Analyzing Factors Associated with Blood Glucose Levels on Female Islamic Student (Santriwati) at Syaichona Cholil 2 Islamic Boarding School in Bangkalan Regency

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Abstract. This is a cross sectional study that aims to analyze the factors associated with blood glucose levels on teenage women. The researcher selected 77 female Islamic students (Santriwati) at the Syaichona Cholil 2 Islamic Boarding School as the respondents by using simple random sampling. The Data were collected by interviews, observations, and measurements which conducted on October 2019. The research variables were the education level, blood pressure status, instant drink consumption, nutritional status, and physical activity which were analyzed by using Correlation Rank Spearman with significance $\alpha = 0.05$. The results showed that factors related to blood glucose levels are blood pressure status ($p = 0.035$) and physical activity ($p = 0.023$); while the level of education ($p = 0.571$), instant drink consumption ($p = 0.955$), and nutritional status ($p = 0.159$) are not associated with blood glucose level. The school suppose to conduct blood glucose screening test on teenagers for early detection of at-risk teenagers.

Keywords: Blood Glucose Levels, Education Level, Blood Pressure, Instant Drink Consumption, Nutritional Status, Physical Activity

1. Introduction

Nowadays, the world faces the challenges of epidemiological transition, where the main causes of morbidity and mortality that were significantly caused by infectious diseases.

U-Go Healthy 2020, March 29, Pacitan, Indonesia

DOI 10.4108/eai.29-3-2020.2314902

However, this time the most significant cause is non-communicable diseases. Based on World Health Organization data (2018), they are 70% of non-communicable diseases which cause human death in the world.

One of Non-communicable diseases which cause human death in the world is diabetes mellitus. In 2015, it was noted that diabetes mellitus occupies the 7th position out of ten main causes of death in lower middle income countries and occupies the 6th position in upper middle income countries, and occupies the 8th position in high income countries (World Health Organization, 2018).

Diabetes mellitus is a serious health problem that occurs both in developing countries and in developed countries. 350 million people in the world suffer the type 2 of diabetes mellitus significantly. It is estimated that in 2045, the number of people who suffer diabetes mellitus increases to 700 million people. Unfortunately, it is estimated that one in two people who suffer from diabetes mellitus apparently does not realize that he has diabetes mellitus. This implies that 50% of people who suffer from diabetes mellitus are not diagnosed (International Diabetes Federation (IDF), 2018).

Diabetes mellitus (DM) or diabetes is a chronic metabolic disorder which is caused by the pancreas does not produce enough insulin or the body cannot use insulin effectively. Insulin is a hormone that regulates the blood sugar levels in a person's body. If the body does not produce enough insulin or the body can not use insulin effectively, the blood glucose levels will increase. This could bring up a high blood glucose level (hyperglycemia). Hence, this result initiates the occurrence of diabetes mellitus (Kemenkes RI, 2014).

There are two types of diabetes mellitus, namely type 1 diabetes which refers to a lack of insulin production by the pancreas and type 2 diabetes which is characterized by a lack of effective use of insulin produced by the body. The most common type of diabetes suffered in Indonesia is type 2 diabetes. 90% of all diabetes cases are type 2 diabetes (Kemenkes RI, 2014).

WHO states that Indonesia is the 7th country with the highest prevalence of diabetes mellitus after China, India, USA, Brazil, Russia, and Mexico. Indonesia has 10 million people who suffer diabetes mellitus (WHO Indonesia, 2015). In addition, WHO also predicts that the people who suffer diabetes mellitus in Indonesia will increase 2-3 times, from 8.4 million in 2000 to 21.3 million in 2030 (Soelistijo, 2015).

The results of the Basic Health Research (Riskesdas) in 2013 noted that 6.9% of Indonesia population or around 12 million people suffer type 2 diabetes mellitus (DM). 29.9% of Indonesia population or around 52 million people suffer impaired glucose tolerance (TGT) and 36.6% or around 64 million people suffer Fasting Blood Sugar (GDP). TGT and GDP are normal transition conditions and diabetes which means that people with TGT and GDP have a high risk of developing type 2 diabetes mellitus. Riskesdas in 2013 also noted that from 33 Provinces in Indonesia, East Java was ranked first which has the highest population who suffer type 2 diabetes mellitus. There were 605 thousand people (Kemenkes RI, 2013).

The risk factors of diabetes mellitus can be grouped into two types, namely unmodified risk factors and modified risk factors. Race, ethnicity, gender, age, family history of diabetes, history of childbirth> 4000 grams or <2500 grams are the unmodified risk factors of diabetes mellitus. Overweight, abdominal/central obesity, lack of physical activity, hypertension,

dyslipidemia, unhealthy/unbalanced diet, history of TGT or GDP Disorder are modified risk factors of diabetes mellitus because this refers to behavior patterns and lifestyle (life style) of individuals (Kemenkes RI, 2014).

Diabetic who has a unmodified risk factors and unhealthy lifestyle (lifestyle) can trigger the increasing of blood sugar. If the diabetic does not care of this condition, this will eventually stimulate the occurrence diabetes mellitus. Unhealthy lifestyle, such an unbalanced diet without enough physical activity, often causes diabetes mellitus.

Teenagers are the age groups that are prone to suffer diabetes, because they usually have unhealthy lifestyles, such as, consuming instant food and drink without having a regular exercise so that it can cause the gradual weight gain. Teenagers with unhealthy lifestyles will be at risk of experiencing TGT and GDP Disorder. If they let this risk without any screening and early treatment, the risk of suffering diabetes mellitus will increase when they grow up (Lukács *et al.*, 2018).

The Riskesdas data in 2013 which was cited by the Ministry of Health of Republic of Indonesia (2014) related to the proportion/presentation of Indonesian population who have risk factors for type 2 diabetes mellitus are as follows: teenagers who were 13-18 years had the greatest risk of 14.0% having more weight, 4.1% were obese, and 26.6% were central obesity. 10 years old teens and over has a proportion of 26.1% lacking in physical activity. 10 years old teen and over have an unbalanced diet, such as consuming sweet food or drink more than 1 time in a day by 53.1%, consuming salty food or drink more than 1 time in a day by 26.2%, and consuming food or fatty drink more than 1 time in a day by 40.1%. Meanwhile, according to sex, the group of teenage woman have a greater proportion in suffering the diabetes that is equal to 12.9% compared to teenage man which is equal to 12.9% (Kemenkes RI, 2014).

Diabetics are generally more than 45 years old. However, teenagers and children lately experience the increasing of diabetics (Kemenkes RI, 2014). A research conducted by (Lukács *et al.*, 2018) shows that teenagers have a risk of in suffering diabetes mellitus by 13%. According to Temneanu et al. (2016), teenage woman have a higher proportion of people in suffering type 2 diabetes mellitus compared to teenage man.

Bangkalan Regency is well known as Islamic students (santri) city, because it has a lot of Islamic boarding schools in which the students have full activities. In addition, the students pay less attention to the food supply they consume, so it affects the blood glucose level. If this blood glucose level is more or less, it will be able to attack the student's healthness.

The results of the Basic Health Research (Riskesdas) in 2013 also showed that Indonesian population of 15-25 years had suffered diabetes mellitus by 1.1%, 17.6% of the age group had experienced TGT, and 26.2% of the population had experienced GDP disorder (Kemenkes RI, 2014). This shows that diabetes mellitus does not only affect adults or the elderly. the diabetes mellitus also attacks the teenagers. The proportion of diabetics will increase with age. Therefore, teenagers who have experienced TGT and GDP disorder without any treatment possibily suffer diabetes mellitus when they reach adulthood.

Diabetes mellitus is a silent killer, because this disease causes many complaints and can attack all body organs (Fatimah, 2016). The complications that occur include heart disease and stroke; kidney failure; neoropathy (nerve damage) in the legs which will increase the

occurrence of foot ulcers, infections, and leg amputation; and diabetic retinopathy or a damage of small blood vessels in the retina that can cause blindness. In general, people with diabetes mellitus are two times more likely to experience death than non-diabetics (Kemenkes RI, 2014).

The purpose of this study is analyzing factors related to blood glucose levels in female Islamic students at Syaichona Cholil 2 Islamic Boarding School in Bangkalan

2. Methodology

Study Recruitment

The ethic clearance of this study has been issued by Dian Eka Januriwasti, S.SiT., M. Kes as a chairman of The Health Research Ethics Committee of STIKES Ngudia Husada Madura with certificate number is 338/KEPK/STIKES-NHM/EC/IX/2019

Sampling Technique

This study is an observational analytic with cross sectional approach. The study was selected female students at the Syaichona Cholil Bangkalan Islamic Boarding School as the respondents which were taken randomly by using simple random sampling. 77 female students were selected as research subjects.

Data Collection

The data was taken by the researcher through interviews, observations, and measurements made at female students at Syaichona Cholil Bangkalan Islamic Boarding School. Data collection was conducted on October 2019.

Before data collected, the students were given an explanation of the objectives, benefits, and research procedures. If the student agrees to be the subject of the study, the student will sign an informed concent sheet before conducting interviews and research data collection.

The data taken through interviews with female students were in the form of characteristics of research subjects, while the data taken through observation and measurement were weight, height, blood pressure, and fasting blood sugar levels.

Data Analysis

The data analysis was conducted by using IBM SPSS Statistics 22 with a confidence interval (CI) of 95%. The data of respondent characteristics are explained using a frequency distribution. Data of education level, blood pressure status, instant drink consumption, nutritional status, and physical activity were analyzed by using the Correlation Rank Spearman.

3. Results

General characteristics of research subjects which include age, education level, body weight, height, BMI, nutritional status, blood pressure, instant drink consumption, physical activity, and GDP levels are listed in Table 1.

Table 1: Characteristics of Research Subjects.

Characteristics	n = 77	%
Age (tahun) [a]	16,10 ± 2,06	
Education Level [b]		
SD Graduate	21	27,3
SMP Graduate	48	62,3
SMA Graduate	8	10.4
Weight (kg)	49,29 ± 9,02	
Height (m)	1,49 ± 0,05	
Body mass index (IMT) [a]	22,03 ± 3,59	
Nutritional status [b]		
Underweight		
Normal	11	14,3
Overweight	34	44,2
Obese 1	13	16,9
Obese 2	18	23,4
Systolic Blood Pressure	1	1,3
(mmHg)[a]	102,34 ± 8,26	
Diastolic Blood Pressure		
(mmHg)[a]	73,25 ± 6,97	
Blood Pressure Status		
Hypotension		
Normotension	52	67,5
Hypertension	24	31,2
Instant Drink Consumption	1	1,3
Rarely		
Often	9	11,7
Every Day	22	28,6
Physical Activity	46	59,7
Light		
Medium	48	62,3
Heavy	24	31,2
Fasting Blood Glucose Levels	5	6,5
(mg/dL)[a]	83,34 ± 17,09	
Status GDP		
Low		
Medium	12	15,6
Disorder	55	71,4
High	9	11,7
	1	1,3

The average age value of the subjects in this study is 16.10 ± 2.06 years. Most of the subjects are a junior high school students (62.3%). The average body weight is 49.29 ± 9.02 kg, the average height is 1.49 ± 0.005 m, and the average IMT is 22.03 ± 3.59. Most of the study subjects have normal nutritional status (44.2%). Meanwhile, most subjects have a hypotensive status for the blood pressure status (67.5%), the average systolic blood pressure is 102.34 ± 8.26 mmHg, and the diastolic is 73.25 ± 6.97 mmHg. Most of the respondents consume instant drink every day (59.7%) and physical activity on a light exercise is 62.3%. The average subject GDP level is 83.34 ± 17.09 mg / dL and most of the students are in the normal category (71.4%).

The results of the bivariat analysis of the relationship between determinant factors and GDP levels are listed in Table 2.

Table 2: Bivariat Analysis of Factors Associated with Fasting Blood Glucose Levels.

Variables	Coefficient Correlation	p
Education Level	0,066	0,571
Blood Pressure Status	0,240	0,035*
Instant Drink Consumption	0,007	0,955
Nutritional status	0,162	0,159
Physical Activity	-0,259	0,023*

*Note: * significant on α = 0,05*

Blood pressure status and physical activity variables are significantly related to GDP levels (p = 0.035 and p = 0.023). Blood pressure status and GDP levels have a positive correlation direction with the weak correlation strength. This shows that the increase of blood pressure is in line with the increase of GDP levels. Meanwhile, the physical activity and GDP levels have a negative correlation direction with weak correlation strength. In other words, GDP levels will decrease by increasing physical activity.

4. Discussions

The results of the bivariat analysis showed that there was no significant relationship between the level of education with fasting sugar levels in the study subjects (p = 0.571). This study is in line with the research in Depok which states that there is no significant relationship between education level and fasting sugar levels of Satlantas and Sumda employees in Depok Police (Leoni, 2012). Likewise, the research which was conducted by (Yekefallah *et al.*, 2015) that the education levels are not significantly related to fasting sugar levels. This shows that a person's fasting sugar level does not depend on the level of education. However, this research is not in line with the theory which states that the higher level of education will affect the level of knowledge, in which a person with a higher level of knowledge will be able to maintain his health (Irawan, 2010).

Blood pressure status and fasting sugar levels in the study subjects showed a significant relationship (p = 0.035). This study is in line with research in China which states that there is a significant relationship between blood pressure and fasting sugar levels (Lv *et al.*, 2018). This

study is also in line with research in Korea which states that early blood pressure is associated with the diabetes increasing of individuals (Cho *et al.*, 2015). Some theories that might explain the relationship of blood pressure and fasting sugar levels are the mechanism in the Rennin Angiotensin System (RAS) (Zhou *et al.*, 2015; Jia, DeMarco and Sowers, 2016; Emdin *et al.*, 2015), and endothelial and inflammatory dysfunction (Conen *et al.*, 2007). However, various studies state that the mechanism of the relationship cannot be explained with certainty.

Bivariate analysis results showed that there was no significant relationship between instant drink consumption and fasting sugar levels in the study subjects ($p = 0.955$). This study is in line with research in Nigeria which states that the instant drink consumption does not affect the diabetes increasing, because it does not have a significant concentration in healthy individuals (Adeleke, Olaniyan and Adeousun, 2013). However, this study is not in line with research in America which states that soft drink (instant drink) can increase sugar levels in school children (Harrington, 2008). Epidemiological studies have provided substantial evidence that regular instant drink consumption can increase the risk of type 2 diabetes increasing (Frank B.Hu, 2009). The results of this study do not relate to fasting blood sugar levels, because soft drink consumption calculations can only be done by calculating how often soft drink are consumed by research subjects without calculating the amount of calories and sugar contained in various soft drink. In addition, the amount calorie and sugar content in soft drink can vary in each package.

The weight gain or obesity is a major causes in the increasing of blood sugar levels so that it can cause type 2 DM, because an increase of BMI can cause a decrease of sensitivity of insulin (Hermawan, 2012). However, in this study, there was no significant relationship between nutritional status and fasting sugar levels in the study subjects ($p = 0.159$). This study is in line with research in Nigeria which states that there is no significant relationship between nutritional status and fasting sugar levels in diabetic patients receiving treatment at the Federal Medical Center, Owo, Nigeria (Oladapo and Koleosho, 2013) and research on high school students in North Denpasar (Astiti and Dwipayana, 2018). Anthropometric measurement to assess the nutritional status is considered practical to measure a person's nutritional status at the population level (Sugondo, 2006). However, the exact type of measurement as a predictor of DM needs to be considered. Several studies have supported the use of waist circumference and waist to hip ratio rather than body mass index as an important and independent predictor of diabetes mellitus (Etukumana, Puepet and Obadofin, 2014).

The results of the bivariat analysis showed that there was a significant relationship between physical activity and fasting sugar levels in the study subjects ($p = 0.023$). This study is in line with research in Palu, Indonesia which states that high level of physical activity is effective in reducing sugar levels of high school teachers (Sakung *et al.*, 2018). The increase of glucose use by the muscles will increase when a person performs heavy physical activity, because endogenous glucose keeps the balanced blood sugar levels. Under normal circumstances, the balanced blood sugar levels can be achieved by various mechanisms of the nerve system, glucose regulation, and hormonal conditions (Kronenberg, 2008).

5. Conclusion

Blood pressure status and physical activity aree factors related to blood glucose levels; while the level of education, instant drinking consumption, and physical activity were not related to the blood glucose levels. The high risk of diabetes mellitus of teenager requires quite serious attention. Screening or early detection of blood glucose levels in schools needs to be applied so that early treatment can be done for the students who are at risk. Thus, this step can prevent the type 2 diabetes mellitus in the future.

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