

Mental Workload and Stress with Blood Glucose Level: A Correlational Study among Lecturers who are Structural Officers at the University

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ABSTRACT

Background: Blood glucose levels must be reasonable to prevent diabetes mellitus. An excessive mental workload and chronic stress can encourage the hormone cortisol to increase the glucose level in the blood. This study aimed to determine the relationship between mental workload and stress on blood glucose level among the lecturers who were structural officers who work at the university in Surabaya, Indonesia.

Methods: It was a cross-sectional study. The subjects were selected from 14 faculties of the University. The total number of subjects was 109 lecturers working as structural officials. The data was collected using a questionnaire to examine mental workload and stress level. The subjects were examined at random for their blood glucose check. The data was analyzed using the Rank Spearman test with a significance level of <0.05.

Results: It shows that there is a correlation between mental workload ($p=0.003$) and stress level ($p=0.003$) with blood glucose level among the lecturers working as structural officers at the university.

Conclusion: A high workload followed by a high level of stress as a lecturer and structural officer working at the university results in a reasonably high tendency to experience an increase in blood glucose level, and thus the risk of developing diabetes mellitus.

Keywords: diabetes; blood glucose; workload; stress; university

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INTRODUCTION

Blood glucose is carried by the bloodstream to all of the cells in the body to supply energy. A person needs normal glucose to reduce the risk of diabetes (1). According to the World Health Organization (WHO) 2018, the most common disease caused by a high glucose level is diabetes mellitus (DM). DM, which is not well-controlled, can cause severe damage to the body's systems, especially the nerves and blood vessels (2). High glucose levels in the long-term, if not treated immediately, will cause complications that can cause damage to various organs of the body. This damage can be paralyzing and life-threatening such as cardiovascular disease, neuropathy, nephropathy and eye diseases that cause retinopathy and blindness (3). Stress can occur from a variety of sources such as a person, their family, community and the work environment (4). Working conditions that are not balanced with the ability of individuals can cause work stress (5). Work stress is considered to be a privacy problem that can be solved by itself. It has developed into a global phenomenon that affects the health of every worker in various types of work (6,7).

The prevalence of people with high blood glucose levels in 2014 was estimated to be 171 million globally (8). In Southeast Asia, the incidence of glucose levels of 4.5 million sufferers. WHO in 2018 showed that the number of people with DM reached 422 million in 2014 (3). The profession with the highest DM based on the diagnosis of doctors in Indonesia from the Indonesia Health Basic Research conducted in 2013 at 4.2% was civil servants. The data on the civil servants in question included the Indonesia Police, the Indonesian Army, government staff and lecturers working at the university (9).

The factors that can affect the levels of glucose and cause DM consist of factors that cannot be modified (age, sex, race and ethnicity, genetic history, history of birth with a birth weight >4000 grams, a history of the mother

suffering from gestational DM and a history of being born with a low body weight <2500 grams). There are modifiable factors (obesity, a lack of physical activity, stress, hypertension, dyslipidemia, and an unhealthy diet) (10). There are also other risk factors such as smoking and alcohol consumption (11). The research conducted by Syam, Agustanti and Halim (2014) state that one of the conditions that increases the risk of DM is stress (12). Stress is caused by the demands of a task being too much and where the time set aside to work is very tight. Overman (2010) said that an overload of work affects a person's mental activity. This is called the mental workload and it is very closely related to the occurrence of stress. This causes health problems such as DM (13). Based on the problem above, the purpose of this study was to conduct a more in-depth study into the relationship between mental workload and stress on blood glucose level among the lecturers working as structural officers at the university in Surabaya, Indonesia.

METHODS

Study design

This study was a quantitative research study with a cross-sectional study design focused on the lecturers working as structural officers (lecturers who hold certain positions e.g. dean, vice dean, etc.) at the university in Surabaya, Indonesia. The study looked into workload and stress as it relates to blood glucose level.

Participant sampling

The data collection process was carried out between 12th and 31st May 2019 at one of the universities in Surabaya, Indonesia. It consisted of the Faculty of Law, the Faculty of Economics and Business, the Faculty of Pharmacy, the Faculty of Veterinary Medicine, the Faculty of Social and Political Sciences, the Faculty of Science and Technology, the Faculty of Public Health, the Faculty of Psychology, the

Faculty of Cultural Sciences, the Faculty of Nursing, the Faculty of Fisheries and Maritime Affairs and the Faculty of Vocational. The independent variables of this study were mental workload and stress level while the dependent variable was glucose level. The samples obtained totaled as many as 109 subjects using proportional random sampling with the inclusion criteria of lecturers working as a Structural Officer including the Dean, the Heads of Department and Study Program Coordinators aged 35-60 years old. Subjects with a history of malignancy or diabetes were excluded.

Measurement

The data on the independent variables obtained by completing the National Aeronautics and Space Administration Task Load Index (NASA-TLX) questionnaire (14). This is a method that used to analyze the mental workload of workers. There was a six-item scale consisting of Mental Demand (MD), Physical Demand (PD), Temporal Demand (TD), Own Performance (OP), Effort (EF) and Frustration level (FR). NASA-TLX measurements were carried out by evaluating two stages, namely weighting each scale (paired comparison) and grading work (rating/event scoring). The score interpretation consisted of low (0-9), moderate (10-29), rather high (30-49), high (50-79) and very high (80-100). The NASA-TLX instrument was tested for validity and reliability with a Cronbach's alpha of 0.84 (15).

The instrument used to measure stress was the Perceived Stress Scale (PSS)(16). This scale is designed to measure the extent to which situations in an individual's life are assessed as stressful. This scale consists of 10 items based on the experiences and perceptions of individuals about what is felt in their lives including feelings of unpredictability, feelings of uncontrollability and feelings of depression (16). The data scores were categorized as mild stress (0-13), moderate stress (14-26) and severe stress (27-40) (17). Cronbach's alpha was 0.71 (18).

Blood glucose level was measured using the Easy Touch Blood Glucose Meter. It was done using an electrochemical detection technique, which is a glucometer monitoring system developed for the rapid determination (<25 seconds) of glucose concentration. This is facilitated over a wide range of glucose concentrations (20-600 mg/dl) from small amounts of capillary whole blood samples (about 4 µl). The results showed that 98.3% of the readings were in the interval of ± 20%. Thus the tools meet ISO standards (19). The interpretation of the scores according to PERKENI 2015 for the GDS measurement was normal at <100 mg/dl, pre-DM at <200mg/dl and positive for DM at ≥200 mg/dl (11). In this study, it was said to be normal if their blood glucose was ≤100 mg/dl and not normal at >100mg/dl. A one-time blood glucose measurement was carried out and chosen by the researchers due to the limitations related to involving the subjects in repeated blood sugar checks, as well as the limited funds available for conducting HbA1c examinations.

Data analysis

The statistical analyses were performed using SPSS(20). Descriptive statistics were used to present the descriptive characteristics of the subjects. Fisher's exact test was used to make sure that the data was homogeneous. The normality test used was Kolmogorov-Smirnov and the

bivariate test used was Spearman Rho to analyze the correlation between both variables. A p-level of < 0.05 was accepted as the level of significance.

Ethical considerations

The Ethical Commission approved of this study in the domain of Health Research at the Nursing Faculty of X University No. 1395-KEPK. Written consent was obtained from all centers. The aim of the study was explained to the participants and signed informed consent forms were collected.

RESULTS

Based on Table 1, the demographic characteristics of the subjects indicate that there are more females (62: 56.9%) than males (47: 43.1%). The most common age range was 41-60 years old, totaling as many as 92 (84.4%). The distribution of marital status showed that the subjects who married totaled 102 (88.7%). The data shows that the highest level of education was a doctoral degree (81.3%). The subjects were mostly the head of a department (41: 37.6%) and study program coordinators (47: 43.1%). Most of the subjects had been worked for 10-25 years (55: 50.5%).

Table 1. Characteristics of subjects (n=109)

Characteristics	n	%	p
Gender			
Male	47	43.1	0.232
Female	62	56.9	
Age			
35-40 years	17	15.6	0.000
41-60 years	92	84.4	
Marital status			
Married	102	88.7	0.469
Widowed or widower	7	11.3	
Education			
Master	28	25.7	0.385
Doctor	81	73.4	
Structural level			
Dean	2	1.8	0.035
Vice-dean	9	17.4	
Head of the department	41	37.6	
Study program coordinator	47	43.1	
Length of work			
<10 years	9	8.3	0.487
10-25 years	55	50.5	
> 25 years	45	41.3	

In Table 2, the data analysis on the relationship between mental workload and blood glucose level obtained a proportion coefficient of (p=0.003). The strength of the relationship between two variables is 0.279, which means that there is a positive relationship. The higher the workload, the higher the blood glucose level. The results of the data analysis of the relationship between stress level and blood glucose level obtained a proportion coefficient of (p=0.003). The level of relationship between the two variables is 0.282, which means that there is a positive relationship. This means that the higher the stress level, the higher the blood glucose level.

Table 2. Correlation of mental workload and stress level with blood glucose levels (n = 109)

Variables	Glucose				Total		p	r
	Normal		Abnormal		n	%		
	n	%	n	%				
Mental Workload								
Moderate	8	7.3	4	3.7	12	11	0.003	0.279
Quite High	27	24.8	16	14.7	43	39.4		
High	19	17.4	35	32.1	54	49.5		
Total	54	49.5	55	50.5	109	100		
Stress Level								
Mild	4	3.7	5	4.6	9	8.3	0.003	0.282
Moderate	50	45.9	35	32.1	85	78		
Severe	0	0	15	13.8	15	13.8		
Total	54	49.6	55	49.5	109	100		

DISCUSSION

The results found that the higher the mental workload, the higher the blood sugar value. Basically, mental workload refers to a mental activity that cannot be directly observed (21). Mental workloads that are overloading and exceeding the individual's ability will result in stress and disrupt the body's metabolism including that of glucose, thus resulting in the risk of an increasing blood sugar value (13). One of the professions with a high workload is a lecturer (9). Lecturers are educators who have a credit load of 12 to 16 credits, working approximately 7.5 hours (22). The mental burden is quite heavy especially for the lecturers who also serve as structural officials. The extra work hours lessen the rest periods and this has an impact on their metabolism, including the work of the organs such as the liver and pancreas (1). The relationship between the mental workload and blood sugar value is significant due to the high mental workload felt by the structural officials. Thus high scores for mental load, time and effort are theoretically related (21).

This research is different to the study conducted by Nisa (2018). It was shown that there is no significant relationship between mental workload and metabolic syndrome. The researchers said that the association between increased blood sugar and the incidence of metabolic syndrome, including partial DM, is due to excessive fruit consumption(23). The research resulted in findings that were not same as those in this study, which showed that mental workload is related to blood glucose value because it is strengthened by the indicators of mental workload, namely where the mental needs and demands of the officials were high enough to unwittingly disrupt the body's metabolic system and increase the action of the hormone catecholamines, glucagon and cortisol. These hormones can increase the blood sugar level. However, according to the results of this study, the strength of the relationship between the mental workload and the blood sugar value has a weakness caused by some inhomogeneous data such as age, structural position and the number of sweet drinks drunk (10).

In this study, the relationship between stress level and blood glucose value was found to be very closely related. In this study, the level of stress that occurs is largely due to pressure and work demands. The results of this analysis are supported by the results of a study conducted by Ullah (2016) indicating that most people with diabetes experience stress before they have diabetes. Their blood glucose then increases very significantly when they have diabetes (24,25). Based on the analysis of the literature

and the results of this research, long-term stress can unwittingly increase the value of blood glucose to the point of causing DM. An increase in glucose can be more severe when the individuals experience stress when they already have DM.

This research shows that the subjects felt unable to control important things. The subjects also sometimes felt unable to finish their work on time, so they felt oppressed. Besides this, the subjects were also easily ill-tempered because they were unable to control their situation. In this study, the frequency distribution of the demographic data showed that women between the ages of 41-60 years had more of a mental burden than others at work. A person's stress level can be more severe if the person also has a conflict at home (4,23). Their stress will increase if the quality performance of the person is decreased (26). Women must be able to manage the problems that occur both at work and home. When both are unable to be overcome, their stress level will arise. This can endanger the individual's condition because the condition accelerates the process of increasing glucose (27).

In addition, in this study, there were more subjects aged 41-60 years old than subjects aged 35-40 years old. An increased age will also affect a person's psychological state. In late adulthood, the deterioration of bodily functions will cause the metabolism to no longer be optimal. This means that the blood sugar can rise and trigger various degenerative diseases such as DM. Therefore, the stress experienced by women puts them more risk of an increase in their blood sugar level. This increase occurs more quickly if the patient is a late adult approaching the elderly age phase due to the decreased function of the body's organs. The body's metabolism, including glucose metabolism, is disrupted, resulting in an increase in blood glucose (28).

Regarding the occupation factor for those who serve as a structural officer, the highest subject distribution was dominated by Study Program Coordinators. This involves a considerable amount of time and work, and any associated stress can increase their glucose level (23). This study also found that the factor of the length of employment as structural officials, for those who had a working span of more than 10 years, resulting in more moderate stress and abnormal blood sugar values than those who worked for less than 10 years. The number of structural officials who have an abnormal blood sugar value is high. The more extended the individual's work, the more that stress occurs. This can unknowingly increase the blood sugar value (29).

In this study, the highest subject distribution was for those undertaking a doctoral degree with moderate stress and abnormal glucose values. Stress can be influenced by several factors such as work, the length of work, education, and disease factors (30,31). The relationship between the factors of a recent high education and glucose values is not known with certainty but there is a possibility that there are stress factors. This is because the higher the education level, the higher the performance and targets that need to be achieved. The teaching staff, especially those who have served as structural officials, have more jobs compared to other educators. The work that piles up requires sufficient time to finish it (4). In this study, it was also found that the demands of time and the burden of thoughts that they experience causes their stress levels to increase. Besides that, an educator who holds multiple special roles in his field needs to maintain his performance. This requires considerable effort. This effort, if the achievement target has not been reached, can cause stress ranging from mild to severe depending on the ability of the individuals to accept it (32). Regarding the distribution of the subjects in this study, most were married. Someone who is married has a different workload compared to an unmarried person, especially for women as they work in addition to being a wife and/or mother (33). Women must be able to manage the problems that occur when at work and at home. They may be unable to overcome problematic eating which can endanger the condition of individuals. This is because this condition can accelerate the process of increasing glucose (27).

More stress will decrease one's self-management, especially in terms of controlling stress. This can increasingly trigger an increase in blood glucose (34). Stress can increase glucose due to stress stimulating the endocrine organs to excrete epinephrine. It has a powerful effect including causing the onset of gluconeogenic processes in the liver, thus releasing large amounts of glucose into the blood (35). Stress will not cause physical illness but if the stress is severe and ongoing, then a chronic physical disease can arise. This happens because the immune system is reduced, and hormone imbalances occur in people who are experiencing stress. Stress hormones (adrenaline and cortisol) can trigger the liver to provide more sugar to the blood in order to provide energy (1). This is very dangerous because an increase in glucose can result in DM.

LIMITATION

The limitation of this study was that blood sugar level was assessed using a one-time glucose measurement via a glucometer.

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CONFLICT-OF-INTEREST DISCLOSURE

No potential conflict of interest relevant to this article was reported.

CONCLUSION

Based on the research, it can be concluded that there is a relationship between mental workload and stress on the blood sugar level of the lecturers working as structural

officers at the university in Surabaya, Indonesia. This is evidenced by the existence of a high score for the aspects of mental needs and time demands. Further research is expected to be able to examine the other factors that can increase the value of the blood sugar level. This is in addition to conducting research into the differences in mental workload, stress level and blood sugar levels in relation to both structural and non-structural officials and a bigger sample of subjects. In addition, an examination of the blood glucose using the HbA1c indicator needs to be considered for more accurate results and the study should also compare a workday with a weekend or off day.

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