



Frequent Interruptions with Light-intensity Calisthenics Reduced Postprandial Hyperglycemia during Prolonged Sitting

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ABSTRACT

Individuals with high levels of sedentary time may have significantly increased the relative risk of diabetes, cardiovascular events, cardiovascular mortality, and all-cause mortality, respectively. This study examined the acute effects of interrupting prolonged sitting with light-intensity calisthenics on postprandial hyperglycemia in healthy adults. Thirty normoglycemic university students participated in this research. Each participant consumed standard 75-grams glucose. The treatment was divided into two trials. First, the control trial, the participants were instructed to sit for five straight hours. The profile of changes in blood glucose was taken at an interval of 30 minutes from minutes 0, 30, 90, 120, 180, 240, and 300. Second, the experimental trial was the same with the control trial except that the participants did light-intensity calisthenics for 3 minutes then sit for 27 minutes, repeating this activity at the 30-minute intervals. Data were analyzed using a paired T-test. The baseline data between trials were not significantly different in some points of blood glucose recording. There was a decrease in the blood glucose level of the experimental group. However, those decrements were not significant statistically. This study found that interrupting sitting time with short bouts of light-intensity calisthenics reduced postprandial hyperglycemia. However, this light-intensity activity reduced the postprandial hyperglycemia although not at a significant level. Given these positive effects observed in healthy participants, it seems prudent to regularly break periods of prolonged sitting with brief bouts of activity. Further study is recommended on more frequent light-intensity bouts of exercise and shorter periods of uninterrupted sitting and at a higher intensity.

Keywords: Prolonged sitting, postprandial hyperglycemia, light-intensity calisthenics.

INTRODUCTION

Diabetes mellitus (DM) is a chronic disease characterized by blood glucose levels (blood sugar) exceeding average values. In type 2 diabetes, blood sugar levels increase due to insulin

resistance due to poor lifestyle (Hilda, 2012). The excessive sugar content of foods can increase blood sugar, causing diabetes.

The prevalence of diabetes was appraised to be 6.4% in 2010, and this will rise to 7.7% in 2030 (Shaw, Sicree & Zimmet, 2010). The World Health Organization (WHO) has forecasted that the worldwide prevalence of diabetes mellitus will surge to 300 million cases in the year 2025 (Pradeepa, Deepa & Mohan, 2002). According to the International Diabetes Federation (IDF), the national occurrence of diabetes in older adults aged ≥ 60 years old in Indonesia was 9 million cases in 2014. The death of 175,936 older adults in Indonesia is due to diabetes, and the incidents of diabetes in older adults that are undiagnosed is 4,854. Even currently the prevalence of diabetes mellitus among older adults in Indonesia is placed fourth in the world after India, China, and the United States of America (Shaw, Sicree & Zimmet, 2010).

Currently, the development of science and technology has changed the human lifestyle where humans become increasingly inactive by spending 70% or more of their time sitting (Owen et al., 2010). Examples of behaviors from inactive lifestyles are driving a car, working at a desk, eating at a desk, playing video games, using the computer, and watching television (Kartzmarkzyk et al., 2009). These inactive lifestyles have consequences in the health sector. When engaging in idle activities, there is less muscle energy (Stephens et al., 2011), which causes insulin resistance where it can lead to diabetes (Amati, et al., 2009), and increase blood pressure (Carretero & Oparil, 2000).

There are many interventions to reduce blood glucose levels and high blood pressure. One way is by physical activity or exercise (Colberg et al., 2010). One of the simplest ways of physical activity is gymnastics and walking (Iwamoto et al., 2009). Regular physical activity is beneficial in controlling blood glucose levels and has a positive impact on blood pressure, lipids, and reduces the risk of death and increases the quality of life. Physical activity has been proven to reduce the risk of type 2 diabetes by 58% in high-risk populations (colberg et al., 2010).

Exercise is known to increase the use of glycogen by skeletal muscle (Routen, 2010) and reduce blood pressure (Fagard & Cornelissen, 2007). Doing a short exercise break for 2 minutes after sitting for 20 minutes is quite effective in reducing postprandial blood glucose levels by 24.1% (Dunstan et al., 2012). Based on the study above, the study of the effects of intermittent exercise

could reduce the risk of chronic hyperglycemia, for this reason the researcher identifies state of the problem, where is there any effect intermittent in gymnastics in postprandial blood glucose levels during prolonged sitting.

LITERATURE REVIEW

Technological developments in all aspects make people spend more time with inactive lifestyles (Hamilton, 2007). Sedentary / lifestyle is not active is a Latin term "sedere" which means to sit. This term is used to classify activities with low energy expenditure, such as prolonged sitting, both at work or leisure (Owen et al., 2009). A sedentary lifestyle is an activity carried out with low energy expenditure such as sleeping, lying down, playing computer, and watching television (Pate et al., 2008).

Healy et al. (2008) reported a close relationship between prolonged inactivity and reduced insulin sensitivity in healthy people, causing type 2 diabetes. Owen et al. (2010) reported that the duration of sitting causes reduced contraction in the muscles that suppress lipoprotein lipase activity in the muscles needed to metabolize triglycerides and HDL cholesterol and decrease glucose uptake in the blood.

Lack of physical activity is related to insulin activity (Ekelund et al., 2009) and is a precursor of type 2 diabetes, which is a significant feature of metabolic syndrome (Helmerhorst et al., 2009). Insulin resistance in the liver can cause dyslipidemia and increases the risk of atherosclerosis associated with metabolic syndrome (Biddinger et al., 2008). Increased time spent on inactive lifestyles and reduced physical activity of mild to moderate intensity is indirectly associated with the risk of metabolic syndrome (Bertrais et al., 2005) and slows lipoprotein lipase activity and results in disruption of triglyceride and HDL cholesterol metabolism (Hamilton et al. , 2007).

Physical activity is also a vital part of management adherence and thus, essential to diabetes care in adult patients. The risks linked to physical inactivity in older adults can be significant because of the prevalence of atherosclerosis, coronary heart disease (CAD), and cerebrovascular disease among them (Meulemen et al, 2000). Physical activity is problematic for many older adults because of the waning of muscle mass and general mobility, strength, and energy. These problems may increase some risks for falls, injuries, and fractures to the weakening of the muscles. Therefore, physical activity among older adults needs to be scheduled, and safety should be deliberated. At least 30 minutes of physical activity per day,

and strength training physical activity helps sustain muscle mass, and energy increases balance and well-being (American Diabetes Association, 2015).

Physical activity programs such as an exercise program should be planned based on the physical and physiological situations of older adults. Care should be exercised to avoid muscular strains, sprains, and injury to the feet or joints. Type 2 diabetes mellitus neuropathy, with the loss of sensation of pressure and pain, can result from foreign objects and abnormalities in gait, and foot injury from poorly fitting shoes (Strauss, & Christensen, 2014). Physical activity that brings about hypoglycemia is another possible risk, particularly in patients consuming oral antihyperglycemic agents or insulin; therefore, the glucose-lowering effects of physical activity should be assessed. In contrast, worsening hyperglycemia can occur during physical activity in patients whose glycemia is poorly controlled (American Diabetes Association, 2004).

METHODS

The method used in this study is experimental. The samples in this study were 30 students selected by purposive sampling method. The criteria used in selecting samples in this study are: 1) Respondents in this study were 30 students at the Adventist University of Bandung, 2) no history of diabetes mellitus in the family 3) normal body mass index and normal fasting blood glucose. The participants were oriented in the research. First, the researchers explained the purpose and usefulness of the study, as well as the ethics of data collection. The researcher asked the respondent to fast at night and checked the blood sugar the next day. Each participant consumed standard 75-grams glucose.

RESULTS

Table 1 *Characteristics of the Study Participants*

Age (year)	<u>Body Mass Index</u>		Heart Rate (beat/min)	<u>Blood Pressure (mmHg)</u>		
	Value	Category		Systole	Diastole	Category
20.9±1.8	21.2±2,9	Normal	79.8±12.9	115.0±12.5	80.8±11.5	Normal

Table 1 shows that the participants were in a healthy range in terms of body mass index, resting heart rate, and blood pressure.

Table 2 Blood Glucose Control Group Profile at Different Time of Measurement

Blood Glucose (minutes) (mg/dl) (mean ± sd)								
	0	30	60	90	120	180	200	300
Mean	89.0	171.1	147.6	135.3	120.5	87.1	84.5	90.2
SD	10.0	43.8	25.2	20.5	24.5	18.2	12.7	12.8

Table 2 shows the result of the mean of the control group in the minutes of 0, 90, 60, 90, 120, 200, and 300. From these data above, it can be concluded that blood glucose arises at the 30th minute after the intake of glucose. In the 60th minute, blood glucose levels start to fall until 200 minutes. However, at the 120th minute, blood glucose levels have returned the normal range of 80-120 mg/dL at 200 minutes to 300 minutes, blood glucose rises again.

Table 3. Description of Control Group and Experimental Group

Time	Experimental		Control	
	Mean	SD	Mean	SD
0	89.6	14.5	91.9	9.96
30	169.3	44.6	175.8	43.7
60	164.1	50.0	150.5	25.2
90	133.6	33.6	136.6	20.5
120	144.7	32.2	120.4	24.5
180	77.7	14.3	84.0	18.1
240	82.5	17.0	79.2	12.6
300	83.9	13.0	83.1	12.7

Table 3 there was an average comparison of experimental and control groups at 0, 30, 60, 90, 120, 180, 240, and 300 minutes. At 0, 30, 90, 120, and 180 minutes from the experimental group, blood glucose levels were smaller compared to the control group with a mean value of

89.67; 169.37; 133.63; 114.47; and 77.76. This means that blood glucose levels in the minutes of measurement time from the experimental group fell better than the control group.

DISCUSSION

Although there was a fluctuation in blood glucose, the paired T-test results in table 4.12 showed insignificant results with $p = 0.69$ greater than $\alpha = 0.05$ ($p > \alpha$).

From the second result of the statistical analysis above shows, the results are not significant. This means that the hypothesis that there is no effect of intermittent in gymnastics on postprandial blood glucose levels during prolonged sitting is accepted. This means that there is no effect of intermittent gymnastic on postprandial blood glucose levels during prolonged sitting.

This is probably due to low-intensity exercise that is done using fat as an energy source so that low-intensity exercise does not withstand the increase in glucose, as Goodwin (2010) said that the energy used when doing low-intensity exercise comes from fat instead of carbohydrates so exercise with low intensity does not hold back increases in blood glucose and Thompson et al. (1998) which states that low intensity exercise has a higher total fat oxidation compared to moderate intensity exercise.

CONCLUSION

The results of data analysis from this study were that there was no effect of intermittent pauses in low-intensity calisthenics on postprandial blood glucose during prolonged sitting with a value of $p > 0.05$ is $p = 0.69$ so that the hypothesis stating there was no effect of intermittent gymnastic pauses on postprandial blood glucose levels during Prolonged sitting is accepted. Although at certain times the blood glucose level in the experimental group fell lower compared to sitting without a break of gymnastics, the data is not statistically significant.

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