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Original Research Article

Effect of fatigue on cognitive performance in neurology residents of faculty of medicine Universitas Sumatera Utara

Eka Mahendrayana*, Fasihah Irfani Fitri, Aldy S. Rambe

Department of Neurology, Faculty of Medicine, Universitas Sumatera Utara/Adam Malik General Hospital, Medan, Indonesia

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***Correspondence:**
Dr. Eka Mahendrayana,
E-mail: eka.mahendrayana@gmail.com

ABSTRACT

Background: Fatigue is a general term used to describe an overall feeling of tiredness. It is one of the most common complaints of people seen in primary health care. Several previous studies have evaluated the effects of fatigue on cognitive function in various clinical and population settings and yielded different results. This study aimed to investigate the effect of fatigue on cognitive performance in neurology residents of Faculty of Medicine of Universitas Sumatera Utara
Methods: This was a crosssectional study involving all of the neurology residents of faculty of medicine universitas Sumatera Utara who fulfilled the inclusion criteria. This study was conducted on November until December 2020. Fatigue was assessed using fatigue severity scale and cognitive performance was assessed using Stroop test. The data was analyse using regression linear test
Results: Total subject in this study was 42 subjects consisted of 26 female and 16 male with mean age of 32.02±3.45 years. The mean of FSS score was 33.71±7.41 and the mean of Stroop test score was 46.37±9.16 second. Using regression linear test we found fatigue affect cognitive function with p=0.002; R=0.470 and R2=0.221 and after stratification analysis based on sex of the subjects found that fatigue affect cognitive function in female subjects with p=0.013; R=0.482 and R2=0.232. According to age of the subject, fatigue affect cognitive function in subject >30 years old with p=0.001; R=0.635; R2=0.403
Conclusions: There is significant effect of fatigue on cognitive performance. Particularly in women and age >30 years old

Keywords: Fatigue, Cognitive performance, Neurology

INTRODUCTION

Fatigue is a general term used to describe an overall feeling of tiredness. It is one of the most common complaints of people seen in primary health care.[1] Many different fatigue classification. Base on its duration, fatigue can be classified into acute fatigue and chronic fatigue. Acute fatigue can be relieved by rest or life-style changes, on the other hand chronic fatigue is a persistent tiredness lasting months that is not relieved by rest. Fatigue can also be classified as mental fatigue and physical fatigue base on cognitive aspects and performance of the motor system.[2]

Resident doctor program is a professional education program in the advanced phase of the medical profession program. In carrying out their duties, resident doctors are required to provide services to patients as well as other academic tasks.[3] Fatigue is also prone to occur in medical workers and is associated with decreased attention and orientation, which are aspects of cognitive function.[4] Cognitive function refers to mental processes involved in

the acquisition of knowledge, manipulation of information, and reasoning. Cognitive functions include the domains of executive function, memory, attention, decision making, and language abilities.[5]

Several studies on the effects of physical fatigue on cognitive function have had different results. Hanson and Lofthus found that physical fatigue significantly lengthened central processing in reaction time task but McMorris and Graydon found that decision making task on a soccers improved with intensity of exercise.[6]In a study conducted by Slimani et al found fatigue affects whole-body endurance and cognitive function. They used stroop test to examined capacity of selective attention and processing speed ability.[7] Stroop test has also been used as cognitive stimulation by comparing changes in the mean flow velocity of post-stroke patients compared to the non-stroke group conducted by Fitri et al and there were significant differences in changes in the mean flow velocity between two groups.[8] Another study conducted by Nurchaeni et al on 62 subjects with anesthesiology residents found a decrease in cognitive function after 24 hours of work.[4]

Aim

Current study aimed to investigate the effect of fatigue on cognitive performance in neurology residents of faculty of medicine of Universitas Sumatera Utara

METHODS

Study sample

The study conducted from 15 November until 15 December 2020. The subjects of this study were taken from neurology department resident population of medical faculty Universitas Sumatera Utara. The determination of the Subject was carried out according to the total sampling method and obtained 42 subjects for analysis. The exclusion criteria were the residents who were outside the city of Medan when the research was conducted and residents who do not yet have shift duty.

Study design

This study was cross-sectional design. This study assessed fatigue using fatigue severity scale and cognitive function using Stroop test. Every subject of this study given fatigue severity scale and stroop test after the subject done their shift for minimum 24 hours. The Fatigue severity scale is a questionnaire to assess the level of individual fatigue. The assessment was carried out to see the effect of fatigue on motivation, activity, physical function, carrying out tasks, disruption to work, family, or social life; whereas the result of this questionnaire was score with 9 for minimum and 63 for maximum score.[9] The results of FSS score indicates that the higher the score the more higher the degree of fatigue. The Stroop color and word test (SCWT) is a neuropsychological test extensively used to assess the ability to inhibit cognitive interference that occurs when the processing of a specific stimulus feature impedes the simultaneous processing of a second stimulus attribute, well-known as the Stroop effect.[10] The result of SCWT can be measured using the formula: total time+(2×mean time per word)×number of uncorrected errors). The result of this test were counted in second.

Statistical analysis

Data from the research was analyzed statistically using the SPSS computer program (statistical product and science service) to analyze the affect of fatigue on cognitive performance between research variable. The effect of fatigue on cognitive performance was analysed using regression linear.

RESULTS

There were 42 subjects in this study whereas the average age of the subjects was 32.02±3.45 years with the most age group more than 30 years old. The female subjects were 26 (61.9%) more than male subjects. Most of the subject's residences were in Medan 43 (95.6%). The most subject with competency level in supervision 21 (50.2%) and for the maritas status, most of the subjects were marriage 35 (83.3%). The demographic characteristic are show in (Table 1).

Table 1: Demographic characteristic of research subjects.

Characteristics (n=71)	N	%
Age average±SD (years) 32.02±3.45		
≤30	14	33.3
>30	28	66.7
Sex		
Female	26	61.9
Male	16	38.1
Residence		
Medan	43	95.6
Deli Serdang	1	2.4
Binjai	1	2.4
Competency level		
Observation	11	26.2
Supervision	21	50.2
Independent	10	23.8
Marital status		
Marriage	35	83.3
Single	7	16.7

The result of fatigue severity scale all of subject with mean 33.71±7.41 and for stroop test with median value around 45.24 (82.06±34.94). For complete data can be seen in (Table 2). From the result of this study fatigue affect cognitive function with p=0.002; R=0.470 and R^2=0.221 and after stratification analysis based on sex of

the subjects found that fatigue affect cognitive function in female subjects with p=0.013; R=0.482 and R^2=0.232. According to age of the subject, fatigue affect cognitive function in subject >30 years old with p=0.001; R=0.635; R^2=0.403. And subject with supervision in competency level found fatigue affect cognitive performance with p = 0.040; R=0.436; R^2=0.190. The complete data can be seen in (Table 3).

Table 2: Characteristics of fatigue severity scale and Stroop test.

Variable	Value
Fatigue Severity Scale	Mean 33.71±7.415
Stroop Test	Mean 46.37±9.16

Table 3: Effect of fatigue on cognitive performance.

Characteristics		Cognitive performance		
		P	**R**	**R^2**
All subject	**Fatigue**	0.002	0.470	0.221
Sex				
Male		0.086	0.443	0.196
Female		0.013	0.482	0.232
Age (years)				
≤ 30		0.36	0.262	0.069
>30		0.001	0.635	0.403
Competency level				
Observation		0.126	0.490	0.240
Supervision		0.040	0.436	0.190
Independent		0.263	0.392	0.154

DISCUSSION

In this study, it was found that the age characteristics of all study subjects had a mean value of 32.02±3.45. This is the same as the study conducted by Nurcaheni et al[4] with the subject of anesthetic resident study with a mean age of 32.55±3.31. In this study, the majority were women with 26 subjects (61.9%), Batak ethnicity with 13 subjects (31.0%), supervision competency level with 21 subjects (50.0%) and 35 subjects (83.3%) were married. In this study, there is a significant effect of fatigue on the cognitive function of all research subjects. Such as a study conducted by Nurchaeni et al which showed a decrease in cognitive function in anaesthesiology residents after 24 hours of work.[8] Likewise in a study conducted by Slimani et al of 10 athletes who had previously intervened to cause mental fatigue, it showed that fatigue affected endurance and cognitive function compared to the control group. Another study conducted by Tanaka et al that induces mental fatigue also shows mental fatigue causes excessive activity in the visual cortex and this activity is associated with impaired cognitive function.[11,12]

In acute muscle fatigue when doing physical activities, the muscles will become tired so efforts are needed from the cortex in order to maintain physical performance for physical fatigue, which is known as a facilitation system consisting of the limbic system, basal ganglia, thalamus, orbitofrontal cortex, dorsolateral prefrontal cortex, anterior cingulate cortex, premotor area, accessory motor area and primary motor cortex. The motivational input to the facilitation system increases the motor output to the peripheral system. In contrast, sensory input from the peripheral system to the motor cortex during muscle fatigue decreases output thereby slowing the rate of activation of the active motor unit. This physical inhibitory system consists of neural pathways connecting the spinal cord, thalamus, secondary somatosensory cortex, insular cortex, posterior cingulate cortex, anterior cingulate cortex, accessory motor area and motor cortex.[13] In acute mental fatigue, the mental workload will activate the mental facilitation system to maintain the performance of cognitive tasks in a state of mental fatigue. However, mental workload also activates the mental inhibition system to impair cognitive task performance. Activation of the mental facilitation system maintains or enhances cognitive task performance, whereas activation of the mental inhibitory system interferes with cognitive task performance. The balance between the activation of these two systems determines whether cognitive task performance is impaired, maintained, or enhanced. Therefore, cognitive task performance is regulated by these two systems through a dual regulatory system.[13]

The prefrontal cortex is the most sensitive to fatigue exposure and sleep deprivation. Fatigue and lack of sleep can trigger changes in histology, neurotransmitters and neuroinflammatory processes in the brain. Histological changes that occur in the prefrontal cortex are the loss of dendritic material in layers II and III of the prefrontal cortex. Changes in neurotransmitter that arise is an increase in noradrenaline which easily penetrates the blood brain barrier and binds to orexin receptors in the prefrontal cortex which plays an important role in attention and memory. Neuroinflammatory processes in the brain in conditions of fatigue and sleep deprivation are triggered by the cytokines tumor necrosis factor (TNFα), interleukin-6 (IL-6), and interleukin-8 (IL-8).[8] After a stratification analysis based on gender, it is known that female show a significant influence on cognitive function. In a study conducted by Engberget al on the general population, it was found that female have higher fatigue levels than male. It has been known for a long time that gender is related to many health inequities, Fatigue is one such inequity.[14] In the study of Engberg et al. The prevalence of fatigue in female was found to be higher at lower socioeconomic levels. However, this research did not analyze the socioeconomic factors of the research subjects. Engberdkk found that Gender and social class interact closely and lead to differences in distribution of resources. Perhaps fatigue is a bodily expression of ill-being, which is related to other health inequities, economic factors and unequal assets in life. Fatigue might enhance health inequities further, since female in the lowest socioeconomic class are more prone

to feel fatigued and therefor might be less likely to be physically active. This could further increase the ill-being for these individuals and the social discrimination of this group. In cognitive function, studies demonstrating gender differences in neurocognitive performance showed that females, on average, perform better than males on tests of fluency, verbal memory, fine motor skills, and perceptual speed, while males tend to perform better on tests of visual memory, visuospatial abilities, and problem-solving.[15] But in this study the significant effect of fatigue on cognitive function in female may be based on the higher fatigue levels than male.

In the age variable after age stratification, it is known that respondents with an older age >30 years show a significant effect of fatigue on cognitive function. In a study conducted by Watt et al showed scores for physical fatigue, reduced activity and reduced motivation increased with age ($p<0.0001$).[16] In terms of cognitive function, according to Bracerman cognitive decline frequently begins as early as 30, starting with a slowing of processing speed then affects memory and attention, and leads to numerous diseases including obesity and depression.[17] In the competency level variable after stratification shows significance at the level of supervision. This may relate to more duties and responsibilities of neurological residents at this level to catch up on time-out of study. So that residents in this group are more prone to fatigue and this overall fatigue affects cognitive function.

Limitations

This study has limitations, it does not differentiate in more detail from each fatigue group, namely muscle fatigue or mental fatigue. It is hoped that the next research can analyze this factor so that it is even better. However, this is the first study so far as researchers have observed the effect of fatigue on cognitive function in normal populations, it is hoped that this study can be useful and encourage similar research in the future.

CONCLUSION

This study shows that fatigue affects cognitive performance in neurology resident participants, particularly in women and aged >30 years. Effective time management is needed for each resident, both for medical and educational services and adequate rest to support excellent cognitive performance.

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