

Demographic Factors and their Relation to Fatigue and Mental Disorders in 12-Hour Petrochemical Shift Workers

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ABSTRACT

Background: Shift workers may be exposed to fatigue and mental disorders due to various work-related risk factors. This study evaluated the impact of demographic characteristics on fatigue and mental disorders among 12-hour shift workers in petrochemical industries.

Methods: This study was conducted among 290 shift workers of Pardis Petrochemical Company in Iran. Data were collected using a general questionnaire for the demographic characteristic as well as multidimensional fatigue inventory (MFI-20) and general health questionnaire (GHQ-28).

Results: Married workers were less likely to suffer from reduced activity levels ($P < 0.027$), depression ($P < 0.032$) and mental disorders ($P < 0.040$). Social dysfunction score ($P < 0.029$) and mental disorders ($P < 0.048$) decreased with shift work experience. Shift workers with non-academic education less likely to suffer from reduced activity levels ($P < 0.000$) and mental fatigue ($P < 0.028$).

Conclusion: Despite the significant difference between the variables, this study showed a weak effect of individual and occupational demographic characteristics on fatigue and mental disorders.

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Introduction

The term 'shift working' refers to a job which is performed in unusual and unconventional times, and is one of the factors affecting workers' health in many workplaces and industries.^{1,2} According to International Labor Organization (ILO) statistics, shift working includes almost 25% of labors in developed countries.³ Some of the main reasons for increasing shift working rate include: 1) the demand for 24-hour vital services such as health, security, transportation

and communication services, 2) the technical need to keep industries with dynamic processes and 3) the economic reasons such as receipt of contestability.⁴ Despite the proved harmful impacts of shift working on workers' health, shift-working population is increasing.⁵ Several studies have been conducted to evaluate the factors affecting the health and wellbeing, specially, in general populations. Demographic characteristics are one of the affective factors in this area.

Shift working is associated with several health problems such as cardiovascular and gastric disorders and with decreased health status which can be related with various factors.^{3,6} In addition, shift working is one of the main reasons for work fatigue.⁷ Fatigue, as a daily experience expressed after an insufficient rest or sleep, heavy physical activity, mental work or being unmotivated for doing an activity,⁸ is one of the considerable distress symptoms.⁹ Fatigue is a common complaint which may be related to the physical, mental and emotional disorders and has a significant clinical and research importance.^{10,11} This issue requires further attention.¹² Based on WHO report, about 450 millions of people in the world are suffering from mental disorders and about half of this is in the form of anxiety and depression.¹³ The study of demographic characteristics role in fatigue and mental health would be useful to reveal the unknown aspects in different workplaces. A few studies on fatigue have used multidimensional fatigue inventory (MFI-20) questionnaire in healthy people without any mental and physical disease. For example, most of these studies have used this tool among patients population. Petrochemical industry is one of the biggest industries, which run on 24-hour basis.³ According to our last literature review, there is no reported study performed on the effects of demographic factors on fatigue and mental disorders among 12-hour shift workers of petrochemical industries using GHQ-28 and MFI-20 questionnaires.

Therefore, the current study was carried out with the purpose of exploring the impact of demographic factors (including age, height, weight, educational status, marital status, the number of children and shift working experience) of 12-hour shift workers on fatigue and mental disorders in petrochemical industry in Iran.

Materials and Methods

Design and sample

This cross-sectional descriptive-analytical study was carried out in Pardis Petrochemi-

cal Company, Iran, in 2013. Study population consisted of those male shift workers with at least one-year shift working experience, with no apparent physical and mental diseases. The entire 12-hour rotating shift workers was scheduled in the form of 7 workdays, 7 work nights and 7 days off, so that the day shift was from 7 in morning to 7 at night and night shift was from 7 at night to 7 in morning. The volunteers were from Health, Safety and Environment (HSE), operation, maintenance, engineering, office work and security departments. At overall, 290 workers declared their agreement to participate in the study, which showed a participation rate of 72.5%. A self-reporting questionnaire including 3 parts (demographic characteristic [age, height, weight, educational level, marital status, number of children and shift working experience], multidimensional fatigue inventory [MFI-20], and general health questionnaire [GHQ-28]) with additional explanations about the study purposes and completing the questionnaire was prepared and distributed among volunteers.

Instruments

Mental disorders

The 28-item General Health Questionnaire (GHQ-28) is generally used as a self-report assessment tool to evaluate the mental disorder status and psychological disorders. The GHQ-28 consists of 28 questions and four sub-scales: physical symptoms (questions 1 to 7), anxiety and insomnia (questions 8 to 14), social dysfunction (questions 15 to 21) and depression severity (questions 22 to 28). Each item scoring is based on a 4-point scale ranging from 1 (never true) to 4 (always true). Likert type response is used in order to score each item (scores from 0 to 3). The scores vary from 0 to 21 for each sub-scale and from 0 to 84 for the total GHQ-28 (which was described as mental disorders in current study). Higher scores show more severe mental disorders.¹⁴ In the present study, the Persian version of the GHQ-28 with cut-off point of 23 was used.¹⁵ Sensitivity, specificity and total mis-

classification rate of GHQ-28 were $70.5\% \pm 2.7$, $92.3\% \pm 2.4$ and $12.3\% \pm 2.4$, respectively.¹⁵

Fatigue

The instrument used for measuring fatigue is Multidimensional Fatigue Inventory (MFI-20) which is a 20-item self-report questionnaire. Five dimensions of fatigue in this tool are general fatigue, physical fatigue, reduced motivation, mental fatigue and reduced activity. Since a 5-point Likert scale is used for each item (scores ranging from 4 to 20 for each dimension), therefore the total score of fatigue ranges from 20 to 100. There are 4 items in each dimension. For two indices of fatigue, the higher scores indicate higher fatigue. However, for the contraindicative questions, the higher scores indicate lower fatigue. It is noteworthy that the capability of this tool is good to evaluate both aspects of physical and mental fatigue. Physical feeling of fatigue and cognitive functions are expressed by "Physical fatigue" and "Mental fatigue" scales, respectively. On the other hand, "Reduced activity" expression considers the effects of both mental and physical risk factors. Also any feeling which disables a person to start an activity is defined in a phrase such as "reduced motivation".^{16,17} The MFI-20 was validated by the developers and indicated good construct validity. Cronbach's alpha coefficient was shown to be 0.80 and the 5 dimensional structures were validated by confirmatory factor analyses.¹⁶ This self-reported assessment tool is the most frequently used questionnaire to measure fatigue in clinical settings in European countries.¹⁸

The Persian version of the MFI-20 was used. The internal consistency reliability of this translated version was 0.85, and the dimensions were highly correlated with the MFI composite score, with all $r > 0.70$.¹⁹

Statistical analysis

Data were analyzed using SPSS version 17 (Chicago, IL, USA). The range of all scores obtained from MFI-20 and GHQ-28 questioners were transformed into 0 to 100

domains for comparison purposes. Cronbach's Alpha was used to assess internal consistency. For all continuous variables, normality was tested by Q-Q test. T-test and one-way ANOVA were used to assess the differences in fatigue dimensions and sub-scales of GHQ-28 based on demographic variables. In addition, the Sidak test was used for multiple comparisons. The results are expressed as Mean \pm SE. The level of significance was set at $P < 0.05$.

Ethical Consideration

The ethics of this study were reviewed and approved by review board of Tabriz University of medical sciences.

Results

Table 1 indicates the demographic characteristics of the study participants. The mean age and shift work experience was 31.53 ± 0.30 years and 5.83 ± 0.17 years, respectively. The mean workers' BMI was 25.49 ± 0.20 . Most of the study participants (77%) were married and worked in the operation department of the company. More than half of the shift workers had an academic education. Table 2 demonstrates the effect of demographic characteristics on total fatigue and its sub-scales. The BMI was grouped into two categories: 18.5-24.9 as normal and 24.9-29.9 as overweight. The results showed no significant impact of mean BMI score, shift work experience and age on fatigue sub-scales. Activity level reduction was significantly lower in married workers ($P = 0.027$). Workers who had children were more active as compared to those with no children ($P = 0.045$). Shift workers with higher educational levels had more activity level decrement ($P = 0.000$) and mental fatigue ($P = 0.028$) than other groups. For the total fatigue (MFI-20) and its sub-scales, the Cronbach's alpha coefficients were obtained as follows: total fatigue: 0.89, general fatigue: 0.72; physical fatigue: 0.68; reduced activity: 0.52; reduced motivation: 0.52, which showed a good internal consistency for the MFI-20 and its sub-scales.

Table 1: Demographic characteristics of the study participants

Age	Mean ± SE	31.53 ± 0.30	
	Range (yr)	21-59	
BMI	Mean ± SE	25.49 ± 0.20	
	Mean ± SE	5.83 ± 0.17	
Shift work experience	Range (years)	1-28	
	Engineering (%)	4.13	
Job title	HSE (%)	7.24	
	Maintenance (%)	14.13	
	Office work (%)	1.37	
	Operation (%)	53.44	
	Security (%)	18.27	
	Education	Middle school (%)	4.13
		Diploma (%)	38.96
Associate (%)		16.21	
Bachelor (%)		36.21	
Marital status	Master (%)	4.48	
	Married (%)	77.24	
	Single (%)	22.76	

Table 3 shows the demographic characteristics in relation with different aspects of mental health. Age, BMI and educational level had no significant effect on mental health aspects. Single workers were more likely to suffer from depression severity ($P = 0.032$) and mental disorders ($P = 0.040$) than married workers. In addition, workers which had children were less depressed than those with no children ($P = 0.045$).

For the total (GHQ-28) and its sub-scales, the Cronbach's alpha coefficients were obtained as follows: mental disorders: 0.95, somatic symptoms: 0.88; anxiety and insomnia: 0.93; social dysfunction: 0.86; severe depression: 0.89. These coefficients showed a good internal consistency for the GHQ-28 and its sub-scales.

Table 2: Mean and Standard Error (Mean ± SE) of multidimensional fatigue among petrochemicals shift workers in association with demographic factors (One-way ANOVA, n = 290)

Variables	General Fatigue	Physical Fatigue	Reduced Activity	Reduced Motivation	Mental Fatigue	Total Fatigue
Age (yr)						
≤ 32	68.65 ± 1.48	41.51 ± 2.06	35.86 ± 1.84	29.99 ± 1.58	42.11 ± 2.05	42.06 ± 1.51
> 32	70.03 ± 1.53	43.18 ± 1.89	34.73 ± 1.75	31.69 ± 1.53	43.87 ± 1.98	43.20 ± 1.45
P-value*	0.52	0.55	0.65	0.44	0.54	0.58
BMI						
Normal weight (18.5-24.9)	69.50 ± 1.55	42.73 ± 2.10	35.50 ± 1.74	31.07 ± 1.55	42.10 ± 2.01	42.83 ± 1.49
Over weight (24.9-29.9)	69.29 ± 1.49	42.11 ± 1.86	35.02 ± 1.85	30.74 ± 1.57	43.12 ± 2.03	42.52 ± 1.48
P-value*	0.92	0.83	0.85	0.88	0.96	0.88
Marital status						
Single	70.00 ± 1.98	41.59 ± 2.07	40.43 ± 2.62	30.87 ± 2.15	45.07 ± 2.84	44.05 ± 2.09
Married	69.22 ± 1.26	42.72 ± 1.58	33.73 ± 1.44	30.91 ± 1.28	45.07 ± 2.84	42.27 ± 1.21
P-value*	0.76	0.68	0.027	0.98	0.44	0.47
Number of children						
0	70.64 ± 1.50	41.59 ± 2.07	36.87 ± 1.89	30.64 ± 1.60	44.78 ± 2.01	43.64 ± 1.49
≥ 1	68.43 ± 1.52	42.72 ± 1.58	31.97 ± 1.71	30.93 ± 1.52	41.51 ± 2.02	41.81 ± 1.48
P-value*	0.30	0.69	0.045	0.89	0.25	0.38
Education level						
Non academic education	68.64 ± 1.60	43.50 ± 1.90	29.35 ± 1.79	29.85 ± 1.61	39.45 ± 1.85	40.59 ± 1.44
Academic education	69.97 ± 1.44	41.59 ± 1.99	39.73 ± 1.69	31.70 ± 1.50	45.79 ± 2.06	44.26 ± 1.48
P-value*	0.54	0.50	0.000	0.40	0.028	0.08
Shift work experience						
< 4 years	70.16 ± 1.92	44.55 ± 2.34	33.04 ± 2.05	30.58 ± 1.81	44.95 ± 2.45	43.16 ± 1.76
4-7	69.65 ± 1.66	41.87 ± 2.25	35.50 ± 2.15	30.87 ± 1.86	41.75 ± 2.50	42.41 ± 1.69
> 7	68.38 ± 1.99	40.88 ± 2.66	37.17 ± 2.37	31.25 ± 2.06	42.58 ± 2.47	42.47 ± 2.01
P-value*	0.78	0.54	0.41	0.97	0.64	0.95

Table 3: Mean and Standard Error (Mean ± SE) of sub-scales mental disorders among petrochemicals shift workers in association with demographic factors (One-way ANOVA, n = 290)

Variables	Somatic Symptoms	Anxiety and Insomnia	Social Dysfunction	Severe Depression	Mental Disorders
Age					
≤ 32	34.64 ± 1.87	41.04 ± 2.14	43.07 ± 1.55	17.87 ± 1.69	18.24 ± 1.57
> 32	35.77 ± 1.77	43.13 ± 1.94	42.94 ± 1.46	18.46 ± 1.70	18.90 ± 1.51
P-value*	0.66	0.47	0.95	0.81	0.67
BMI					
Normal weight (18.5-24.9)	35.05 ± 1.90	41.34 ± 2.13	42.08 ± 1.50	19.93 ± 1.71	34.10 ± 1.57
Over weight (24.9-29.9)	35.44 ± 1.75	42.95 ± 1.95	43.88 ± 1.50	18.44 ± 1.71	35.17 ± 1.51
P-value*	0.88	0.58	0.40	0.83	0.62
Marital status					
Single	38.82 ± 2.68	38.82 ± 2.68	46.97 ± 2.95	46.39 ± 2.39	38.78 ± 2.29
Married	42.47 ± 1.65	34.20 ± 1.46	40.75 ± 1.64	42.01 ± 1.18	33.44 ± 1.23
P-value*	0.13	0.071	0.084	0.032	0.040
Number of children					
0	36.66 ± 1.92	44.36 ± 2.18	45.04 ± 1.68	20.87 ± 1.91	36.73 ± 1.66
≥ 1	34.25 ± 1.72	40.57 ± 1.90	41.33 ± 1.35	16.02 ± 1.51	33.04 ± 1.43
P-value*	0.350	0.19	0.083	0.045	0.09
Education level					
Non academic education	36.76 ± 2.00	41.48 ± 2.24	40.88 ± 1.53	18.44 ± 1.84	34.39 ± 1.67
Academic education	34.11 ± 1.68	42.68 ± 1.88	44.62 ± 1.45	18.01 ± 1.60	34.85 ± 1.44
P-value*	0.31	0.68	0.08	0.86	0.83
Shift work experience					
< 4 years	38.85 ± 2.23	44.73 ± 2.70	45.85 ± 2.02	19.55 ± 2.01	37.24 ± 2.00
4-7	35.00 ± 2.10	43.67 ± 2.28	44.05 ± 1.68	20.43 ± 2.23	35.78 ± 1.78
> 7	31.99 ± 2.32	38.09 ± 2.49	39.14 ± 1.78	14.53 ± 1.86	30.94 ± 1.85
P-value*	0.09	0.13	0.029	0.09	0.048

Discussion

The current study aimed to assess the impact of demographic characteristics of 12-hour shift workers in a petrochemical company on fatigue and mental disorders. The main findings showed that, except some cases, there was no meaningful effect in this respect.

Age

Many studies result in an ambiguous and conflicting relationship between age and fatigue. While some of these studies have shown a significant positive relationship between fatigue and age,^{18,20} others have failed to show any significant relationship in this respect.²¹ Although one study has demonstrated a lower fatigue level in old people,²² the results of the current study showed no significant effect of age on fatigue. A possible explanation for these conflicting findings

is the use of one-dimensional tools for fatigue assessment in most previous studies,²³ while fatigue is a multidimensional concept and consists of other components such as physical and mental aspects.²⁴ In addition to differences in methods and tools used for fatigue assessment, other aspects of fatigue may also influence this ambiguity. The results of the present also do not support the findings of other studies, which have used MFI-20 tool for fatigue assessment. For example, a study on anesthesiologists demonstrated that there is no significant relationship between age and fatigue.²⁵ A Study on Colombian population showed a linear increase between age and fatigue.¹⁸ Another study conducted on healthy people of Denmark without any chronic disease reported a linear decrease in general and mental fatigue with age, whereas activity level decrement

was not linear and physical fatigue was extremely consistent with a very gentle slope.²³

Conflicts in the findings may also be impressed by cultural circumstances, racial-ethnic differences and understudy community properties (such as job and gender). A study conducted among general population in Iran using GHQ-28 questionnaire showed an increased risk of mental disorders with age,¹² which is not in line with our findings.

Body Mass Index (BMI)

Unfortunately, there are only a few studies on the effects of BMI's on fatigue and mental disorders among healthy people. Although higher BMI values seems to result in reduced activity and early physical fatigue, no significant impact of BMI was seen on fatigue and mental disorders aspects in this study. A survey among American older adults showed that women with higher BMI were more likely to suffer from fatigue than men.²⁶ Moreover, no significant difference was found between BMI groups (normal weight, overweight and obese) in males,²⁶ which is consistent with the findings of the current study. Another study reported a correlation between BMI and mental health with factors such as gender, age, mental disorders type and their severity.²⁷

Marital status and number of children

The research among Japanese workers show that singles experienced higher fatigue than married ones.²⁸ The results of this study, however, showed significant differences only in activity level reduction. In a study on working population showed that having children had no effect on fatigue levels,²⁹ which contradicts the findings of this study. In other word, having children had a positive effect on reduced activity. Current study showed that the workers who are parents are less suffering from reduced activity levels. This may be attributed to their endeavor to provide welfare to their families.

Some investigations conducted in Iran have shown a higher risk of mental disorders in married people compared to singles,¹² which is not in line with our findings. In addition, marriage is an important factor for

maintaining mental health.³⁰ In this study, married and those who had children had a lower level of depression than other groups. Since about 77% of shift-workers in this study were married and they were permitted to go home once a week in the month, it may have been a major motivation to tolerate the hardships of the work. Besides, matrimony is highly regarded in Iran, and therefore this can reduce depression, mental disorders and increase life expectancy.

Educational level and shift work experience

There is evidence that high educational and social level can results in less fatigue.³¹ However, there are also studies that have shown not such an association.³² The results of the present study showed that mental fatigue and reduced activity increased with educational level. It is worth mentioning that 55% of our study population worked in technical-engineering, operation and official sections, which have uneventful, steady and stationary duties. These conditions of work may have been resulted in reduced activity.

It is likely that mental fatigue results from long 12-hour and uneventful working shifts. Current study did not found a significant effect of shift working experience on fatigue aspects. A study among Iranian population showed a decrement in mental disorders by promotion in educational levels,¹² which do not supports the findings of the current study. In the current study, longer shift work experience caused a significant reduction in mental disorders and social dysfunction. A possible explanation may be that the circadian rhythm will catch a fair adaptation with rotation shift by longer shift work experience, and therefore this may lead to decreased mental disorders.

Limitations of this study such as sample size and self-report subjective assessments should be considered. Additional research in large shift working groups and some objective assessments should be carried out to well evaluate and corroborate the findings of this study.

Conclusion

In general, a weak effect of demographic characteristics was found on fatigue and mental disorders. The results showed the maximum impression of demographic characteristics in reduced activity among 12-hour shift workers. In addition to the tools and methods used in the study, some factors such as sample community, cultural status and racial-ethnic differences can also affect the unknown aspects of fatigue and mental disorders, and therefore this can result in the ambiguity and contradictory findings. The findings confirm that MFI-20 questionnaire is an instrument, which the researchers can rely on, to assess fatigue in industrial workers. It is therefore recommended that MFI-20 questionnaire, which has been mainly used for patient groups so far, should be used in other industrial and occupational groups, particularly for shift workers.

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Competing interests

The authors declare that there is no conflict of interest.

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