The relationship between mental workload and general health among welders of Tehran Heavy Structures Metal Company

Sajad Zare[1], Naser Hasheminejad[1], Tania Dehesh[2], Davood Hasanvand[*,3], Reza Kazemi[4], Saeid Ahmadi[5]

[1]Department of Occupational Health, School of Public Health, Kerman University of Medical Sciences, Kerman, Iran
[2]Department of Epidemiology and Biostatistics, School of Public Health, Kerman University of Medical Sciences, Kerman, Iran
[3]Student research committee, Kerman University of Medical Sciences, Kerman, Iran
[4]Department of Ergonomics, School of Public Health, Shiraz University of Medical Sciences, Shiraz, Iran
[5]Department of Occupational Health, School of Public Health, Qazvin University of Medical Sciences, Qazvin, Iran

[*]Corresponding author: email address: dhdavood20@gmail.com (D. Hasanvand)

ABSTRACT

Mental workload is one of the factors that influence individuals' performance in the work environment as well as their efficiency and productivity. The present study aimed at examining the association between mental workload and general health among welders of Tehran Heavy Structuress Metal Company.This cross-sectional study was conducted in 2016. The sample included 100 welders who were working in Tehran Heavy Structures Metal Company. Sampling was done through conducting a census. A demographic questionnaire, General Health Questionnaire-28 (GHQ-28), and National Aeronautics and Space Administration Task Load Index (NASA-TLX) mental workload questionnaire were used to collect data. The obtained data were fed into SPSS (version 22) and analyzed through Chi-square, one-way ANOVA, Kruscal Wallis Test, Pearson product moment correlation, and Mann-Whitney U Test.The results showed that the participating welders had an average age of 36.16 ± 7.81, an average work experience of 9.65 ± 5.83, and a BMI of 25.95 ± 3.39 kg/m^2. The mean and standard deviation of the overall score of welders' mental workload were 65.88 ± 21.15. The cut-off scores for the total mental workload questionnaire and the subscales were respectively set at 23 and 6. The results demonstrated that 26% of the welders were suspected of mental disorder. Furthermore, the results of Pearson correlation indicated that there was no significant relationship between the overall score of NASA mental workload and that of general health (p-value>0.05).Welders' mental workload is relatively high. Therefore, further research should be conducted in order to identify main risk factors that lead to mental and health disorder. Future studies should also be performed to present some solutions for te purpose of decreasing or preventing these side effects among welders as much as possible.

Keywords: mental workload; general health; performance; welders.

INTRODUCTION

In recent years, half of the world population is living in cities and suburbs because of industrialization and immigration. As a result of these social and economic changes, the number of stressful situations and socio-psychological problems is on the rise in the society. Significant changes are also observed in epidemic diseases and people's health needs. Nowadays, psychological problems, such as psychosis and chronic depression are among the most important factors causing disability and early death [1]. Work-related stress and workload are two influential factors that threaten the fitness and health of a wide range of people in organizations [2].Over the past years, the subject of workload and its influence on organizations has received considerable attention in discussions related to organizational behavior [3].Workload and work-related stress affects individuals' safety, health, and comfort and have a direct relationship with people's performance [2].The workload has to do with the amount of overall work that should be done by somebody or a group of people in a particular period of time [4]. Mental workload encompasses factors that impact the mental process of information processing, decision making, and individuals' response in the workplace [5,6]. It was first

proposed by NASA to study staff members who supervised control systems. The aim was to assess human errors, physical and mental needs, understanding of management systems, the ability to recognize warning signs, and the speed of decision making in sensitive jobs [7,8]. One procedure for measuring mental workload is National Aeronautics and Space Administration Task Load Index (NASA-TLX). This index is one of the most important and widely used tools to assess the mental workload that may be imposed on an operator [9,10]. The index consists of six subscales including mental demand, physical demand, temporal demand, performance, effort, and frustration. The mean of these six subscales is considered as the overall workload [11]. General health is a subcategory of the health system and is defined as a collection of important social actions which mainly rely on prevention strategies [12]. Based on the definition proposed by the World Health Organization (WHO), health is far more than lack of disease or inability and entails complete physical, mental, and social well-being. WHO emphasizes that none of these dimensions has priority over others [13]. In fact, the most important phenomenon in today's world is a human resource [14]. The studies that have concentrated on the mental health condition of Iranian people over 15 have indicated that, on the average, around 21% of people suffer from mental disorders. These studies have also shown that women are more vulnerable than men when it comes to mental illnesses [15]. It is believed that if a person is flexible in difficult situations and can keep his/her mental balance in every situation, he/she enjoys a high level of mental health [16]. Numerous studies in Iran and across the world have concentrated on workers' health [17]. However, there are few studies investigating the relationship between welders' mental workload and general health. Thus, the present study aimed at examining the association between mental workload and general health among welders of Tehran Heavy Structures Metal Company in 2016.

MATERIALS AND METHODS
Sample and sampling procedure
This cross-sectional study was conducted in the winter of 2015. The sample consisted of 100 welders who were working in Heavy Structures Metal Company. Sampling was done through conducting a census.

Instrument
A survey was used to collect data. It consisted of three sections: the first one aimed at collecting participants' demographic information. The second section comprised of NASA-TLX questionnaire, while the third section involved the General Health Questionnaire-28 (GHQ-28).
Demographic features questionnaire
This questionnaire was completed by the welders and included information such as age, work experience, academic degree, marital status, and body mass index (BMI). It also asked participants whether they had a second job and if they were smokers.
NASA-TLX questionnaire
NASA-TLX contains two main parts. The first one measures the workload, while the second one is used to assess the importance of each workload subscale in relation to other subscales from respondents' point of view [16].The index, which was developed by Hart and Staveland (1988), is a well-known measure for evaluating workload from a personal perspective [18]. It is a multidimensional tool that provides an overall score based on the mean scores of six subscales, namely mental demand, physical demand, temporal demand, performance, effort, and frustration [19]. A large number of studies have confirmed the reliability and validity of this instrument in assessing workload [20]. Studies conducted by Malekpour have approved the reliability and validity of the instrument, with the reported Cronbach alpha being 0.83 [1].A brief description is provided for each of the six subscales. The person who collects data should read these descriptions to the respondent before completing the questionnaire based on his/her answers. The total score for each subscale is 100, with a 20-point likert scale ranging from 5-very low to 100-very high [18]. The descriptions for the six subscales are as follows:
Mental demand
How mentally demanding was the task? (This could include decision making processes, calculations, thinking processes, and remembering past information). And, whether the task was difficult or easy, simple or complicated.

Physical demand

How physically demanding was the task? (This could include a lot of physical pulling, pushing, and movement). And whether the task was easy or difficult, included a break, or demanded strenuous physical activity.

Temporal demand

How hurled or rushed was the pace of the task? And whether the pace was fast or slow.

Performance

How successful were you in accomplishing what you were asked to do? How much were you happy with your performance?

Frustration

How insecure, discouraged, irritated, stressed, and annoyed were you?

Effort

How hard did you have to work mentally or physically to accomplish your level of performance?

General Health Questionnaire-28 (GHQ-28)

In order to assess the welders' general health condition, GHQ-28 was used. This questionnaire is a screening device for identifying some psychiatric disorders. It is not a diagnostic test and can only be used to screen people who are suspected of some mental disease [21,22,23].

GHQ-28, which was designed by Goldberg and Hiller (1979), entails four subscales which assess somatic symptoms, anxiety and insomnia, social dysfunction, and severe depression. Each subscale is measured through seven items [24]. Previous studies have provided considerable evidence for the reliability and validity of this instrument. Based on the studies conducted in Iran, the reliability and validity of the instrument with the cut-off score of 23 varies from 0.68 to 0.94, while, with the cut-off score of 6, they range between 0.84 and 0.93 [12]. A four-point likert scale is used for each item of the questionnaire with anchors at 0-never, 1-sometimes, 2-often, and 3-always. A respondent's score may vary from 0 to 84 [25]. In this study, the cut-off score was set at 23, meaning that welders who scored above it were suspected of mental disorder.

STATISTICAL ANALYSIS

The data obtained through the demographic questionnaire, NASA-TLX, and GHQ-28 were fed into SPSS (version 22). Chi-square, one-way analysis of variance (ANOVA), Kruscal Wallis Test, Pearson product-moment correlation, and Mann-Whitney U Test were conducted to analyze the data.

RESULTS

Table 1 illustrates the demographic features of the participants.

Table 1. Welders' demographic features (n=100)

Variable	Variable	Percentage
Age (in years)	<25	8
	25-35	39
	35-45	43
	>45	10
Work experience (in years)	<10	60
	10-15	26
	15-20	10
	>20	4
Academic degree	Lower than a diploma	52
	Diploma	44
	University degree	4
Marital status	Single	8
	Married	92
Second job	Yes	3
	No	97
BMI(kg/m^2)	≤ 19	2
	19-23	17
	>23	81
Smoking status	Smokers	48
	Non-smokers	52

According to this table, the lowest mean score belongs to frustration (22.4±9.7), while the highest one has been recorded for effort (83.8±16.80). The overall mean score for

mental workload is 65.88±21.55. Table 2. Studied welders' mean, standard deviation, minimum, and maximum for the six subscales and the overall score of NASA-TLX mental workload (n=100).

Table 2. contains the mean scores of the six mental workload subscales as well as the overall mean score.

Mental workload subscales	Mean-Standard deviation
Mental demand	73±25.28
Physical demand	69.7±29.14
Temporal demand	71.3±26.64
Performance	75.1±21.39
Effort	83.8±16.80
Frustration	22.4±9.7
Overall score	65.88±21.15

.

As observed in this table, with a cut-off score of 23, the prevalence of mental health disorder is 26% among the welders.Table 3. The results of

the four subscales and the overall score of general health for the studied welders (n=100)

Table 3. displays the results for the four subscales of GHQ-28 as well as the overall health score of the welders

General health subscales	Disorder percentage
Somatic symptoms	18
Anxiety and insomnia	10
Social dysfunction	74
Severe depression	6
Overall score for general health	26

Table 3 indicates that, in the light of general health subscales, 18% of the participants suffer from somatic disorders, 10% are suspected of anxiety and insomnia, 74% suffer from social dysfunction, and 6% have severe depression

and suicidal tendencies. Table 4 shows the results of Pearson correlation conducted to find the association between the overall mean score of mental workload and the subscales of general health.

Table 4. The results of correlation between overall mental workload score and the subscales of general health for the studied sample (n=100)

Variable	Somatic disorder	Anxiety and insomnia	Social dysfunction	Severe depression and suicidal tendencies	Overall score in general health	Overall score in mental workload (NASA)
Somatic disorder	---	---	---	---	---	---
Pearson correlation	1	0.599**	-0.125	0.068	0.655**	-0.103
P-value	---	0.001	0.216	0.501	0.001	0.307
Anxiety and insomnia	---	---	---	---	---	---
Pearson correlation	0.599**	1	-0.203*	0.514**	0.796**	-0.116
P-value	0.001	---	0.043	0.001	0.001	0.251
Social dysfunction	---	---	---	---	---	---
Pearson correlation	-0.125	-0.203*	1	-0.104	0.274**	0.354**
P-value	0.216	0.043	---	0.305	0.006	0.001
Severe depression	---	---	---	---	---	---
Pearson correlation	0.068	0.514**	-0.104	1	0.600**	-0.024
P-value	0.501	0.001	0.305	---	0.001	0.816

[**] Two tailed, significant at 0.01

[*] Two tailed, significant at 0.05

As indicated in Table 4, the results of Pearson correlations demonstrated significant associations between overall score of general health and each of the four subscales, namely somatic disorder (p-value=0.001), anxiety and insomnia (p-value=0.001), social dysfunction (p-value=0.006), and severe depression (p-value=0.001). Additionally, there was a significant correlation between the overall score of NASA mental workload and social dysfunction (p-value=0.001). On the other hand, significant relationships were observed between somatic disorder and anxiety and insomnia (p-value=0.001) and between somatic disorder and the overall general health score (p-value=0.001). Nevertheless, no significant correlation was detected between somatic disorder and social dysfunction (p-value=0.216) or somatic disorder and severe depression (p-value=0.501). With respect to mental workload, significant correlations were observed between the overall score of NASA mental workload and its subscales, including mental demand (p-value=0.001), physical demand (p-value=0.001), temporal demand (p-value=0.001), performance (p-value=0.001), effort (p-value=0.001), and frustration (p-value=0.007).In contrast, no measurable relationship was detected between the overall score of general health and the subscales of NASA mental workload, namely mental demand (p-value=0.762), physical demand (p-value=0.524), temporal demand (p-value=0.53), performance (p-value=0.279), and effort (p-value=0.412).

DISCUSSION

The current study aimed at examining the relationship between mental workload and general health among welders of Tehran Heavy Structuress Metal Company in 2016. The minimum and maximum scores of mental workload were 30 and 90, respectively. Also, the overall score was 65.88±21.15. This is similar to the mean score obtained in Malekpoor et al.'s study (68.14±14.61) (1). Based on the findings, it can be concluded that, save for frustration, in all the subscales of NASA-TLX, the scores were considerablyhigh, a phenomenon that indicates the professional nature of welding. The subscale scores obtained

in Safari et al.'s study were all similar to the ones recorded in this research. The only discrepancy was observed in the case of frustration [26]. According to our findings, 26% of the welders were suspected of adverse health condition. Zare et al. (2012) investigated the prevalence of mental disorder among the workers of Gol Gohar Mining Company. The overall cut-off score was considered to be 23 and the cut-off score for each subscale was set at 6. They found that 29.4% of the participants were suspected of mental disorders, a finding that is very similar to the ones obtained in the present study [12]. The results also indicated that there is no significant relationship between welders' general health and age, work experience, and academic degree (p-value>0.05). Mokremi et al. (2008) also came to a similar conclusion, showing that there is no significant relationship between general health and age, work experience, and academic degree (p-value=0.23) [27]. The results of Pearson correlation demonstrated that there is no significant association between age and the overall score of NASA mental workload (p-value=0.552). No significant correlation was either observed between work experience and the overall score of NASA mental workload (p-value=0.374) or BMI and the overall score of NASA mental workload (p-value=0.456). These findings are in line with the ones obtained by Safari et al. (2012). However, Young et al. [28] concluded that there is a significant relationship between the overall score of mental workload and age (p-value<0.05), in the sense that older workers are exposed to heavier workload compared to their younger counterparts. This discrepancy can be attributed to the differences in the sample of each research, the nature of the jobs, and the number of individuals who participated in each study. The results of Pearson correlation showed a significant positive relationship between academic degree and the overall score of NASA mental workload (p-value=0.002). This is in agreement with Haghi et al.'s (2013) findings (p-value=0.01) [11]. In contrast, the results of Safari et al.'s (2012) study indicated no significant correlation between academic degree and the overall score of mental workload (p-value>0.05) [26]. The results of Kruscal Wallis Test demonstrated that there is no significant difference in the general health of

the four age groups (p-value=0.066).

The results of the current study indicated that welders' mental workload is considerably high. This can be due to factors like lack of a regular work-rest cycle and lack of work shift cycles or regular work shifts. Other influential factors may involve working for 12-14 hours a day, being forced to make orders ready immediately, having no job security because of nature of existing work contracts (workers are forced to sign one-year contracts; even some workers are forced to sign conditional one-year contracts upon the employer's request), having inappropriate sanitary facilities and amenities, working in improper environments (some welders are forced to work in outdoor areas and are exposed to direct sunlight), working in an undisciplined, disordered environment, and not recruiting occupational health and safety engineers in this industry. All these factors increase welders' mental stress. Further research should be conducted in order to identify main risk factors that lead to mental and health disorder. Future studies should also present some solutions to decrease or prevent these side effects among welders as much as possible.

ACKNOWLEDGEMENT

"The authors declare no conflict of interest"

REFERENCES

1.Malekpour F, Mohammadian Y, Malekpour A, Mohammadpour Y, Sheikh Ahmadi A, Shakarami A. Assessment of mental workload in nursing by using NASA-TLX. Journal of Urmia Nursing And Midwifery Faculty. 2014;11(11):0-.

2.Holmes S. Work-related stress: a brief review. The journal of the Royal Society for the Promotion of Health. 2001;121(4):230-5.

3.de Jong AE, Leeman J, Middelkoop E. Development of a nursing workload measurement instrument in burn care. burns. 2009;35(7):942-8.

4.Banbury S, Tremblay S. A cognitive approach to situation awareness: theory and application: Gower Publishing, Ltd.; 2004.

5.Morrow D, North R, Wickens CD. Reducing and mitigating human error in medicine. Reviews of human factors and ergonomics. 2005;1(1):254-96.

6.Hart SG, editor. NASA-task load index (NASA-TLX); 20 years later. Proceedings of the human factors and ergonomics society annual meeting; 2006: Sage Publications.

7.KHANI JR, SAREMI M, KAVOUSI A, MONAZAM MR, ABEDI M. The effect of whole-body vibration on vehicle driver's reaction time and mental and physiological workload. 2012.

8.Hoonakker P, Carayon P, Gurses AP, Brown R, Khunlertkit A, McGuire K, et al. Measuring workload of ICU nurses with a questionnaire survey: the NASA Task Load Index (TLX). IIE transactions on healthcare systems engineering. 2011;1(2):131-43.

9.Mazloum A, Kumashiro M, Izumi H, Higuchi Y. Quantitative overload: a source of stress in data-entry VDT work induced by time pressure and work difficulty. Industrial health. 2008;46(3):269-80.

10.Sarsangi V, Saberi H, Hannani M, Honarjoo F, Salim Abadi M, Goroohi M, et al. Mental Workload and Its Affected Factors among Nurses in Kashan Province during 2014. Journal of Rafsanjan University of Medical Sciences. 2015;14(1):25-36.

11.Haghi A RH, Habibi A, Zeinodini M. Evaluation of Mental Workload on Complex Missions Emergency Personnel; NASA-TLX. Occupational Medicine Quarterly Journal. 2016;7(3):37-45.

12.Zare S, Shabani N, Babaei Ha, Asghari M, Aminizadeh R, Nazemorroaya V, Et Al. Paper: Investigation Of The Relationship Between General Health And Workers'sleep Quality And Work Incidence In Gole Gohar Mineral Industries Co. SIRJAN. 2013, 21(2): 112-19.

13.Ahmadi S. Study Job Burnout Educational Manager in Triple Amputation Esfaham. Journal Research Esfahan University. 2002;13(1):275-84.

14.Kakooei H, Zare S, Akhlaghi A, Panahi D. Evaluation of sleep quality in bus drivers in Tehran. Traf Manag Stud. 2010;5(16):1-10.

15.Pournik O. Sleep quality among health care workers. Archives of Iranian medicine. 2013;16(2):100.

16.Khandan M, Maghsoudipour M. Survey of Workload and Job Satisfaction relationship in a Productive Company. Iran Occupational Health. 2012;9(1):30-6.

17.Davari S. Health and its determinants. Tehran, contemporary works. 2007;25.

18.Hart SG, Staveland LE. Development of NASA-TLX (Task Load Index): Results of Empirical and Theoretical Research. In: Peter AH, Najmedin M, editors. Advances in Psychology: North-Holland; 1988. p. 139-83.

19.Stanton NA, Young MS. Driver behaviour with adaptive cruise control. Ergonomics. 2005;48(10):1294-313.

20.Rubio S, Díaz E, Martín J, Puente JM. Evaluation of subjective mental workload: A comparison of SWAT, NASA-TLX, and workload profile methods. Applied Psychology. 2004;53(1):61-86.

21.Goldberg DP, Hillier VF. A scaled version of the General Health Questionnaire. Psychological medicine. 1979;9(01):139-45.

22.Nourbala A, Mohammad K, BAGHERI YS, Yasami M. Study of mental health status of individuals above 15 years of age in Islamic Republic of Iran in the year 1999. 2002.

23.Mohammadbeygi A, Ghamari F, Salehi B. Depression symptoms prevalence, general health status and its risk factors in dormitory students of Arak universities 2008. Arak Medical University Journal. 2009;12(3):116-23.

24.BARZIDEH M, CHOOBINEH A, TABATABAEI SH. Job stress dimensions and their relationship to musculoskeletal disorders in nurses. 2012.

25.Noorbala A, Mohammad K. The validation of general health questionnaire-28 as a psychiatric screening tool. Hakim Research Journal. 2009;11(4):47-53.

26.Safari S, Mohammadi H, Kazemi M. Evaluation Mental Work Load in Nursing Critical Care Unit with National Aeronautics and Space Administration Task Load Index (NASA-TLX). J Health Syst Res. 2013;9(6):613-19.

27.Mokarami H, Kakooei H, Dehdashti A, Jahani Y, Ebrahimi H. Comparison of general health status and sleeping quality of shift workers in a car industry workshop 2008. Behbood Journal. 2010;14(3):Pe237-Pe43, En40.

28.Young G, Zavelina L, Hooper V. Assessment of workload using NASA Task Load Index in perianesthesia nursing. Journal of PeriAnesthesia Nursing. 2008;23(2):102-10.