in this study was in the moderate category (39.80 points; SD=5; range 24-49), which, in comparison with the findings of previous studies conducted among general hospitals' nurses, especially considering the mean age of the studied samples, seems to be at an unsatisfactory level of WAI. In a recent study[12] conducted among 272 nurses, the mean WAI score was 38.1 points (SD=5.7) for nursing technicians and assistants with a mean age of 41.7 years (SD=9.3; range 23-65 years) who were more than 10 years older than the nurses in this study, and it was in the good category. Likewise, the mean WAI score was 38.6 (SD=6.2) among 1,194 Brazilian nurses and nursing aides with a mean age of 40.3 (SD=13.1) years[25], and it was 38.3 (SD=6.1) among 1212 Croatian nurses with a mean age of 42 (range 32-47) years[26], and both were in the good category of WAI.

The distribution of WAI scores revealed that 17.8% of nurses were in the poor (7-35 points) and 25.7% in the moderate (36-39 points) work ability category (in total, 43.5% of nurses were in poor to moderate WAI category). In line with this finding, the distribution of poor and moderate WAI scores among a sample including 236 Iranian nurses was 11% and 36.9%, respectively (in total, 47.9% of nurses were in poor to moderate WAI category)[19]. However, the results of the study conducted by NEXT[27], the most extensive international research on the collection of WAI data among 22,355 registered nurses from 10 European countries, showed that the distribution of poor (7-27 points) and moderate (28-36 points) WAI scores was 3.5% and 19.5%, respectively (in total, 23% nurses were in poor to moderate WAI category), almost half of those obtained in this study. However, when the distribution for each country was considered, only in Poland, similar to the results of this study, 42% of the nurses showed poor to moderate WAI scores. With respect to the obtained mean WAI score and high proportion of its poor to moderate categories, a high risk of disability and early retirement among the studied nurses can be predictable in the near future. Hence, planning and implementation of appropriate intervention measures to help improve work ability are recommended.

The results of univariate analysis revealed statistically and inversely significant associations between age, job experience, and BMI and WAI scores. Age and job experience were also explored in previous studies[28-30] as significant determinants of WAI. It has been reported that aging is associated with a reduction in functional capacity, work ability, and employability[31]. In longitudinal surveys, BMI showed a U-shaped association with mortality and low WAI scores[32]. Overweight and obesity are associated with increased risks of a wide range of diseases, such as cardiovascular diseases, mental disorders, and musculoskeletal problems, and their final outcome is disability and early retirement[32].

The findings of this study revealed a strong and negative association between WAI scores and diseases. Chronic diseases have been identified to be one of the major determinants for disability and work-related absence[33,34]. In a recent study, Alavinia and Burdorf among 11,462 participants of the Survey of Health, Ageing and Retirement in Europe (SHARE) found that, independent from self-perceived poor health, chronic diseases were strongly related to the risk of unemployment and labor force exit[35]. In this study, more than one quarter of the participants reported a chronic disease, of which musculoskeletal problems, digestive diseases, and skin diseases accounted for the most prevalent diseases. These findings are in agreement with the findings of the study conducted by NEXT[27].

Tuomi et al. have introduced musculoskeletal problems as a disease with a negative effect on work ability[36]. Literature shows that working in ICUs impose a high degree of biomechanical and ergonomic risks that can lead to the development of chronic MSDs/discomforts[8]. The findings of the studies on MSDs in health care settings revealed that MSD symptoms seemed to be experienced much more by ICU nurses[8,37]. The prevalence of musculoskeletal problems among a sample of 201 Turkish ICU nurses[38] was 19.9% (n=40), which is higher than those reported in this study with a sample size consisting of 214 nurses. The reasons for higher prevalence of MSDs among nurses in ICUs as well as surgical wards have been explained by Kee and Seo[37] to be activities related to patient handling and transferring, such as moving, lifting, and repositioning of patients.

According to the results, work ability was influenced by general fatigue (B=-0.31, 95% CI=-0.53, -0.09, P=0.005) and physical fatigue (B=-0.44, 95% CI=-0.65, -0.23, P<0.001). This is consistent with the findings of a recent study conducted by Vasconcelos et al.[12], which re-

Table 4. Multiple linear regression results for WAI scores by diseases and different dimensions of workload and fatigue

Variable		*B	CI	P-value
Disease		–5.82	–7.16, 4.48	<0.001
BMI	25<	-	-	-
	25-30	–0.84	–2.16, 0.47	0.20
	30>	–3.29	–8.22, 1.64	0.19
Age	30<	-	-	-
	30-39	0.38	–1.24, 2.01	0.63
Job experience	<5	-	-	-
	>5	–0.65	–2.25, 0.94	0.42
		MFI-20		
BMI	25<	-	-	-
	25-30	–1.20	–2.48, 0.06	0.06
	30>	–2.35	–7.16, 2.44	0.33
Age	30<	-	-	-
	30-39	–0.53	–2.11, 1.03	0.50
Job experience	<5	-	-	-
	>5	–0.64	–2.21, 0.91	0.41
General fatigue		–0.31	–0.53, –0.09	0.005
Physical fatigue		–0.44	–0.65, –0.23	<0.001
Mental fatigue		–0.12	–0.33, 0.08	0.23
Reduced activity		0.01	–0.13, 0.16	0.82
Reduced motivation		–0.20	–0.42, 0.01	0.07
		NASA-TLX		
BMI	25<	-	-	-
	25-30	–1.54	–2.95, –0.14	0.03
	30>	–2.95	–8.29, 2.39	0.27
Age	30<	-	-	-
	30-39	–0.18	–1.91, 1.54	0.83
Job experience	<5	-	-	-
	>5	–1.20	–2.91, 0.50	0.16
Mental demand		0.02	–0.003, 0.04	0.08
Physical demand		0.01	–0.02, 0.04	0.46
Temporal demand		–0.04	–0.08, –0.0001	0.04
Performance		0.04	0.01, 0.07	0.005
Effort		0.01	–0.02, 0.05	0.54
Frustration		–0.04	–0.07, –0.02	<0.001

* Adjusted by BMI, age, and job experience

ported that perceived fatigue was associated with inadequate work ability among Brazilian nurses. Fatigue is a gradual and cumulative process that reflects a decrement in vigilance, motivation, and ability of individuals to perform a particular task[39]. Furthermore, fatigue has been associated with a variety of both physical illness and mental health measures[40], which may affect work ability.

According to the study findings (Table 4), from the NASA-TLX sub-scales, temporary demand (B = -0.04, 95% CI=-0.08, -0.0001, P=0.04) and frustration (B=-0.04, 95% CI=-0.07, -0.02, P<0.001) showed an inverse and significant association with WAI scores, while performance showed a direct and significant association (B=0.04, 95% CI=0.01, 0.07, P=0.005). Temporary demand and frustration have been identified as significant risk factors in the occurrence of MSDs[41] accounting for the main cause of permanent work disability (PWD)[42]. Tuomi et al. reported that the occurrence of poor work ability may be manifold when a combination of the presence of a disease, high work load, and high level of stress symptoms are to be considered[36]. They concluded that there are several workload factors, such as heavy physical work, hot and cold work environments, lack of freedom, few possibilities to develop, and role conflicts at work, which predict poor work ability or disability. Considering the above mentioned findings from Tuomi et al. and the results obtained from this study on the associations found between WAI scores and diseases, fatigue, and workload, it is suggested to develop a healthy work environment characterized by a well-structured preventive attitude toward controlling diseases and a well-designed organizational framework toward increasing the level of performance and motivation, reducing the level of fatigue, as well as reducing the workload in all hospitals equipped with ICUs.

Study limitations

The cross-sectional study design, nature of subjective collected data, small number of sample size, and unequal distribution of male and female nurses should be considered when using the findings of this study.

Conclusion

There is a lack of studies conducted on WAI among ICUs' nurses. With respect to the sensitivity and importance of the work in ICUs, it is necessary for nurses working in such units to have work ability and work capacity corresponding to their job demands. The results of this study showed that ICUs' nurses were to have a lower mean WAI score when compared with values reported for general hospitals' nurses. Given a moderate level of mean WAI score and a high proportion of its poor to moderate categories, it is recommended to develop appropriate intervention measures toward improving nurses' work ability. High prevalence of musculoskeletal problems underlines a crucial need for identifying and reducing ergonomic risk factors as well as redesigning jobs in such units.

Based on the findings of this study, individual characterizations, disease, fatigue, and workload were the most important factors associated with work ability. Hence, de-

velopment of health care programs with the aim of setting up a healthy work environment characterized by a well-structured preventive attitude toward promotion of health and controlling diseases and a well-designed organizational framework toward increasing the level of performance and motivation, reducing the level of fatigue, as well as reducing the workload in all hospitals equipped with ICUs is necessary to promote nurses' work ability.

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References

1) de Vries HJ, Reneman MF, Groothoff JW, Geertzen JH, Brouwer S. Self-reported work ability and work performance in workers with chronic nonspecific musculoskeletal pain. J Occup Rehabil 2013; 23(1): 1-10.
2) Tuomi K, Ilmarinen J, Jahkola A, Katajarinne L, Tulkki A. Work Ability Index 2nd ed. Helsinki (Finland): Institute of Occupational Health; 2006.
3) Sell L, Bültmann U, Rugulies R, Villadsen E, Faber A, Søgaard K. Predicting long-term sickness absence and early retirement pension from self-reported work ability. Int Arch Occup Environ Health 2009; 82(9): 1133-1138.
4) Schouten LS, Joling CI, van der Gulden JW, Heymans MW, Bültmann U, Roelen CA. Screening manual and office workers for risk of long-term sickness absence: cut-off points for the Work Ability Index. Scand J Work Environ Health 2015; 41(1): 36-42.
5) Roelen CA, Heymans MW, Twisk JW, van der Klink JJ, Groothoff JW, van Rhenen W. Work ability index as tool to identify workers at risk of premature work exit. J Occup Rehabil 2014; 24(4): 747-754.
6) Tuomi K, Ilmarinen J, Seitsamo J, et al. Summary of the Finnish research project (1981-1992) to promote the health and work ability of aging workers. Scand J Work Environ Health 1997; 23 (Suppl 1): 66-71.
7) Tuomi K, Ilmarinen J, Klockars M, et al. Finnish research project on aging workers in 1981-1992. Scand J Work Environ Health 1997; 23 (Suppl 1): 7-11.
8) Sezgin D, Esin M. Predisposing factors for musculoskeletal symptoms in intensive care unit nurses. International nursing review 2015; 62(1): 92-101.
9) Tan CC. Occupational health problems among nurses. Scand J Work Environ Health 1991; 17(4): 221-230.
10) Snape J, Cavanagh SJ. Occupational stress in neurosurgical nursing. Intensive Crit Care Nurs 1993; 9(3): 162-170.
11) Mehta RK, Parasuraman R. Effects of mental fatigue on the development of physical fatigue A neuroergonomic approach. Human Factors: The Journal of the Human Factors and Ergonomics Society 2014; 56(4): 645-656.
12) Vasconcelos SP, Fischer FM, Reis AO, Moreno CR. Factors associated with work ability and perception of fatigue among nursing personnel from Amazonia. Rev Bras Epidemiol 2011; 14(4): 688-697.
13) Prochnow A, Magnago TS, Urbanetto JD, Beck CL, Lima SB, Greco PB. Work ability in nursing: relationship with psychological demands and control over the work. Rev. Latino-Am. Enfermagem 2013; 21(6): 1298-1305.
14) Barker LM, Nussbaum MA. The effects of fatigue on performance in simulated nursing work. Ergonomics 2011; 54(9): 815-829.
15) Aging, working hours and health: some preliminary statistics from the 3rd European Survey on working conditions. In: Costa G, Sartori A, editors. The 4th Conference on Ageing and Work Promotion of Work Ability and Employability. 2002.
16) Jahangiri M, Rostamabadi A, Hoboubi N, Tadayon N, Soleimani A. Needle Stick Injuries and their Related Safety Measures among Nurses in a University Hospital, Shiraz, Iran. Saf Health Work 2015; 7(1): 72-77.
17) Kujala V, Remes J, Ek E, Tammelin T, Laitinen J. Classification of Work Ability Index among young employees. Occup Med (Lond) 2005; 55(5): 399-401.
18) Kujala V, Tammelin T, Remes J, Vammavaara E, Ek E, Laitinen J. Work ability index of young employees and their sickness absence during the following year. Scand J Work Environ Health 2006; 32(1): 75-84.
19) Abdolalizadeh M, Arastoo AA, Ghsemzadeh R, Montazeri A, Ahmadi K, Azizi A. The psychometric properties of an Iranian translation of the Work Ability Index (WAI) questionnaire. J Occup Rehabil 2012; 22(3): 401-408.
20) Hart SG, NASA-task load index (NASA-TLX): 20 years later. Proceedings of the human factors and ergonomics society annual meeting; 2006: Sage Publications.
21) NASA Task Load Index (NASA-TLX). Version 1.0: Paper and pencil package. Moffett Field, CA: Human Performance Research Group, NASA Ames Research Center, 1986.
22) Hoonakker P, Carayon P, Gurses AP, et al. Measuring workload of ICU nurses with a questionnaire survey: the NASA Task Load Index (TLX). IIE Trans Healthc Syst Eng 2011; 1 (2): 131-143.
23) Mohammadi M, Mazloumi A, Nasl seraji J, Zeraati H. Designing questionnaire of assessing mental workload and determine its validity and reliability among ICUs nurses in one of the TUMS's hospitals. Journal of School of Public Health and Institute of Public Health Research 2013; 11(2): 87-96.
24) The Multidimensional Fatigue Inventory validation and fatigue assessment in Iranian distance education students. In: Hafezi S, Zare H, Mehri SN, Mahmoodi H, editors. 2010 4th

International Conference on Distance Learning and Education (ICDLE). IEEE; 2010.
25) Rotenberg L, Griep RH, Fischer FM, Fonseca MD, Landsbergis P. Working at night and work ability among nursing personnel: when precarious employment makes the difference. Int Arch Occup Environ Health 2009; 82(7): 877-885.
26) Milosevic M, Golubic R, Knezevic B, Golubic K, Bubas M, Mustajbegovic J. Work ability as a major determinant of clinical nurses' quality of life. J Clin Nurs 2011; 20(19-20): 2931-2938.
27) Hasselhorn H-M, Müller BH, Tackenberg P. NEXT scientific report July 2005. In: Wuppertal The European NEXT-Study (Nurses' Early Exit Study. University of Wuppertal, NEXT-Study Coordination). 2005. p. 1-56.
28) Mazloumi A, Rostamabadi A, Saraji GN, Foroushani AR. Work ability index (WAI) and its association with psychosocial factors in one of the petrochemical industries in Iran. J Occup Health 2012; 54(2): 112-118.
29) Rostamabadi A, Mazloumi A, Foroushan AR. Work Ability Index (WAI) and its health-related determinants among Iranian farmers working in small farm enterprises. J Occup Health 2014; 56(6): 478-484.
30) van den Berg TI, Elders LA, de Zwart BC, Burdorf A. The effects of work-related and individual factors on the Work Ability Index: a systematic review. Occup Environ Med 2008; 66 (4): 211-220.
31) Ilmarinen JE. Aging workers. Occup Environ Med 2001; 58 (8): 546-552.
32) Laitinen J, Näyhä S, Kujala V. Body mass index and weight change from adolescence into adulthood, waist-to-hip ratio and perceived work ability among young adults. Int J Obes (Lond) 2005; 29(6): 697-702.
33) Lerner D, Allaire SH, Reisine ST. Work disability resulting from chronic health conditions. J Occup Environ Med 2005; 47(3): 253-264.
34) Collins JJ, Baase CM, Sharda CE, et al. The assessment of chronic health conditions on work performance, absence, and total economic impact for employers. J Occup Environ Med 2005; 47(6): 547-557.
35) Alavinia SM, Burdorf A. Unemployment and retirement and ill-health: a cross-sectional analysis across European countries. Int Arch Occup Environ Health 2008; 82(1): 39-45.
36) Tuomi K, Eskelinen L, Toikkanen J, Jarvinen E, Ilmarinen J, Klockars M. Work load and individual factors affecting work ability among aging municipal employees. Scand J Work Environ Health 1991; 17(Suppl 1): 128-134.
37) Kee D, Seo SR. Musculoskeletal disorders among nursing personnel in Korea. Int J Ind Ergon 2007; 37(3): 207-212.
38) Arzu İ . Study on work-related musculoskeletal disorders in intensive care unit nurses. AJCI 2014; 8(2): 68-76.
39) Yamazaki S, Fukuhara S, Suzukamo Y, et al. Lifestyle and work predictors of fatigue in Japanese manufacturing workers. Occup Med (Lond) 2007; 57(4): 262-269.
40) Williamson RJ, Purcell S, Sterne A, et al. The relationship of fatigue to mental and physical health in a community sample. Soc Psychiatry Psychiatr Epidemiol 2005; 40(2): 126-132.
41) Habibi E, Taheri MR, Hasanzadeh A. Relationship between mental workload and musculoskeletal disorders among Alzahra Hospital nurses. Iran J Nurs Midwifery Res 2015; 20(1): 1-6.
42) Abásolo L, Lajas C, León L, et al. Prognostic factors for long-term work disability due to musculoskeletal disorders. Rheumatol Int 2012; 32(12): 3831-3839.