Original Article

Workload and Quality of Working Life in Shift and Nonshift Workers of a Water and Wastewater Contracting Company in 2018

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Abstract

Background: Workload is one of the most important factors leading to the occurrence of work-related injuries that can have impacts on quality of working life (QoWL). Therefore, the purpose of this study was to compare workload and QoWL in shift and nonshift workers of a water and wastewater contracting company. **Materials and Methods:** In this cross-sectional study, workload and QoWL for all workers of a water and wastewater contracting company were investigated. Fifty-one shift workers and 38 daytime workers completed NASA Task Load Index (TLX) as well as QoWL Scale by Van Laar *et al*. The data were analyzed by R software. **Results:** The results showed that physical demands of NASA-TLX in shift workers were higher than those in daytime ones. Among the dimensions of QoWL Scale, only the difference between the average scores for home–work interface was significant in a way that the conditions for the group of shift workers were more favorable. **Conclusions:** The results of this study showed that the volume of work and the quality of work in shift and nonshift workers are not significantly different and One reason is that the shift group had 12 hours more work and 24 hours more rest. The correlation between the dimensions of workload and QoWL demonstrated that increased workload would lead to a decline in QoWL.

Keywords: Quality of life, shift work, workload

Introduction

One of the cases proposed as a risk factor for the health status of employees is shift work.[1,2] Although in the past, work shift was kind of work schedule involving a few workers, it is now considered as a common work schedule that can adversely affect the quality of human life; therefore, in recent years, lots of studies have been conducted about its effects on health status.[3] According to a report released in 2001, about one-fifth of the world's labor force was doing shift work.[3] In addition to having impacts on mental health status of workers, shift work similarly leads to disorders in circadian cycle as well as gastrointestinal and sleep ones. The 24-h working systems are kinds of work shifts that can be observed among workers in Iran and in many other countries including Japan.[4]

Among the other important factors, shaping health status of employees is workload. From an ergonomics perspective, the most important factor affecting the occurrence of work-related injuries and accidents is lack of proportionality between workload and abilities and limitations of individuals.[5] Studies have shown that shift work especially that with high workload and a rise in working hours to more than 24 h have a significant impact on the performance of employees such as nurses.[6] A number of methods have been also developed to measure workload. The NASA Task Load Index (NASA-TLX)

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is one of the well-known tools for the evaluation of workload on an individual basis which has been extensively taken into consideration in studies related to the performance and efficiency of individuals.[7] NASA-TLX is a multidimensional approach that provides a total rating of workload based on the weighted averages of the six subscales of mental demand, physical demand, temporal demand, performance, frustration, and effort.[8,9]

Another important issue that can be affected by individuals' occupation is the quality of their life. In a definition provided by Armstrong, quality of working life (QoWL) means the satisfaction of employees in an organization with meeting their needs through resources, activities, and results that are obtained from involvement in the workplace.

In the definition proposed by Van Laar *et al.*, QoWL includes job and career satisfaction (JCS), working conditions (WCS), general well-being (GWB), home–work interface (HWI), stress at work (SAW), and control at work (CAW).[10,11]

Several investigations have also indicated that increased workload could reduce the quality of life.[12-16]

One of the occupations with a shift work system is working in contracting companies such as water and wastewater ones. In such companies, individuals are working in various shifts including morning, evening, and night shifts as well as 24-h ones. So far, no study has been undertaken on QoWL for 24-h shift workers and its relationship with workload. Moreover, it seems that the comparison of daytime workers and 24-h shift workers in terms of the dimensions of QoWL and workload can be interesting. Thus, this study was to compare the dimensions of workload and QoWL in daytime workers and shift ones in one of the water and wastewater contracting companies in Tehran in Iran in order to identify the differences or lack of differences between both groups.

Materials and Methods

Study sample

This cross-sectional study was conducted in 2018 on workers of a water and wastewater contracting company in Tehran, Iran. The samples were entered into the study by census. The total population of the workers in the company included 100 individuals who were all men and 89 workers out of them met the inclusion criteria for the present study. First, informed consent was obtained from the individuals, and then, a briefing session was held with the presence of members of the research community. After that, the questionnaires were provided to the individuals and their completion was monitored. The questionnaires were distributed among these individuals including 51 cases related to shift workers and 38 ones associated with daytime workers. The working hours of daytime workers were from 8 a.m. to 4 p.m. and for 6 working days per week. In contrast, shift workers had working hours comprising 24-h work and 48-h rest. The inclusion criteria for this study were determined as no history of diseases including cardiovascular, gastrointestinal, skeletal, muscular, and respiratory disorders as well as migraines, panic attacks, sleep disorders, and psychiatric disorders genetically or before involvement in the current job or due to accidents. Having no second job concurrently was also considered as an inclusion criterion in this study.

Study tools

Tools used in this study included a demographic questionnaire, NASA-TLX, and QoWL Scale by Van Laar *et al*.

NASA Task Load Index

NASA-TLX is a multidimensional scale that was developed by Hart and Staveland in 1988.[17] This inventory has six subscales that measure theses dimensions, respectively: mental demands, physical demands, temporal demands, performance, frustration, and effort.[8] Studies Rubio *et al*. have confirmed the reliability and validity of this index for the workload evaluation.[18] Each subscale is characterized by a line and a dipole (high/low) with numbers ranging from 0 to 100 expressed in both ends of the line. The method for overall workload calculation is adaptive weighted workload (AWWL) method which has simpler scoring processes and its reliability has been approved by Miyake and Kumashiro.[19,20]

Quality of Working Life Scale by van Laar *et al*.

This questionnaire is composed of 24 items that are set through a five-point Likert-type scale ranging from totally disagree, disagree, neutral, agree, and totally disagree. These items assess 6 areas including JCS, WCS, GWB, HWI, SAW, and CAW, and item 24 separately evaluates satisfaction with QoWL.[11] The questionnaire was also reviewed by Rahimi, and at the end of this study, its reliability was reported to be 0.85.[21]

Statistical analysis

After collecting the questionnaires, the data were analyzed by R software and using descriptive and analytical methods, and first, Kolmogorov–Smirnov test confirmed the normality of the data. Pearson and one-way analysis of variance (ANOVA) tests were used to analyze the data.

Results

The mean age of participants in the study was 35.6 (8.74) years. In addition, the minimum and maximum age of these individuals was 22 and 61 years, respectively. In the group of daytime workers, the average age of the participants was 36.31 years and that was 35.07 among shift workers. The education level of the participants is shown in Table 1.

In terms of work experience in the shift work system, 12 individuals out of the daytime workers had experience in this respect and their mean work experience in this system was equal to 3.41 years. The mean work experience of shift workers in this system was 7.61 years. Figure 1 shows the mean and standard deviation scores of NASA-TLX in both groups of daytime workers and shift workers.

Table 1: Education level of the study participants

Level of education	Under diploma	Diploma	Associate degree	License	Master of science and higher
Percentage	28.1	25.8	14.6	25.8	5.6

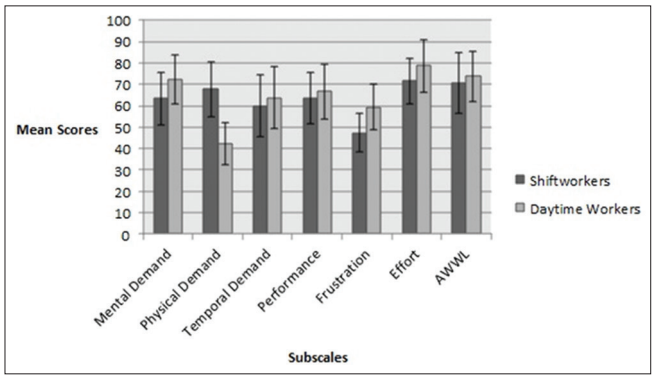

Figure 1: NASA-Task Load Index mean scores in shift workers and daytime workers. Error bars represent standard deviation of means

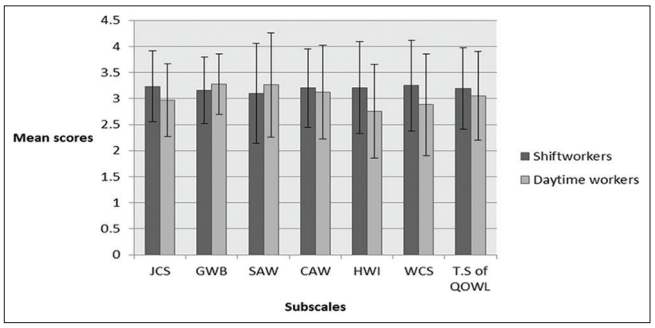

Figure 2: Quality of working life mean scores in shift workers and daytime workers. Error bars represent standard deviation of means

The highest mean score in each of the two study groups was associated with the scores for effort that was 78.68 and 71.56 for shift workers and daytime ones, respectively. Among the subscales of NASA-TLX, only the mean scores of the subscale of physical demands in shift workers were higher than those in daytime workers and such a difference was statistically significant ($P = 0.000$). In terms of the subscales of mental demands, temporal demands, performance, frustration, and effort, the mean scores in daytime workers were lower than those obtained by daytime workers. It is noteworthy that no statistically significant difference was observed between both groups in these subscales although the difference between the two groups showed obvious differences in subscales such as frustration ($P = 0.076$) and mental demands ($P = 0.07$). It is also notable that the total score for AWWL showed no significant difference between both groups in this study.

Figure 2 illustrates the means and standard deviations of dimensions of QoWL Scale by van Laar *et al*. in both groups of shift workers and daytime workers.

Of these dimensions, only the difference in HWI was statistically significant. In other dimensions as well as the total score for QoWL, no significant differences were found between the scores of both shift workers and daytime ones. Among the dimensions examined, only GWB and SAW among daytime workers had favorable conditions which had no statistically significant difference with those in shift workers.

Another analysis on the relationship between age and dimensions of workload and QoWL using the Pearson correlation coefficient showed that the age of individuals was only significantly associated with level of performance ($P = 0.027$, $r = 0.435$) and WCS ($P = 0.027$, $r = -0.44$).

In addition, one-way ANOVA test was used in this study to investigate differences in the dimensions of workload and QoWL in individuals with different levels of education. Accordingly, only the values for the subscales of physical demands and mental demands out of the dimensions of workload between individuals with various levels of education were significantly different ($P = 0.008$, df = 4, $F = 3.67$), and the highest level of physical and mental demands was observed among individuals with an education level of under diploma with the mean score equal to 72.4.

Table 2 shows the results of investigating the correlation between NASA-TLX and QoWL using the Pearson correlation coefficient in the participants in the present study. It should be noted that only those values were listed in this table whose correlation coefficient between them was statistically significant ($P < 0.05$).

The remarkable point about Table 2 was that most of the dimensions had a significant relationship with each other despite the low number of correlation coefficients. In addition, a secondary analysis was conducted based on the correlation between work experience in shift work system and the dimensions of workload and QoWL using the Pearson correlation coefficient. The results showed that work experience in shift work system had no significant relationship with the dimensions of workload; however, such relationships were significant in terms of JCS, GWB, CAW, WCS, and total score for QoWL ($P < 0.05$). All these relationships were reversed, and the highest correlation coefficient was associated with the relationship between the work experience in shift work system and WCS with a correlation coefficient equal to −0.4.

Discussion

Analysis of the scores for NASA-TLX in this study showed that the score for the subscale of effort was greater compared to other workload subscales which was in agreement with the results of investigations by Sarsangi *et al*. and Zheng *et al*. on health service personnel.[22,23] Besides, a review of the results of NASA-TLX in both groups of shift workers

Table 2: Pearson correlation coefficient values (P<0.05) between NASA-Task Load Index and quality of working life in the study participants

Subscales	r	Subscales	r	Subscales	r	Subscales	r
Frustration, SAW	−0.24	Performance, QOWL	−0.22	Temporal demand, frustration	0.34	Mental demand; temporal demand	0.34
Frustration, CAW	−0.4	Frustration, effort	0.28	Temporal demand, effort	0.42	Mental demand, performance	0.27
Frustration, HWI	−0.47	Frustration, JCS	−0.34	Performance, effort	0.43	Mental demand, effort	0.24
Frustration, WCS	−0.42	Frustration, GWB	−0.37	Performance, GWB	−0.31	Physical demand, temporal demand	0.36
AWWL, HWI	−0.24	Effort, WCS	−0.25	AWWL, WCS	−0.27	Frustration, total score of QOWL	−0.43
JCS, WCS	0.75	JCS, HWI	0.75	JCS, CAW	0.7	JCS, GWB	0.66
SAW, HWI	0.47	GWB, WCS	0.58	GWB, HWI	0.61	GWB, CAW	0.59
Frustration, SAW	−0.24	SAW, AWWL	−0.22	SAW, JCS	0.26	SAW, WCS	0.43
HWI, WCS	0.8	CAW, WCS	0.57	CAW, HWI	0.58		

JCS: Job and career satisfaction, WCS: Working conditions, GWB: General well-being, HWI: Home-work interface, SAW: Stress at work, CAW: Control at work, AWWL: Adaptive weighted workload

and daytime workers indicated that the level of physical demands in shift workers was significantly higher than that in daytime workers and this difference was also statistically significant. It was concluded that shift workers in this study were under more pressure in terms of physical dimensions because of working in 24-h shifts and no sleep during their shift work and it was likely that factors such as frustration have led to the high extent of physical demands felt by such individuals that was far higher than those in daytime workers with 8-h shifts as well as more enough sleep and rest processes. Although the difference between the values of other subscales of NASA-TLX between the two groups was not statistically significant, it was remarkable that such subscales had higher values in daytime workers, but they had more favorable conditions in shift workers. The results of the study by Sarsangi *et al*. also revealed a significant correlation between the dimension of effort and the total score for mental workload and shift work.[22]

The highest score and the most favorable conditions were related to the dimension of GWB for daytime workers and WCS for shift workers out of the subscales of the QoWL. Nevertheless, in the study by Arab, GWB obtained the highest mean score out of the different domains of quality of life.[24] The results of a study by Zakerian *et al*. also concluded that JCS and WCS had acquired the highest and the lowest mean scores among the different domains of QoWL.[10] In this study, the bulk of participants stated that the shifts had been chosen consciously and they preferred the conditions of 24-h work shifts and 48-h rest to 8-h daily work. However, daytime workers selected the dimension of GWB as the most favorable dimension out of the dimensions of QoWL due to their appropriate work-rest cycle. It is noteworthy that in the majority of the dimensions of QoWL, shift workers had more favorable WCS compared to daytime workers. In this respect, these results were similar to those in the study by Kaliterna *et al*. in their study on shift and nonshift workers, which found that shift workers reported requirements for more physical efforts to get the jobs done; however, they had no differences with nonshift workers in terms of life satisfaction and overall QoWL.[25]

In addition, as shown in Table 2, the results of correlation showed that the majority of dimensions of NASA-TLX had a significant relationship with each other which was consistent with the findings of other studies.[22,26] There was also a significant relationship between many dimensions of NASA-TLX and QoWL. The strongest correlation between the dimensions of NASA-TLX and QoWL was a correlation between levels of frustration at HWI with a Pearson correlation coefficient equal to − 0.47. It is worth mentioning that all the significant relationships between the dimensions of NASA-TLX and QoWL were reversed. These findings were consistent with the results of a number of other studies.[4] Besides, numerous studies showed an inverse correlation between workload, QoWL, and domains of quality of life in workers.[13,27-29] In all of these studies, it was clearly stated that workers reported decreased quality of life and QoWL as their workload increased.

Conclusions

The results of this study showed that the volume of work and the quality of work in shift and nonshift workers are not significantly different. In some ways, the conditions of shift workers were even more favorable, and most of these people consciously chose shift work and were satisfied with their WCS because they had more free time in the study community. Similarly, the significant and inverse correlation of many dimensions of NASA-TLX and QoWL indicated that increased workload led to a fall in QoWL in workers in the present study. Therefore, it seems that further studies on individuals with 24-h work shifts and 48-h rest are necessary. Checking the health status of workers in contracting companies such as water and wastewater contracting company from different perspectives can be also used for future research studies. It was also suggested to study individuals of different age groups as well as women in forthcoming studies. Likewise, workload and QoWL in daytime and shift workers should be evaluated under different circumstances and through other research instruments. Furthermore, the comparison of the effect of very high mental workload and very low mental workload (such as

vigilance in control rooms) on QoWL in individuals can be also considered for future research studies.

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Conflicts of interest

There are no conflicts of interest.

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