

The effect of mental work load on personals' sleep quality and reaction time, on the hospitals' laboratories of Isfahan

El efecto de la carga de trabajo mental sobre la calidad del sueño y el tiempo de reacción de los personales en los laboratorios de Isfahan de los hospitales

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Abstract

Introduction: When people do mental activity for a long time, they will often see cognitive fatigue, reflected in deteriorated task function and decreased motivation to continue to work to do it. The present study aims to investigate the effect of mental fatigue and workload on sleep quality and reaction time in hospital laboratories staff in Isfahan.

Method and material: Eighty personals of four hospitals' laboratories in Isfahan participated in this study. The end points and their predictors were measured at the beginning and at the end of the shifts. Mental fatigue, sleep quality, reaction time, Mental workload and attention were measured by Flicker perception equipment, Pittsburgh questionnaire, reaction timer equipment, NASA TLX online questionnaire, and CPT program respectively. Paired sample t test and linear regression was applied to the data using SPSS 20.

Results: Sleep quality had highest correlation with reaction time. Linear regression results showed gender was the most effective factor on the sleep quality (P value <0.004). Education and attention were significant predictors of reaction time. Paired sample t test results showed mean number of errors and omission errors were statistically different between beginning and at the end of the shift work ($p < 0.05$).

Conclusion: Most of the laboratory personals were female who had low sleep quality and high reaction time. Commission error could affect reaction time, by decreasing the commission error reaction time decreased. The reaction time could be also affected by education.

Keywords: mental work, personals' sleep, reaction time, hospitals' laboratories, Isfahan

Resumen

La variedad de necesidades de cuidadores de pacientes bipolares significa la importancia de realizar intervenciones dedicadas para ayudar a este grupo de cuidadores en función de las condiciones culturales del país en el que viven; El presente estudio, por lo tanto, trata de abordar esta cuestión a través de un método diferente. Las familias de 28 pacientes con trastorno bipolar tipo 1 que fueron tratados durante al menos dos meses por un solo psiquiatra ingresaron gradualmente al estudio durante un período de seis meses. Recibieron el número de teléfono del psiquiatra que asistía tan pronto como el paciente estaba en remisión según la misma entrevista con el psiquiatra. Un total de 1908 textos fueron enviados y recibidos y cada familia envió un promedio de 68.14 mensajes de texto durante los tres años, con un mínimo de 40 y un máximo de 83. Todos los mensajes de texto fueron transcritos textualmente y fueron evaluados por tres miembros de la facultad a través del método de análisis de contenido cualitativo.

En este estudio encontramos tres temas y había algunos códigos en cada tema.

El primer tema fue "Entrenamiento", que los cuidadores solicitaron asesoramiento sobre los síntomas y las pruebas, el curso de la enfermedad, aseguramiento, efectos secundarios de los medicamentos y su manejo, cómo dejar de fumar, cómo controlar los comportamientos de alto riesgo y verificar citas con el médico, obteniendo un total de 1079 mensajes de texto recibidos.

El segundo tema fue "Informes" que contenía una descripción de los síntomas de emergencia y la solicitud de asesoramiento, informando la respuesta o la falta de res-

puesta a los medicamentos, informando el cumplimiento de la medicación y la dosis tomada.

El tercer tema: "La expresión de los sentimientos", incluida la expresión de gratitud, diciendo felicitaciones por las celebraciones nacionales y de otro tipo y expresando enojo y odio.

En general, los cuidadores de pacientes con trastorno bipolar tienen muchas necesidades; satisfacer estas necesidades afecta el resultado de los pacientes y los cuidadores, pero requiere una mayor atención por parte del equipo de atención médica y es necesario que estas necesidades se evalúen en el contexto de cada país distinto.

Palabras clave: bipolar, cuidador, sms, estudio cualitativo

M

ental fatigue means that alteration in the psycho-physiological state that people see during and following the course of long time of asking mental activity that needs sustained mental efficiency¹. Mental fatigue is observed as a reduced efficiency for mental works².

When people work on a mental function for a long time, they will often see mental fatigue, reflected in deteriorated task performance and decrease motivation to continue to work to do it³⁻⁵.

An increase in the number and kind of errors can generally be seen. An important observation is that mentally fatigued people often say having problem in their attention concentrate and that they are easily distracted, denoting that mental fatigue could have effects on elective attention⁶. Sleep is the most important improvement chance to recovery energy and refill psychophysiological resources⁷. The antecedent research has demonstrated that a good sleep in night decreased the levels of fatigue and increased quietness in morning⁸, but some health problem like obesity, diabetes mellitus, hypertension and reduced cognitive performance is related to poor sleep quality⁹⁻¹¹.

Cognitive performance, like working memory, attention and speed of information processing, play an important role in the function of a lot of tasks; therefore, even interim failure of cognitive and mental function can guidance to earnest outcomes for people, especially when an exact and instant answer is needed¹².

Some studies have also showed a wide range of cognitive decrease due to lack of sleep. People feel sleepy and decrease alertness level when they have Sleep deprivation¹³. It may also lead to such cognitive function disorders as decrease ability to focus, decreased ability to learn, increased reaction time and remind new facts, and Faulty motor skills¹⁴. A relationship between cognitive function

disorders and sleep disorders have showed by some studies on laboratory setting. Studies on truck drivers, medical student, and pilots have illustrated an increase in the accidents and human mistake resulting from sleep deprivation because of shift work¹⁵.

The prevention of earnest errors in medical care has long been of anxiety to health professionals, as well as legislatures. However, the recent report by the Institute of Medicine (IOM), has concentrate attention on the problem, and its result, that each year, more Americans die due to medical mistakes made in hospitals rather than injuries from car accidents^{16,17}. The most important target in medicine is to warrant high-quality care. The first amplitude of quality pertains to safety, which means that without any accidental injury and mistake. The role of clinical laboratories is to swiftly produce dependable data, based upon which clinicians can take the true decisions. In order to attain efficiency and quality in the laboratory procedure, errors should be known and then decrease to zero, thus achieving a practically achievable and medically admissible standard¹⁸.

To the best of our knowledge, no study has concentrate on the impression of mental fatigue, mental workload and sleep quality on cognitive function (reaction time) and attention of personals of laboratory hospitals, in particular. The aim of this study is addressing this gap in the article by surveying whether mental fatigue, mental workload and sleep quality could decline the cognitive performance and attention. Of particular interest to this study was surveying the laboratory personals mental fatigue, mental workload, reaction time, sleep quality and attention in the beginning and in the end of shift work.

Participant

The participants were 26 male and 54 female laboratory personals working in four hospitals in Isfahan. The deprivation criteria contained use of hypnotic drugs, psychiatric illness, major systemic disease, sleep disorders and unwillingness to take part in study.

Study protocol

The shift schedule was adjusted based on the hospital requirements. The morning shift begin at 7:30 am and finished at 1:30 pm, the afternoon shift started at 1:30 pm and ended at 7:30 pm, and the evening shift started at 7.30 pm and ended at 7:30 am. This was a cohort study. At first, the participants completed a testimonial and then completed a history questionnaire asking for their demographic information. To assess the partakers' cognitive function, reaction timer and continues performance test were used. Pittsburgh Sleep Quality Index questionnaire was employed to assess the sleep quality. To measure workload, online questionnaire NASA TLX was used. Each measurement device was used twice for each person in shift and three shift were measured (Morning, Afternoon, Evening). The control group was the morning shift personals and the encounter groups were the afternoon and evening shift personals.

During the cognitive performance testing, the participants were seated in workplace, with one researcher being present in order to supervise the tests.

Cognitive test

Reaction time test

Reaction timer test related to the speed at which the information is processed and the suitable selection. Reaction timer, used in this study, was the equipment that showed 3 different colors and recorded the reaction time in millisecond. The participants had 2 second for pressing the key. If they didn't press the key, the equipment would show another stimulus. The equipment had a monitor that showed a number of stimuli; number of error, number of true stimulus and the time of reaction for any stimulus. The model of this equipment was PM-RT16881

Continuous test performance (CPT)

We used continuous performance test as a scale of attention, mistake and sustained attention.in this study the validated Persian version of instrument was used. The test contain of 150 stimuli showing on the monitor. The duty of the partaker was to press the spacebar on their keyboards as soon as the number "4" was shown on the monitor. The appearance time for each stimulus was 150 MS, with a duration of 500 MS between every two stimuli. The number of correct answer, omission error, commission error, and the reaction time (in MS) were note as the dependent variables¹³.

Sleep quality (Pittsburgh Sleep Quality Index questionnaire)

The laboratory staffs' sleep quality in 3 different shifts was measured with standard Pittsburgh Sleep Quality Index questionnaire. All the staffs completed the questionnaire.

Mental fatigue

Mental fatigue was measured with Flicker perception equipment. This Flicker perception equipment had a low frequency light that looked like a flasher to the participants. In the case of low mental fatigue, the participants saw the light stable due to low frequency. As the mental fatigue increased, so did the frequency of light. The model of this equipment was pm-ss22881.



To measure the staffs' mental workload, nasal TLX online questionnaire was used.

Statistical analysis

To describe the numerical average of 95% and the standard deviation, paired sample t test was used to analyze the data. To test of two the independent groups' means, multiple linear regression were conducted to control for the dependent variables. The significance level was decided to be 5%.



The mean of the participants' age were 34.21±8.79. The youngest person was 19 years old and the oldest person was 57 years old. The mean of the working experience was 9.94±8.69. The participants' academic degrees were diploma (6.3%), Bachelor (18.8 %), master (67.5%) and PhD (7.5%).

According to [Table 1], the results of the correlation between reaction time and sleep quality and mental fatigue showed that the mental fatigue in the beginning and at the end of shift work had negative effect on the reaction time (n= 80).

Table 1: Correlation between reaction time and sleep quality and mental fatigue

	Reaction time	
	Beginning of shift work Correlation (p-value)	End of shift work Correlation (p-value)
Sleep quality	0.199 (0.07)	0.207(0.064)
Mental fatigue	-0.034 (0.764)	0.087(0.441)

As shown in [Table 2], the results of linear regression showed that the evening shift work had the lowest effect on sleep quality and the night shift had the greatest effect on sleep quality. However, there was not any significant difference between them. The differences between sleep quality and workload, mental fatigue, work history, education and age were not statistically significant. This could be due to low sample size. Gender was the only predictor that had significant difference with sleep quality. According to what this model predicts, only gender could have effect on the sleep quality.

Table 2: Predictors of sleep quality scores using linear regression in this study controlled for age, sex and education drive

	B	95% CI	P value
Shift work Morning Evening Night	Reference 0.327 2.170	3.152 3.807 5.938 1.597-	0.852 0.254
Mental Workload	0.055-	0.028 0.140-	0.191
Mental fatigue	0.023	0.109 0.156-	0.726
Hospital Kashani Khorshid Eesabn Maryam	2.523- 2.103- 0.942	.0621 5.669- 1.236 5.443- 6.033 4.148-	0.114 0.213 0.713
Gender Female	4.190	6.962 1.417	0.004
Work history	0.033	0.367 0.435-	0.867
Education Bachelor master PHD	0.073 0.395- 4.600-	5.625 5.479- 4.884 5.676- 2.561 11.761-	0.979 0.882 0.204
Age	0.003	0.381 .0387	0.987

The result of Linear regression in [Table 3] showed that different shift work, mental workload, mental fatigue, different hospital, omission error, correct response, sex and work history couldn't have effect on the reaction time and amount of p value didn't have significant difference. But based on the prediction of this model, number of error, commission error and education could affect the reaction time but decrease it.

Table 3: Predictors of response times using linear regression on the subjects at the beginning of the shift by controlling for age, sex and level of education experience

	B	95% CI	P value
Sleep quality	0.000	0.003 -0.003	0.937
Shiftwork morning Evening Night	0.003 -0.008	0.048 -0.041 0.044 -0.060	0.876 0.756
Mental Workload	0.001-	0.000 0.002-	0.60
Mental fatigue	0.002-	0.000 0.004-	0.134
Hospital Eesabnmaram Kashani Khorshid	0.000 0.028 0.036-	0.068 0.066- 0.070 0.013- 0.011 0.085-	0.977 0.186 0.133
Number of error	0.028-	0.016 0.041-	0.000
Comission error	0.027	0.054 0.001	0.036
Omission error	0.053	0.096 0.010	0.15
Correct answer	0.027	0.056 0.000	0.58
Gender Male Female	Reference 0.009	0.052 0.032-	0.649
Work duration	0.003-	0.001 0.009-	0.186
Education Bachelor master PHD	-0.057 -0.079 -0.144	0.018 -0.133 -0.008 -0.150 -0.040 -0.247	0.137 0.030 0.007
Age	0.003	0.009 -0.001	0.129

Moreover, the results obtained from pair sample t test [Table 4] indicated that there was a significant difference between the Commission error, Response time, Reaction time and mental fatigue in the beginning and the end of the shift work. However, there wasn't any significant difference between Omission error and number of error in the beginning and the end of shift work.

Table 4: Mean Comparison of variable in beginning and finishing of shift work

	Variable	Before	After	P value
Cpt	Commission error	0.81±1.04	0.47±0.71	0.003
	Omission error	0.26±0.68	0.36±1.12	0.313
	Response time	0.41±0.03	0.43±0.04	0.000
Rt	Reaction time	0.54±0.14	0.56±0.17	0.000
	Error	1.68±1.46	1.28±1.21	0.26
Mental fatigue	frequency	33.75±6.16	38.15±9.06	0.000

Discussion

One of the target of our study was to specify the solidarity of sleep quality and mental fatigue between the reaction time in the beginning and at the end of shift work (evening and night shift). It showed high sleep quality could decrease the reaction time. At the end of shift work, mental fatigue had more effect on the reaction time. In other words, when mental fatigue increased, so did the amount of reaction time. However, there wasn't any significant difference among them that could be due to low sample size. The degree of correlations was the indication of the fact that the study was on the right track.

Some studies have examined the role of permanent cognition in the relationship between work stressors and defective sleep. A cross-sectional study showed that work stressors and permanent cognition have negative relationship with subjective sleep quality(9). The result of this article was in a line with our finding that emphasized the importance of sleep.

The second aim of this study was to determine the variables that had effect on sleep quality. In shift work variable, the night shift had more effect on sleep quality than the evening shift, though P value in none of them was significant due to low sample size. In regard to hospital variables, Kashani hospital had the most effect on the sleep quality than the khorshid and Eesabn Maryam hospital. However, P value wasn't not significant due to differences in the number of staffs. The only variable that had the greatest effect on sleep quality was gender (female). But a study showed that significant_ratio of both men and the women of this carefully screened, noncomplaining sample endorsed PSQI scores demonstrator of sleep disorder, with significantly more women than men endorsing such high PSQI scores (10). The result of this study was in line with ours suggesting some more results 1. Most of the participants in our study were woman 2. female had a lot to do at home in addition to their task duty in their workplace.

Another aim of this study was to determine the variables that had effect on the reaction time. The first variable that had affected the reaction time, was number of error. Meaning that, when the number of error decreased, the

amount of reaction time increased and the participants for making the right decision need more time. The second variable was commission error. Meaning that, in a situation with some similar stimulus it needs more time to recognize true stimulus. The third variable was education (Master and Ph.D.). It showed that participant with high degree of education could take correct decision faster than other participants.

The last aim of this study was comparing the changes of variables during a shift work. It is found that, there wasn't any significant difference between the beginning and at the end of the shift work in number of omission error and number of error. To put it simply, number of error wasn't affected by the shift work. But for the commission error response, reaction time and mental fatigue the amount of p value was less than 0.05.

Although there wasn't significant difference between the numbers of error in the beginning and at the end of shift work, the difference between the amount of reaction time in the beginning and the end of the shift work was significant. It showed that the participants at the end of shift work for concentration and making correct decision need more time compared with the beginning of shift work.

One study done among emergency physicians, short-term memory demonstrate a significant decline at the end of both day and night shifts(19-21) . This finding was in a line with our result that confirms the result of the study.

Conclusions

The primary purpose of the current study was to determine correlation between reaction time mental workload, mental fatigue and sleep quality. Further, the study also aimed to find the effect of shift work, mental workload, mental fatigue, hospital, gender, work history, education and age on the sleep quality and effect of sleep quality, shift work, mental workload, mental fatigue, hospital, gender, work history, education, CPT variable, number of error and age on the reaction time.

Sleep quality highly correlated with reaction time among the other variables. The predictor of sleep quality had the

greatest effect related to gender. And, finally, reaction time highly correlated with the number of error, commission error, and education.

More broadly, more studies are needed to determine how many participants must participate in the study to achieve accurate answer. Moreover, further studies are required to determine the how much of mental workload and mental fatigue that could affect the reaction time and sleep quality of laboratory staffs of hospitals.

Acknowledgements: This study was a master thesis in medical university of Isfahan, Iran. The thesis code was 395180 and its ethic code was IR.MUI.REC.1395.3.180. We would like to appreciate the peoples and organizations who take part in our research, especially laboratory staffs of Ayatollah Kashani, Noor Ali Asghar (khorshid), and Alzahra and Eesabn maryam hospitals.

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