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Turkish validity and reliability of the occupational fatigue exhaustion / recovery scale

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Abstract

This study aims to conduct the Turkish reliability and validity study of The Occupational Fatigue Exhaustion Recovery Scale (OFER) for determining the occupational fatigue for the shift workers and to assess the relationship between occupational fatigue and sleep. Methods: The study was a methodological study conducted between January and February 2018 with 302 workers in Sanlıurfa Organized Industrial Zone. The Occupational Fatigue Exhaustion Recovery Scale (OFER) and Fatigue Severity Scale (FSS) were used to assess occupational fatigue, and Pittsburgh Sleep Quality Index (PSQI) was used to evaluate sleep quality. In the Turkish adaptation of The Occupational Fatigue Exhaustion Recovery Scale, the Cronbach's alpha coefficient was found as reliable in the internal consistency in chronic fatigue (85), acute fatigue (.67) and recovery (.68) subscales. It was determined as good in test-retest reliability in all the subgroups compared to ICC test (2,1). It was found that the factor loads, which accounted for 63.2% of the scale in the descriptive variance analysis, were between the values of .600 and .830. A moderate positive correlation was determined between sleep quality and chronic fatigue (r=.300) and between sleep quality and acute fatigue (r=.331); whereas, a moderate negative correlation was determined between sleep quality and recovery (r=-.380) ($p<.05$). Occupational Fatigue Scale was found to be valid and reliable for Turkish in evaluating the occupational fatigue in employees working in shifts. The training planned to reduce fatigue of workers and enhance their sleep quality will reduce the health-related risk factors for workers and therefore make a significant contribution in preventing occupational accidents.

Keywords: Reliability and validity, occupational diseases, fatigue, sleep

Introduction

Although fatigue has no universally accepted definition, it is understood to be a multidimensional complex experience that affects the life quality of the individual negatively if it is not controlled [1,2]. Fatigue for an employee may be understood as the inability to continue work further, and reaching a psychosomatic exhaustion point Long working hours, heavy workload, and difficulty of working conditions may underpin worker fatigue. Consequently diminished reflexes and decreased the strength of fatigued workers may contribute to work-related accidents [3-5]. Work-related fatigue is a source of concern in many industrialized countries. Many studies have emphasized that workers experience occupational Fatigue [6,7]. Which affects the occupational health and safety, health costs, personal well-being, personal efficiency, and health indicators and economy of the country. [8,9]. Occupational fatigue affects more than 20 percent of the working population in the United States, resulting in more than $ 136 billion in costs per years in lost productivity and health care costs [10]. Work accidents between 2008-2013 were examined in a study conducted with forest workers in New Zealand. It was reported that there were 12.921 work accidents and 32 workers died. Fatigue, lack of education, perceptions of occupational safety cultures, and poor health status are shown along with the top causes of the accidents [4,11]. Unfortunately, the fatigue problem is frequently only noticed after major accidents. For example, Harrington, Three Mile Island, Chernobyl, and Exxon Valdez oil spill events showed that occupational fatigue level is an important factor among workers [12]. Other reasons affecting the occupational accidents can be listed as the decrease in productivity of the employees due to fatigue, distraction, which underpin unsafe workplace behaviors [7,13].

Further, work-related fatigue is closely related to chronic stress contributing to coronary heart disease, emotional disorders such as depression and exhaustion, weakness in the immune system,

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and impaired sleep quality [14-16]. In the studies conducted among healthcare professionals, increase in critical incidents, i.e., medical errors and injuries, were associated with worker fatigue [7,17]. Fatigue can be classified as acute or chronic, depending on the causes. Acute fatigue in workers is usually seen as a condition that occurs after a certain period and is defined as a temporary condition experienced by healthy people during their work or daily life activities [5,7]. Long-term fatigue, which does not decrease with sleeping and resting, is defined as chronic maladaptive fatigue [18]. Chronic fatigue is commonly found among workers subjected to repeated exposure to high levels of acute fatigue, experiencing low recovery between the shifts [5]. Fatigue signs have both objective and subjective character. How people perceive fatigue is of great importance.

For this reason, surveys can be used to assess fatigue [1]. Although the Occupational Fatigue Exhaustion / Recovery Scale (OFER) is used in other languages to evaluate occupational fatigue, it does not have Turkish validity and reliability. Since there is no existing Turkish scale with which to assess occupational fatigue, we believe that undertaking a reliability study of the Turkish version of the OFER scale is a significant contribution to the literature and of ongoing value for future studies of workplace fatigue in the Turkish language.

Material and Methods

Type of the Study

This study is both cross-sectional and methodological conducted to assess the validity and reliability of the Turkish version of the "Occupational Fatigue Scale." It was undertaken among workers in a Spinning factory located in Sanliurfa Organized Industrial Zone between January 2018 – February 2018.

Population and Sample of the Study

The population of the study was composed of 340 people working in the Spinning factory. Although the number of people to be included in the sample is suggested to be 10-20 times more than the number of items, the whole population was aimed to be reached without selecting the sampling. All the workers participating in the study were informed about the study, and their verbal consents were obtained. Participation in the study was 302 out of 340 (90%).

Ethical Considerations

Ethics committee approval required for the study and work permit from the factory and the permission to use the scale from the scale author Dr. Peter Winwood was obtained.

Design of the Study

Since the scale was adapted from a different language (English) and culture (Western), the validity and reliability studies were conducted in two stages. Language validity in the first step, as well as construct validity, concurrent criterion validity, internal consistency, and test-retest reliability in the second step, were evaluated. Also, the PSQI (Pittsburgh Sleep Quality Index) recommended being used together in the use of the scale was used (Winwood et al. 2005). 1st Step: By the translation-back translation method, the items of OFER Scale were translated from English to Turkish by three language experts and the scale translated into Turkish was reviewed again by getting three experts' opinions. The scale whose Turkish translation was completed was then re-translated back to the original language by three experts, and the Turkish version of the scale was prepared.

2nd Step: Before applying to the sample group, the scale was evaluated by conducting a pre-application to 15 factory workers working in a similar line of work, and it was applied to the sample group without changing any item (n=302). Then, it was applied two weeks after again to 75 people selected among them, and its test-retest reliability was evaluated.

Data collection tools

It was planned to be collect information with a questionnaire consisting of two parts and prepared by the literature. The first part included questions containing the sociodemographic characteristics of the workers and Occupational Fatigue Scale (OFER), Fatigue Severity Scale (FSS), and Pittsburgh Sleep Quality Index (PSQI) were involved in the second part.

The Occupational Fatigue Exhaustion/Recovery Scale (OFER)

OFER was developed by Winwood et al. in 2005 to measure occupational fatigue. The Cronbach's alpha coefficient of the scale was found to be 0.93 for chronic fatigue, 0.82 for acute fatigue, and 0.75 for recovery. The scale consists of 15 items and three subscales; (1) chronic fatigue includes 1-5 questions, (2) acute fatigue 6-10 questions (3) and recovery 11-15 questions. The statements consist of experiences about fatigue at work and home within the last few months. Questions including negative statements are coded reversely, and thus the scoring is made. A seven-point Likert scale (ranging from 0 = strongly disagree to 6 = strongly agree) is used for the scale responses. The scale has no total score, and the scores are calculated separately for each subscale (item scores / 30 x 100). A score of 0-100 is obtained from the scale. While high scores in the subscales of chronic and acute fatigue signify an increase in occupational fatigue, high scores in the subscale of recovery signify a recovery between the shifts. 0-25 indicates low fatigue, 25-50 moderate/low fatigue, 50-75 moderate/high fatigue and 75-100 high fatigue [5,17].

The measurement tool used for the concurrent criterion validity

Fatigue Severity Scale (FSS)

It is among the most frequently used scales for fatigue assessment. It was developed by Krupp et al., (1989) and its Turkish validity and reliability study was performed by Armutlu et al., (2007). Its conformity to Turkish society was determined, and the Cronbach's alpha internal consistency coefficient was found as 0.89. In the scale composed of a total of 9 items, each item is scored between 1-7 (1=I completely disagree, 7=I completely agree) and the total score is calculated by taking the mean of 9 items. Those having a score of 36 or higher points are considered as "tired." The lower the total score, the less the fatigue [19,20].

Pittsburgh Sleep Quality Index (PSQI)

PSQI is a sleep questionnaire that helps to assess sleep quality, sleep rate, presence, and severity of sleep disturbance within the last month. Its Turkish validity and reliability study was conducted by Ağargün et al. The scale consists of 19 items and measures seven subscales of sleep quality including subjective sleep quality (C1), sleep latency (C2), sleep duration (C3), habitual sleep efficiency (C4), sleep disturbances (C5), sleep medication (C6), and daytime

dysfunction (C7). Total PSQI score is obtained by summing seven sub-scores, and the total score is between 0-21. PSQI total score definitively differentiates the good sleepers (PSQI total score ≤5) from poor sleepers (PSQI >5) [21].

Data Evaluation

Data analysis was performed by using SPSS (Statistical Package for Social Sciences) V 20 program, and the p-value significance level p<.05 was adopted. In the evaluation of descriptive data, number, percentage, mean±standard deviation, median, and min-max values were used. Item total score correlation, internal consistency (Cronbach's alpha) to assess the reliability of the scale and ICC (2,1) for test-retest were used. In the concurrent criterion validity for content validity, Pearson moment-product correlation coefficient was used. In the investigation of the sample size for the validity of the results obtained from the explanatory factor analysis, Kaiser-Meyer-Olkin (KMO) and Bartlett's Test were used.

Data Collection

Before the distribution of the questionnaire, voluntary participation information about the study was given, and it was stated that they could withdraw from the study at any time. The completion of the questionnaire was undertaken by each participant for approximately 15 minutes under surveillance.

Results

Demographics

Age average was 33.76±7.1, 94% of the participants were male, 71.2% had primary and lower educational level, 82.8% were married, 25.8% had a health problem, and 47.4% were smokers.

Reliability analysis of OFER Scale

Table 1 shows the Cronbach's alpha coefficient and item mean scores of OFER scale in the internal consistency analysis for reliability. It was found that the Cronbach's alpha coefficient did not significantly increase when any one of the items in the scale is removed. The Cronbach's alpha coefficients of OFER scale with fifteen items are found as .85 in the chronic fatigue subscale, .67 in the acute fatigue subscale, and .68 in the recovery subscale (Table 1.)

Test-retest reliability of the OFER scale

Table 1. Item point averages and cronbach's alpha values of OFER Scale

		Item Score Averages	Alpha value in case of deleting the item	Cronbach's alpha
1	Most of the time, I feel that "my tolerance is running out"	2.83± 2.28	.823	.85
2	Most of the time, I'm afraid to wake up for another day of work	2.09±2.30	.835	
3	I often wonder how much longer I can continue to go to work	2.72±2.35	.810	
4	Most of the time, I feel like "I live to work"	3.10±2.48	.836	
5	Too much things are expected from me at the work.	2.98±2.28	.833	
6	I have very little energy after a work shift	3.40±2.22	.527	.67
7	I usually feel exhausted when I come home from work	3.48±2.29	.541	
8	My work consumes all of my energy every day	3.09±2.27	.514	
9	Generally, I have a lot of energy for my family or friends	3.59±2.06	.703	
10	Usually I have plenty of energy for my hobbies and other activities after work	4.25±1.89	.740	
11	I don't have enough time to get my full energy between the shifts.	3.32±2.20	.623	.68
12	Although I'm tired after the shift, I usually come back to life with the start of the next shift	3.10±2.22	.646	
13	I rarely pick up my strength between shifts	3.28±2.03	.590	
14	Getting rid of work fatigue between shifts is not a problem for me	2.70±2.14	.635	
15	I often feel exhausted from one shift until starting to the next one.	3.23±2.27	.655	

Item response scale ranged from 1 (strongly disagree) to 6 (strongly agree)

OFER scale was re-administered to 75 people who participated in the study 15 days later. The test-retest reliability coefficient of the items of the scale was evaluated with ICC (2,1). It was found to be good in all subgroups. Independent samples t-test was conducted to determine whether or not there is a difference between the mean scores obtained from the two measurements of test-retest reliability coefficient and no statistically significant difference was found between the mean scores (Table 2.)

Validity analysis of the scale

The equivalent form validity of the OFER scale

To compare the concurrent validity of the OFER scale, its relationship with the Fatigue Severity Scale (FSS) was examined. There was a moderate positive correlation between OFER scale scores and Fatigue Severity Scale (FSS) total scores (Table 3).

Kaiser-Meyer-Olkin (KMO) to determine the adequacy of samples before factor analysis, and Bartlett's test of Sphericity analysis

for the adequacy of the sample size was performed. It was found that the Kaiser-Meyer-Olkin (KMO) test results were 0.904, and Barlett's Test was 2183.97 and p=0.00. According to these results, the sample size, the size of the observed correlation coefficients, and partial correlation coefficients were found to be compatible and adequate for factor analysis.

When the factor structure of the scale was examined, it was determined that three- dimensional structure consisting of 15 items explained 63.2% of the total change in OFER scores according to the principal component factor analysis. The factor loads of the OFER scale were determined between .600-.830 (Table 4).

According to the Occupational Fatigue Exhaustion/Recovery Scale, it was found that chronic fatigue subscale means scores of the sample group were 45.81 ± 31.15, acute fatigue subscale mean scores were 59.63±23.48, Recovery subscale mean scores were 52.18±17.37.

When examining the Occupational Fatigue statuses according to the sleep quality, those with poor sleep quality had higher chronic fatigue and acute fatigue scores and lower recovery scores than those with good sleep quality (p<.05) (Table 5).

Table 2. Test-Retest Reliability Results of OFER Scale

	Test Mean±Standard Deviation	Re-test Mean±Standard Deviation	t	p	ICC	95 % CI
Chronic Fatigue	51.82 ± 33.46	52.22 ± 33.47	0.15	.87	.879	.808-.924
Acute Fatigue	59.11 ± 23.92	59.24 ± 23.92	0.05	.95	.795	.676-.871
Recovery	50.05 ± 15.90	47.02 ± 16.95	1.34	.18	.787	.663-.865

Note. ICC=Intraclass correlation coefficient

Table 3. Correlation Values Of The OFER Scale with FSS and PSQI Scale Scores

	OFER-CF	OFER-AF	OFER-IR	FSS	PSQI
OFER-CF	1				
OFER-AF	.607	1			
OFER-IR	-.518	-.559	1		
FSS	.464	.462	-.447	1	
PSQI	.300	.331	-.380	.426	1

Note. OFER = The Occupational Fatigue Exhaustion/Recovery Scale; CF = chronic fatigue; AF= acute fatigue ; IR = recovery; FSS = Fatigue Severity Scale; PSQI= Pittsburgh Sleep Quality Index

Table 4. Explanatory Factor Analysis Results of the OFER Scale

		Chronic Fatigue	Acute Fatigue	Recovery
1	Most of the time, I feel that "my tolerance is running out in my job"	.661		.85
2	Most of the time, I'm afraid to wake up for another day of work	.601		
3	I often wonder how much longer I can continue to go to work	.717		
4	Most of the time, I feel like "I live to work"	.600		
5	Too much things are expected from me at the work.	.610		
6	I have very little energy after a work shift		.820	
7	I usually feel exhausted when I come home from work		.830	
8	My work consumes all of my energy every day		.822	
9	Generally, I have a lot of energy for my family or friends		.765	
10	Usually I have plenty of energy for my hobbies and other activities after work		.770	
11	I don't have enough time to get my full energy between the shifts.			.684
12	Although I'm tired after the shift, I usually come back to life with the start of the next shift			.753
13	I rarely pick up my strength between shifts			.565
14	Getting rid of work fatigue between shifts is not a problem for me			.651
15	I often feel exhausted from one shift until starting to the next one.			.735

Item response scale ranged from 1 (strongly disagree) to 6 (strongly agree)

Table 5. Occupational Fatigue Status Based On Sleep Quality

OFER	Poor Sleep Number(%)	Good Sleep Number(%)	x^2	p
CHRONIC				
Low	48 (51.6)	45 (48.4)	15.10	.002
Low/moderate	60 (30.0)	30 (33.3)		
Moderate/high	33 (60.0)	22 (40.0)		
High	52 (81.3)	12 (18.8)		
ACUTE				
Low	6 (31.6)	13 (68.4)	19.47	.001
Low/moderate	61 (57.5)	45 (42.5)		
Moderate/high	52 (62.7)	31 (37.3)		
High	74 (78.7)	20 (21.3)		
RECOVERY				
Low	17 (77.3)	5 (22.7)	12.27	.006
Low/moderate	84 (71.8)	33 (28.2)		
Moderate/high	83 (59.3)	57 (40.7)		
High	9 (39.1)	14 (60.9)		

Discussion

Measuring occupational fatigue is very important in terms of occupational health. Protecting the mental and physical health of the workers from the negative effects of the workplaces, taking precautions against work accidents and occupational diseases, and providing them to work in comfortable and safe environments reach their goals by performing occupational health and safety together. We believe that there are numerous studies related to Occupational Fatigue, which are needed in Turkey. To fulfill this need, this study intended to evaluate the validity and reliability of the Turkish version of OFER.

Discussion on the Reliability of OFER

It is generally accepted that the Cronbach's alpha value should be at least α=.60 and above on a Likert-type scale [22]. The reliability coefficient of the scale in the study was determined as .85 in the chronic fatigue subscale, .67 in the acute fatigue subscale, and .68 in the recovery subscale. In Peter's study, they were found as .93 in the chronic fatigue subscale, 82 in the acute fatigue subscale, and .75 in the recovery subscale [5]. The relatively low Cronbach's alpha coefficient may be because the sample size was lower compared to the original version of the scale. It was seen that the Cronbach's alpha coefficient did not significantly increase when any of the items in the scale was omitted.

In this study, test-retest was re-administered to 75 participants 15 days later, and dependent groups t-test was applied to determine whether or not there is a difference between the mean scores obtained from two measurements and no statistically significant difference was found between the mean scores (p>.05). It was found to be good in all subgroups in the evaluations conducted with ICC (2,1). The results have shown that OFER has high test-retest reliability, and it does not show any change depending on the scale over time, and it is reliable.

Discussion on the Validity of OFER

In this study, Fatigue Severity Scale (FSS) was used for equivalent form validity and Pearson moment product correlation was found as r=.464, r=.462, and r=.447. There was a moderate positive correlation between the two measurement tools. It is reported in the literature that correlations of .30 and higher calculated for the criterion validity coefficient can be evaluated as an indicator for the validity of the test [23]. These results support the hypotheses tested.

In the exploratory factor analysis, Kaiser-Meyer Olkin (KMO) technique is the most commonly used technique for the sample size adequacy. The KMO value varies between 0 and 1, and this value is recommended to be greater than 0.60. Bartlett's test of Sphericity tries to determine whether or not the data are from a multivariate normal distribution [24]. KMO test result of the present study was found as 0.904, and Bartlett's test was 2183.97 and p=000. According to these results, it was found that the data came from multiple normal distributions, the sample size was sufficient, and it was suitable for factor analysis.

To validate the construct validity in the Turkish adaptation of the scale, exploratory factor analysis was used to verify the adaptation of the factors. In the analysis, three subscales were obtained with an eigenvalue higher than one by using Principal Components Method and Varimax Rotation Method. It was seen that three factors explained 63.2% of the total variance change. In the scale adaptation studies, explaining 30% of the total variance was reported to be a sufficient value [25]. In this study, the factor loads were determined to change between .600 and .830. These values indicated that the scale was acceptable.

When examining the mean scores of the employees from OFER

whose validity and reliability was completed, it was determined that there were low chronic fatigue and high acute fatigue and recovery. When the literature is examined, it has been shown that employees working in shifts generally experience fatigue, which is compatible with the present study [4,7,16,17]. When OFER mean scores were compared based on age group, any difference was not determined. In the study conducted by Winwood et al., in Australia, it was found that adolescents had more fatigue and lower recovery. Similarly, in the study by Chen, the youngest group had fatigue at most. However, the studies in the literature have been conducted on healthcare professionals. Among healthcare professionals, the young ones work mostly in more exhausting and busy services such as the emergency department and intensive care. There is no such discrimination in factory workers, and every age group works in all departments of the factory [17,26]. When evaluating OFER mean scores based on gender, it was determined that men had higher scores in chronic fatigue and acute fatigue subscales compared to women. In the study by Winwood, it was shown that there was no difference in terms of gender. The difference was associated with the fact that men work overtime more at factories and work in departments requiring more muscle strength [26].

When the scores obtained from the OFER were evaluated, it was determined that acute fatigue was higher in married participants than the singles in the acute fatigue subscale. In Chen's study, it was shown that fatigue was higher in married people [17]. We think that this is may be due to the increased responsibilities of married people about home and children.

Chronic and acute fatigues of those with health problem were found to be higher in those without any health problem. In Laberge's study, acute and chronic fatigues of those with health problem were also found to be higher than those without health problem [27]. The health problem may have increased the occupational fatigue due to the negative outcomes it caused both in social and business lives.

When the employees were examined in terms of the Pittsburg Sleep Quality Index, 63.9% had poor sleep quality, and 36.1% had good sleep quality. Those who have poor sleep quality had higher chronic and acute fatigue scores and lower recovery scores compared to those with good sleep quality.

Sleep is one of the living activities that affect the quality of life and health of individuals, and it has a physiological, psychological, and social dimensions [28]. Shift work system reduces work efficiency and productivity due to its negative effects on the health of employees and the high fatigue feeling it caused [29]. Many studies have shown that shift work is associated with impaired subjective sleep quality [5,17,30]. It can also be asserted that shift work has a negative effect on the sleep pattern, and thus, the employees experience more occupational fatigue.

Conclusion

Validity and reliability testing of the Turkish version of the Occupational Fatigue Exhaustion/Recovery Scale developed initially been in English by Winwood et al., was conducted and it was found to be a valid and reliable tool in evaluating the occupational fatigue in employees working in shifts. Therefore, the scale may be recommended to be used in Turkish studies to assess occupational fatigue.

In providing workplace healthcare services, it is important to determine the occupational fatigue and plan and apply health training on this subject. Occupational fatigue making a positive effect on sleep that has an important place in life quality. The training planned to reduce fatigue of workers and enhance their sleep quality will reduce the health-related risk factors for workers and therefore make a significant contribution in preventing occupational accidents.

Competing interests
The authors declare that they have no competing interests.

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Ethical approval
Before the study, permissions were obtained from the local ethical committee.

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