Nutritional Status, Blood Glucose, and Blood Pressure as Factors for Early Detection of Metabolic Risk in College Students: Observational Research

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Keywords: Metabolic Syndrome, Body Mass Index, Blood Glucose, Blood Pressure.

Abstract: Metabolic health problems are increasingly receiving attention among students because modern lifestyles tend to be less active and unhealthy eating habits. Nutritional status, random blood glucose, and blood pressure are important indicators that can provide an overview of a person's metabolic health status. Low awareness of the importance of metabolic disorders early detection and lack of understanding of the relationship between nutritional status, random blood glucose, and blood pressure can cause delays in preventative action and management of the risk of metabolic disorders. This study aims to determine the relationship between nutritional status, random blood glucose, and blood pressure as factors for early detection of the risk of metabolic disorders in students. This observational study with a cross-sectional approach was conducted in July 2023 in Universitas Respati Yogyakarta and carried out on health students from several health study programs taken by accidental sampling. The number of samples in the research was 35 respondents. The instruments used were microtoise, body scales, digital blood pressure meter, glucometer, and recording sheet. The respondents' average body mass index (BMI) was 25.84, with a body weight of 63.76 kg and a height of 157.31 cm. Respondents' average random blood glucose and blood pressure were respectively 89.63 mg/dL and 112/80 mmHg. Body weight and BMI correlate fairly strongly with diastolic blood pressure, with r=0.394 (p=0.019) and r=0.414 (p=0.013). A relationship exists between body weight and BMI with diastolic blood pressure. It is hoped that the research results will provide further insight into the importance of early detection of metabolic risk in students so that it becomes a more effective prevention and health intervention strategy in the campus environment.

1 INTRODUCTION

College is a critical phase of life, where students face new academic, social, and environmental demands that can impact their health. A health problem that is often found is metabolic syndrome disorder. Metabolic syndrome is a group of symptoms from various cardiometabolic risk factors including insulin resistance, glucose intolerance, dyslipidemia, and central obesity. This condition increases the risk of cardiovascular disease, type 2 diabetes, orthopedic problems, and mental disorders (Djausal, 2015). Someone is categorized to suffer from metabolic syndrome if they experience at least three of five conditions, namely hypertension (high blood pressure), low HDL levels (dyslipidemia), high triglyceride levels, high blood sugar levels or prediabetes, and obesity with fat accumulation in the abdomen (Rahma Listyandini, Fenti Dewi Pertiwi, 2020)

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Sucipto, A., Puspaningtyas, D. E., Sari, P. M., Styaningrum, S. D., Rahmawati, D. M., Lestari, G. P., Sintia, R. D. and Ananda, D. P.
Nutritional Status, Blood Glucose, and Blood Pressure as Factors for Early Detection of Metabolic Risk in College Students: Observational Research.
DOI: 10.5220/0013660300003873
Paper published under CC license (CC BY-NC-ND 4.0)
In *Proceedings of the 1st International Conference on Medical Science and Health (ICOMESH 2023)*, pages 50-54
ISBN: 978-989-758-740-5
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Metabolic diseases have increased significantly among the global population. Previous research showed that the prevalence of metabolic syndrome among the global population is 20-25% (Rini, 2015). College students, as a relatively young age group, are often considered to be at low risk for these diseases. However, lifestyle changes, unhealthy diets, and high levels of stress can lead to increased metabolic risk in this group. The results of a research study conducted by Wohangara and Santoso showed that the majority of the nutritional status of Tarumanagara University students class of 2017 was obese (45.2%), did not exercise (41.1%), and had the habit of consuming junk food once per week (Wohangara and Santoso, 2021). Cases of metabolic syndrome in adolescents have increased over the past year last decade. Research conducted by Dieny et al found that the increase in the incidence of metabolic syndrome in adolescents was caused mainly by an increase in obesity rates among adolescents (Dieny, Widyastuti and Fitranti, 2015).

Some of the reasons for the increase in the prevalence of metabolic syndrome in teenagers are due to lack of physical activity, fast food, stress, lack of sleep, and high sugar (Rochmah *et al.*, 2014). Students tend to spend a lot of time in front of screens, whether studying, working, or socializing digitally, which can lead to a decrease in physical activity. Apart from that, unhealthy food choices and the habit of consuming drinks high in sugar also contribute to the increased risk of metabolic health problems among students.

This situation is a serious concern because metabolic health problems can impact academic performance, psychological well-being, and overall quality of life (Rochmah *et al.*, 2014). Students who experience metabolic health problems tend to face a high risk of long-term illnesses, such as type 2 diabetes, heart disease, and other health problems. Therefore, further understanding of the factors that cause and influence metabolic health problems among students is very important to develop effective prevention and intervention strategies, one of which is through early detection of the risk of metabolic syndrome. Early detection can be done by carrying out routine checks such as adolescent nutritional status, blood pressure, and blood glucose levels in adolescents. Therefore, regular examinations are key in preventing and managing metabolic syndrome in adolescents (Sihombing and Tjandrarini, 2015).

2 METHODS

This research is an observational study with a cross-sectional approach. This study aims to determine the relationship between nutritional status, random blood glucose, and blood pressure as factors for early detection of the risk of metabolic disorders in students. Data collection was carried out at the Anthropometry Laboratorium, Universitas Respati Yogyakarta in July 2023. This research population was active students of the Faculty of Health Sciences, Universitas Respati Yogyakarta totaling 35 students. The sampling process is carried out by *accidental sampling.* The tools used in collecting data are microtoise, body scales, digital sphygmomanometers, glucometers, and recording sheets.

The data collection process is carried out by taking anthropometric measurements (body weight and height) first, after that measuring blood pressure and checking blood glucose which are then recorded in an observation sheet. The data collection process was assisted by three student research assistants who played a role in anthropometric measurements and blood pressure checks. All assistants have obtained previous perceptions to be able to carry out valid measurements on respondents.

All respondents were explained the entire research process, their rights, and obligations. Respondents signed informed consent as an agreement to participate in the research. The data collection process is carried out after obtaining the ethical clearance from the Health Research Ethics Commission, Faculty of Health Sciences, Universitas Respati Yogyakarta with number 056.3/FIKES/PL/V/2023 and research permit number 088/PPPMPL-Eks/V/2023. The data normality test used Shapiro Wilk because the sample size was <50 people. Normality test results for body weight, body height, body mass index (BMI), random blood glucose, and diastolic blood pressure were normal (>0.05). The bivariate variable test uses the Annova because the data is from more than 2 categories and is normally distributed. For the data not normally distributed, the statistical analysis used is Kruskal-Wallis.

3 RESULTS AND DISCUSSION

Table 1 presents the data on respondent characteristics. Based on the characteristics of the respondents, it is known that the normality test results

with *Shapiro-Wilk* showed that age and systolic blood pressure data were not normally distributed.

Table 1. Characteristics of Respondents

Variable	Mean±SD	p#
Age (years)	22 (20 – 23)*	<0.001
Body weight (kg)	63.76±15.16	0.064
Height (cm)	157.31±6.12	0.395
BMI (kg/m^2)	25.84±6.41	0.083
Random blood glucose (mg/dL)	89.63±12.78	0.497
Systolic blood pressure	112 (99 – 136)*	0.004
Diastolic blood pressure	80.54±8.42	0.093

*median (minimum-maximum)
#normality test with Shapiro-Wilk

The median age of respondents is 22 years with a minimum age of 20 years and a maximum of 23 years. The average body weight of respondents was 63.76 kg with a standard deviation (SD) of 15.16 kg. The average height of respondents was 157.31 cm with an SD of 6.12 cm. The average body mass index (BMI) of respondents was 25.84 kg/m2 with a SD of 6.41 kg/m2. The mean random blood glucose (GDS) was 89.63 mg/dL with an SD of 12.78 mg/dL. The median systolic blood pressure is 112 mmHg with a minimum and maximum range of 99-136 mmHg, while the average diastolic blood pressure is 80.54 mmHg with an SD of 8.42 mmHg.

Based on Figure 1, there is a difference in nutritional status based on Asian standards and Indonesian standards. Based on Asian standards, the number of respondents in the normal category is less than the Indonesian standard. Meanwhile, the Asian standard overweight category is higher than the Indonesian standard. This is because the Asian standard categorization range for normal BMI is narrower than the Indonesian standard, in which the Asian standard for normal BMI is 18.5 – 22.9 kg/m^2 while the Indonesian standard for normal BMI is 18.5 – 25 kg/m^2 (Iqbal and Puspaningtyas, 2018).

Table 2 shows differences in the characteristics of health indicators based on nutritional status based on Asian standards. The median age for underweight and normal group is 21 years, with an age range between 20 and 23 years. Body weight increased along with increasing nutritional status, with the highest value in the obesity group (78.01 ± 11.66 kg) and the lowest in the underweight (44.2 kg). The average height of the normal group (159.13 ± 6.29 cm) tends to be higher than the nutritional status of other groups. BMI increased along with increasing nutritional status, with the highest value in the obesity group (32.39 ± 4.57 kg/m2) and the lowest in the underweight group (18.16 kg/m2).

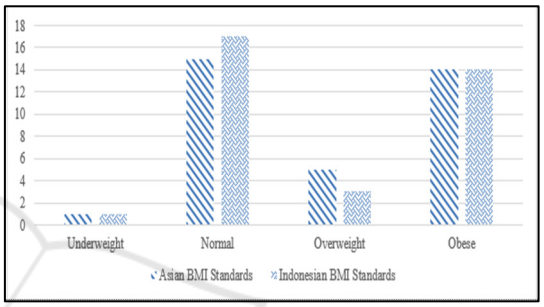

Figure 1. Distribution of Nutritional Status Based on Asian Standards and Indonesian Standards

The average random blood glucose in each group was within the normal range (73-90 mg/dL). Median systolic and diastolic blood pressure for each group was within the normal range. There were no significant differences in age, height, random blood glucose, or systolic diastolic blood pressure between the underweight, normal, overweight, and obese groups (p=0.700; 0.378; 0.614; 0.693; 0.216). There are significant differences in body weight and BMI between the underweight, normal, overweight, and obese nutritional status groups (p<0.001).

Table 2. Differences in Characteristics of Health Indicators Based on Asian Standard Nutritional Status

Variable	Mean ± SD				
	Underweight	Normal	Overweight	Obesity	p
Age (years)	21	21 (20-23)*	22 (20-23)*	22 (20-23)*	0.700*
Body weight (kg)	44.2	52.12± 6.74	62.68 ± 6.17	78.01± 11.66	<0.001*^
Height (cm)	156	159.13± 6.29	158.10 ± 6.18	155.16 ± 5.88	0.378**
BMI (kg/m^2)	18.16	20.51± 1.43	25.03 ± 1.19	32.39 ± 4.57	<0.001*^
Random blood glucose (mg/dL)	73	89.93± 14.29	88.40 ± 7.23	90.93 ± 12.93	0.614**
Systolic blood pressure	112	113 (99-136)*	111 (104-116)*	116 (104-136)*	0.693*
Diastolic blood pressure	84	78.73± 7.29	76.00 ± 6.32	83.86 ± 9.56	0.216**

*median (minimum-maximum)
kruskal-wallis
**Annova
^significant at p<0.001

Table 3. Differences in Characteristics of Health Indicators Based on Indonesian Standard Nutritional Status

Variable	Mean ± SD				
	Underweight	Normal	Over weight	Obesity	p
Age (years)	21	22 (20-23)*	21 (20-22)*	22 (20-23)*	0.568*
Body weight (kg)	44.2	52.89 ± 6.72	65.37 ± 6.61	78.01 ± 11.66	<0.001*^
Height (cm)	156	158.82 ± 5.96	159.17 ± 8.43	155.16 ± 5.88	0.394**
BMI (kg/m^2)	18.16	20.91 ± 1.77	25.77 ± 0.64	32.39 ± 4.57	<0.001*^
Random blood glucose (mg/dL)	73	89.71 ± 13.38	88.67 ± 10.21	90.93 ± 12.93	0.622**
Systolic blood pressure	112	111 (99-136)*	113 (104-116)*	116 (104-136)*	0.796*
Diastolic blood pressure	84	78.29 ± 6.97	76.67 ± 8.62	83.86 ± 9.56	0.247**

*median (minimum-maximum)
kruskal-wallis
**Annova
^significant at p<0.001

Table 3 shows the differences in characteristics of health indicators based on nutritional status based on Indonesian standards. The median age for the underweight and overweight group is 21 years old, with an age range of 20 to 23 years. Similar to Asian standards, body weight increased along with increasing nutritional. The average height of the overweight group (159.17±8.43 cm) is considered to be higher than the nutritional status of other groups. There is a difference in BMI for the normal group (20.91 kg/m2) and overweight group (25.77 kg/m2) based on the Indonesian standard and Asian standard, in which the Indonesian standard is higher than the Asian standard. There were no significant differences in age, height, random blood glucose, or systolic diastolic blood pressure between the underweight, normal, overweight, and obese groups (p=0.568; 0.394; 0.622; 0.796; 0.247). There were significant differences in body weight and BMI between the underweight, normal, overweight, and obese nutritional status groups (p<0.001).

Table 4 shows that there is no significant correlation between body weight, height, and BMI with random blood glucose levels and systolic blood pressure. However, there is a significant positive correlation between body weight and BMI with diastolic blood pressure.

Table 4. Correlation Test Between Nutritional Status and Blood Glucose Levels and Blood Pressure

Variable	Body Weight (kg)		Height (cm)		BMI (kg/m^2)	
	r	p	r	p	r	p
Random blood glucose (mg/dL)*	0,142	0,417	-0,029	0,867	0,139	0,427
Systolic blood pressure#	0,216	0,213	0,155	0,373	0,160	0,357
Diastolic blood pressure*	0,394	0,019^	-0,110	0,529	0,414	0,013^

*pearson
#spearman
^significant at p<0.05

The results of this research are in line with research conducted by Utami and Ulumuddin et al, which states that there is a relationship between body mass index and systolic and diastolic blood pressure with weak relationship strength. This shows that body mass index is not the main factor that influences blood pressure in type 2 diabetes mellitus patients (Utami, 2019), (Ulumuddin and Yhuwono, 2018). This is different from the results of research conducted by Nurmalasari et al which shows that there is no significant relationship between BMI and fasting blood glucose levels in adults and the elderly with a p-value> 0.05 (Efon Nurmalasari, Melvinawati Kristina Naibaho and Ahmad Fitra Ritonga, 2021). The results of research conducted by Rosiana et al on differences in nutritional status and quality of food intake in elderly people who took and did not follow Prolanis showed that there were differences in nutritional status between subjects who took and did not take Prolanis (p=0.029), but there were no differences in quality of food intake based on prolanis participation (p=0.538) (Rosiana Dwi Astiti, Ani Margawati, Ayu Rahadiyanti, 2019).

An increase in body weight and BMI will contribute to blood pressure (Fadlilah, Sucipto and Amestiasih, 2019). Increased body weight can affect blood pressure through several mechanisms. Several factors that can explain this relationship include an increase in the amount of fat tissue, increased insulin levels, increased heart rate, and genetic factors. Increasing body weight can increase the amount of fatty tissue in the body, which in turn can increase blood volume and blood pressure. Additionally, increased body weight is also associated with increased insulin levels, which can cause sodium and water retention, thereby increasing blood volume and blood pressure. Apart from that, increasing body weight can also cause an increase in heart rate and genetic factors can also influence blood pressure

(Efon Nurmalasari, Melvinawati Kristina Naibaho and Ahmad Fitra Ritonga, 2021; Kalangie, Warouw and Umboh, 2016). The indicators of nutritional status that most influence blood pressure in male adolescents are BMI and waist circumference, in female adolescents it is neck circumference, and in both genders, it is BMI (Novianingsih and Kartini, 2022). The results of the study showed that the indicator of nutritional status that most influences blood pressure in adolescent boys is BMI and in adolescent girls is neck circumference.

4 CONCLUSIONS

There is a relationship between body weight and BMI and diastolic blood pressure. It is hoped that the research results will provide further insight into the importance of early detection of metabolic risk in students so that it can become a more effective prevention and health intervention strategy in the campus environment. By understanding the risk factors involved, it is hoped that the results of this research will provide better insight into the development of health programs that can motivate positive behavioral changes and improve metabolic health among students. Through this effort, it is hoped that positive changes in lifestyle and health can be achieved, which in turn can have a positive impact on students.

ACKNOWLEDGEMENTS

The researchers would like to thank the Research and Community Service Institute (LPPM) of Universitas Respati Yogyakarta, which has provided grant funds through the internal research grant scheme for the 2023 fiscal year. The research contract agreement letter is 01/Pen/Hibah.Int/PPPM/V/2023. The researcher would also like to express his thanks to the laboratory assistant for the assistance and permission given as well as the enumerator friends who helped in collecting research data

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