

ORIGINAL ARTICLE

Analysis of the Interrelations among Shift Work, Job Stress, Job Satisfaction and Health: a Petrochemical Complex Case Study

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ABSTRACT

This study was aimed to investigate the interrelations among shift work, job stress, job satisfaction, and health at Shazand Petrochemical Company in Iran. The current research was carried out in two phases. The influencing and influenced variables and specified their priorities as per level of influence were identified in the first phase. An integrated Fuzzy-DEMATEL method was applied to analyze this study. A multiple regression method was used to determine the significance of the variables in the second phase. The results of this study indicated that the shift work was the most effective variable in health. Whereas, job satisfaction and job stress were in the second and third places, respectively. The multiple regression analysis was confirmed that the results of the fuzzy-DEMATEL regarding shift work, job stress, and job satisfaction significantly affect employees' health. It can be concluded that shift working, where night shifts included, would have negative impact on health. This finding emphasized the importance of shift work as a major challenge in industrial workplaces.

KEYWORDS: *Shift Work, Job Stress, Job Satisfaction, Health.*

INTRODUCTION

Nowadays, in the industrial world, many job-related threats have challenged the health of the workforce such as shift work. According to Wickwire et al. findings [1], shift work was a time period outside the working hours from 6 am to 7 pm. Shift workers, compared to non-shift workers, encounter with the consequences of insomnia, low sleep quality, and daily sleepiness [2]. Furthermore, different studies revealed

that working in rotational shifts, specifically in night shifts, may increase the risk of chronic diseases such as type 2 diabetes and cardiovascular problems [3-4].

Hoboubi et al. [5] stated that job stress occurs when there is no consistency between job requirements and the worker's competence. Troesch and Bauer [6] in a study found that this inconsistency would have negative consequences on individuals' health as well as the performance of organizations. Guo et al. [7] also expressed that if individuals act passively when confront such stresses, more negative

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effects such as exhaustion, low job satisfaction, conflict, violence, etc. would be revealed.

The results of the previous studies regarding relationships between job satisfaction and health assessment indicated that the job satisfaction associated with overall happiness, mental health, and a longer life expectancy. Job satisfaction is an individual's basic condition for their presence and cooperation with their organization. This important factor significantly affect job satisfaction on both individual and organizational productivity, the level of individuals' commitment to the organization, their physical and mental health, etc. [8-5-9].

The results of some studies showed that the relationship between shift work and job satisfaction were not definitive and they were sometimes contradictory, e.g. Sveinsdóttir concluded that on 348 shift work nurses stated that there was no significant relationship between shift work and job satisfaction [10]. On the contrary, Conway et al. [11] claimed that shift work decreases hospital workers' job dissatisfaction in Italy. Similarly, Gerber et al. found that shift work may increase job discontent among Swiss police officers [12].

The current study was aimed to investigate the interrelations among shift work, job stress, job satisfaction, and employees' health at Shazand Petrochemical Company located in Iran. This research's methodology may provide developed health and safety strategies for managers. The methodology, results, and findings of this study were explained in the second, third, and fourth section, respectively.

METHODS

This descriptive-analytical study was carried out at Shazand Petrochemical plant located in Arak, this area well known as "Industrial Capital of Iran". Shazand Petrochemical Company is active in producing different petrochemical products such as polyethylene, propylene, etc.

This study was aimed to investigate the interrelations among shift work, job stress, job satisfaction, and the employees' health at Shazand Petrochemical Company and was conducted in two following phases:

Phase I: Fuzzy-DEMATEL analysis:

The purposive sampling method, as the first step of phase I, was used to select 25 ergonomists and occupational health experts. Whenever a limited number of individuals have the specific information required the purposive sampling could be applied. In this research, the participants were selected among experts with at least four years of relevant work experience and were directly concerned with the ergonomic and occupational health-related activities at Shazand Petrochemical Company. The variables of this study (i.e. shift work, job stress, job satisfaction, and health) were defined to them.

In the second step of phase I, a 4×4 questionnaire matrix was designed to determine the level of the variables influencing one other on a basis of a pair-wise comparison and considering a 5-points qualitative scale (no effect, very low effect, low effect, high effect, and very high effect).

In the next step, the 25 experts were asked to complete the matrix based on the 5-points qualitative scale. The qualitative values were then converted to quantitative values using Triangular Fuzzy Numbers (TFN) [13]. In this method, each qualitative value was represented by a triangular fuzzy number (m, α, β) , where m is the mean, α and β are the left and right tolerances, respectively. In this case, the fuzzy equivalents for each of the above qualitative values were determined as follows: no effect (0, 0, 0.2), very low effect (0.25, 0.15, 0.15), low effect (0.5, 0.15, 0.15), high effect (0.75, 0.15, 0.15), and very high effect (1, 0.2, 0). The above fuzzy equivalents were defuzzified and converted to the final quantitative values using Equation 1.

$$\mu_T(x) = \frac{m + \beta}{2(1 + \beta)} + \frac{m}{2(1 + \alpha)} \quad (1)$$

In the fourth and final step of phase I, DEMATEL technique [14] was applied to analyze the interrelations among the variables. MATLAB (version 2017) software tool were also used to confirm the results. The following activities were conducted to complete this step:

Firstly, the direct-relation matrix formation: The mean of the 25 matrices from the previous step was calculated to form a consolidated matrix, hereinafter called the average matrix.

Secondly, the direct-relation matrix normalization: Normalization coefficient is equal to the maximum of the sum of the rows and of the sum of the columns of the average matrix. The normalization step was performed through multiplying the direct-relation matrix by the normalization coefficient inversely.

Thirdly, the total-relation matrix formation: unlimited sequence series of direct and indirect variables' effects on each other as a geometric progression were calculated.

Finally, Obtaining the casual diagram: The sum of each row (D) in the matrix represents the level of the impact on each variable has on other variables. The sum of each column (R) indicates the level of the influence received by each variable. Therefore, the $R+D$ value for each variable shows the level of its interrelations with other variables and is the horizontal axis of the casual graph. Also, the positive $R-D$ value for each variable implies that the variable is an influential variable while the negative $R-D$ value indicates a reverse result. The $R-D$ value is the vertical axis of the diagram. Calculating these values for all variables specifies their priorities in terms of how much they influence other variables or are influenced by them.

Phase II: Multiple regression analysis:

The influencing and influenced variables as well as the interrelations among them were determined in the first phase. In phase II, the effects of the influencing variables were further investigated.

The statistical population of phase II were included 2176 employees working in rotational shifts including night shifts for at least three years. The Cochran's sample size equation (Equation 2) and the random sampling method statistical were used and consequently, 327 individuals were selected. Based on Equation 2, N represent the size of the population (2176 employees). For p and q , the maximum value of 0.5 was used. At 90% confidence level, d is equal to 0.05 and Z^2 is equal to 3.842; therefore, the sample size (n), was calculated as 327.

$$n = \frac{\frac{z^2}{d^2}}{1 + \frac{1}{N} \left(\frac{z^2 pq}{d^2} - 1 \right)}$$

(2)

In the second step of phase II, standardized questionnaires were applied to collect the data required on the research variables. Survey of shift workers (SOS) questionnaire developed by the shiftwork Research team [15], MRC/ESRC social and applied psychology unit at University of Sheffield (UK), was used to study the shift work variable. It should be noted that the SOS questionnaire was slightly modified as per opinions and comments of Shazand's occupational health experts requested to adjust the questions for the purpose of this study. The variable of job stress was measured through the Generic job stress questionnaire proposed by the National Institute for Occupational Safety and Health (NIOSH, U.S.). The Job Descriptive Index (JDI) which is the most valid and widely-used questionnaire for job satisfaction was applied to measure the third variable. The 1987 version of the JDI developed by Smith et al. was used in this study which includes 72 questions. Finally, the health variable was estimated using Goldberg's General Health Questionnaire (GHQ-28)[16].

The next step was to test the validity and reliability of the above-mentioned questionnaires. The content validity of the questionnaires were verified according to the confirmation by 30 ergonomists and occupational health experts at Shazand Company. The Cronbach's alpha test was also used to measure the reliability of the questionnaires. The obtained values of Cronbach's alpha for the four questionnaires were more than 0.7, indicating that the data collection tools had an acceptable reliability.

In the fourth step of phase II, the questionnaires were distributed among the study sample (327 employees). In this regard, the employees were briefed about the questions and how they should be answered.

In the fifth and final step of phase II, the multiple regression technique and SPSS version 21.0 were employed to analyze the data and to investigate the effects of the independent variables on the dependent variable.

RESULTS

As mentioned in section 2.1., the Fuzzy-DEMATEL analysis was carried out to investigate the interrelations among the study variables and to prioritize them in terms of how much they influenced other variables or were influenced by them.

The results of the analysis have been presented in Table 1. The causal diagram of the variables interrelations also has been shown Figure 1.

Considering the *R-D* values in Table 1, work shift, job stress, and job satisfaction were identified as the influencing variables due to their positive values of 0.8, 0.3, and 0.4, respectively. The negative *R-D* value for health (-1.5) indicates that this variable was influenced by the other variables.

The priorities of the influencing variables considering the *R+D* and *R-D* values together have been presented in Figure 1. As per the diagram, shift work was received the first priority. Job satisfaction and job stress were ranked at the second and third places, respectively. This implies that shift work as the most influencing variable affected the health of the employees directly as well as indirectly through affecting job satisfaction and job stress, which also influenced the health of the personnel.

The results of the multiple regression analysis were conducted to assess the effects of the independent

variables on the dependent variable, and have been shown in Table 2. The regression results confirmed that the regression function is significant while the *F*-statistics is equal to 137.85 at the significant level of 95%.

As per the *P* values in Table 2, all three independent variables (shift work, job stress and job satisfaction) had significant impacts on health as the dependent variable ($P \leq 0.05$). Also, with regards to the β values, shift work, and job stress had the highest and the lowest effects on health, respectively. The negative β value indicates that the independent variable had a negative effect on health, e.g. job stress had a negative value for β implying the negative effect of job stress on health (i.e., the higher the stress level, the poorer the health), while the positive β value for job satisfaction infers that the higher the satisfaction level, the better the health.

The multiple regression analysis confirmed the results of the fuzzy-DEMATEL for independent variables of shift work, job stress, and job satisfaction significantly influenced the health of the employees. Shift work was also confirmed as the most influencing variables, and job satisfaction and job stress were placed in the second and third places, respectively.

Table 1. The results of the interrelations among variables

Variables	D	R	R+D	R-D
Work shift	7.97	7.12	15.09	0.84
Job stress	9.32	9.05	18.37	0.27
Job satisfaction	9.19	8.79	17.98	0.4
Health	8.39	9.91	19.72	-1.52

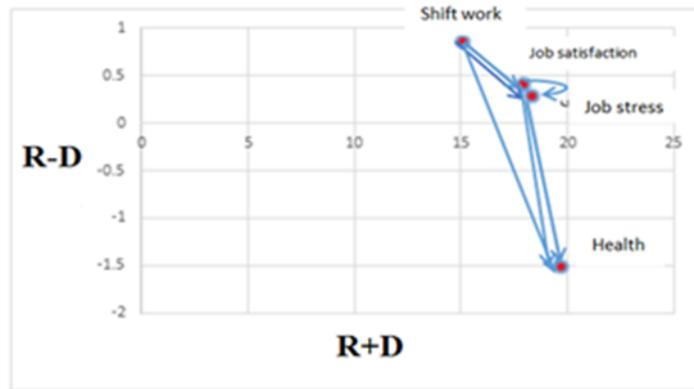


Fig. 1. Causal diagrams of the variables interrelations

Table 2. The results of the independent variables impact on the dependent variable

	Unstandardized coefficient		Standardized coefficient	t	P
	B	Standard error	Beta (β)		
Constant	1.732	0.105		16.501	0.0001
Shift work	-0.567	0.035	-0.75	16.27	0.0001
Job stress	-0.114	0.056	-0.139	2.052	0.041
Job satisfaction	0.148	0.052	0.193	2.858	0.005

95% significant level

DISCUSSION AND CONCLUSION

The present study was carried out to investigate the interrelations among shift work, job stress, job satisfaction, and employees' health at Shazand Petrochemical Company in Iran. The study was carried out in two phases: phase I identified the

influencing and influenced variables and specified their priorities as per their level of influence. This was performed using an integrated Fuzzy-DEMATEL analysis. Phase II studied the significance of the variables effects applying the multiple regression method.

The results of both phases confirmed that shift work was the most affective variable regarding

employees' health. Job satisfaction and job stress were identified as the second and third influencing variables, respectively. The interrelations analysis indicated that shift work affected the health of the employees directly as well as indirectly through affecting job satisfaction and job stress, which also influenced the health of the personnel. Such findings emphasize the importance of shift work as a major challenge in industrial workplaces and are in line with the findings of Deng et al. [2], Hulsegge et al. [3], and Proper et al. [4] all confirming that shift working had negative effects on the health of the employees in working environments.

It was stated by Conway et al. [11] that shift work was associated with poor sleep, while shift work decreases hospital workers' job dissatisfaction in Italy. According to the results of the above study, shift work increased job satisfaction in hospital workers. This is not in line with the findings of the present study and might be due to the differences in the sample populations of the two studies and also different job nature of hospital staff and workers in a petrochemical plant. On the contrary, according to Gerber et al. [12], shift work increased job discontent in Swiss police officers, which confirms the results of the present study. The study of Gerber et al. [12] also stated that shift work increased social stress and sleep disorders in the police officers. A research on 348 shift work nurses claimed that there were no significant relationships between shift work and job satisfaction [10].

In the study of Ma et al. [16], it was presented that non-day shift workers may be exposed to more stress. This also confirms the findings of the present study in terms of the effect of shift work on job stress.

This can be concluded that shift working, where night shifts included, would have negative consequences for the health of the employees. Also, shift working increases the stress level, which itself negatively affects the health. In terms of the shift work influence on job satisfaction, the findings of the studies are sometimes contradictory as other factors such as the nature of the job, the employees' characteristics, etc. might differentiate the results. Regardless of the positive or negative effect of shift work on job satisfaction, this study confirmed that job satisfaction positively affect the health of the workers.

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CONFLICT OF INTEREST

There is no conflict of interest for any of the authors.

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