Profile of Pattern of Fiber Intake and Physical Activity in Diabetes Mellitus Screening in Indonesian Female Students

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ABSTRACT

Background: Diabetes mellitus (DM) is a persistent metabolic condition characterized by the presence of high blood glucose levels due to impairments in insulin secretion, insulin action, or both. Obesity is one of the prominent risk factors in female, which is influenced by fiber intake and physical activity. Studies regarding the prevalence of physical activity and fiber intake are still limited. Therefore, this study aims to measure physical activity, fiber intake, BMI, and random plasma glucose in Indonesian Female students. *Methods:* This study examines 8th and 9th graders (aged 13–14) at Thursina Islamic Boarding School, Malang. Height and weight were assessed using standard methods. Physical activity was evaluated with the PAQ-A and fiber intake with a Food Frequency Questionnaire. Blood samples were collected using a single-use lancet. Statistical analysis was performed using SPSS. *Result:* This study included 43 subjects with mean BMI 25.46±4.98 kg. The majority of students had a tendency to have low fiber intake (60.5%) and low levels of physical activity (62.8%). Majority of the students had healthy weight and rare fiber intake dominate compared to other classifications (27.9%), and subjects with health weight and low physical activity (30.2.%). None of them had a high range of random plasma glucose. *Conclusion:* Despite Indonesian students in Malang having a normal weight and a normal range of plasma glucose, they have low physical activity and a low pattern of fiber intake.

Keywords: diabetes mellitus; body mass index; random plasma glucose; children; adolescence; obesity; physical activity; fiber intake

INTRODUCTION

Type 2 diabetes (T2DM) is a metabolic disorder characterized by peripheral insulin resistance and beta cell inability to adapt, resulting in hyperglycemia [1]. While it was formerly thought to be an adult pathology, it is becoming more common among adolescent. Prevalence and incidence of T2DM in children and adolescent continue to increase throughout the world. Adolescent with diabetes (of any type) are at a higher risk of developing various problems. Early detection, screening, and treatment of children with type 2 diabetes mellitus are critical for preventing long-term problems [2].

One of the most common risk factors for T2DM is obesity [3]. Obesity is currently the most frequent health issue affecting children in both developed and developing countries. Between the years 1975 and 2016, there was a notable rise in the global age-standardized prevalence of obesity among children and adolescents aged 5-19 years.

For girls, the prevalence climbed from 0.7% (with a 95% credible interval [CrI] of 0.4- 1.2) to 5.6% (with a CrI of 4.8-6.5). Similarly, for boys, the prevalence grew from 0.9% (with a CrI of 0.5-1.3) to 7.8% (with a CrI of 6.7-9.1) [4]. Based on the latest data obtained from the National Health Survey of Indonesia, it was found that the prevalence of overweight and obese children between the ages of 5 and 12 was recorded at 19.6% in 2013. Furthermore, there was a decrease in the prevalence of overweight and obese children under the age of 5 from 11.8% in 2013 to 8% in 2018 [5].

According to the World Obesity Federation's projections in 2019, it was anticipated that the number of children and adolescents aged 5-19 years affected by obesity would reach 206 million by 2025 and 254 million by 2030 [6]. Among the 42 nations projected to have over 1 million children affected by obesity in the year 2030, Indonesia is included in this group [7]. There is a significant difference in the incidence of obesity between females and males.

Female face a heightened susceptibility to obesity due to a combination of unmodifiable life situations and modifiable lifestyle factors, including inadequate sleep patterns, consumption of high-fat meals, and insufficient levels of physical exercise. These lifestyle factors present opportunities for potential intervention [8].

Several factors influence the incidence of obesity, which is also associated with the incidence of T2DM. The development of healthy food habits and physical activity is an essential strategy for preventing obesity and also type 2 diabetes, since dietary consumption is directly linked to diabetes etiology [9]. Several meta-analyses, mostly conducted in Western countries, found that increased dietary fiber consumption is associated with a decreased risk of developing type 2 diabetes mellitus. However, food habits are different between Asian and Western countries. Moreover, increased physical exercise appears to be advantageous for blood glucose homeostasis and the prevention of obesity and type 2 diabetes mellitus [10] Therefore, we aimed to measure pattern of fiber intake and physical activity in Indonesian female students.

METHODS
This descriptive research included 8th and 9th grade female students aged 13 to 14 from Thursina Islamic Boarding School in Malang, East Java. The Faculty of Medicine Health Research and Ethics Committee accepted this study, with ethical clearance number 139/EC/KEPK/FKUA/2022.

The subject's guardians had already provided informed consent. Height and weight were assessed by healthcare experts using conventional anthropometry. A wall- mounted tape measure (Onemed) was used to measure height to the nearest 0.1 cm, and body weight to the nearest 0.1 kg (Onemed).

Body Mass Index (BMI) was computed by dividing weight in kilograms by height in meters squared. Based on the BMI-for-age percentile growth charts, BMI was classified as underweight (5th percentile),

healthy weight (5th percentile - 85th percentile), overweight (>85th percentile - 95th percentile), and obese (95th percentile). Capillary blood samples were obtained from the student's index or middle finger with a single-use lancet to test random plasma glucose (ACCU CHECK). Samples were taken at around half past 9 in the morning. Random plasma glucose levels were classified as normal (200 mg/dL) or excessive (200 mg/dL).

Physical activity is assessed based Physical Activity Questionnaire Adolescent (PAQ-A). The PAQ contains 8 items and is filled in based on the intensity and duration of the respondent's physical activity. The final result is the average of all items, classified into low if the final value is <2.5, while it is said to be high if the final value is ≥2.5.

Meanwhile, fiber intake patterns were measured using the Food Frequency Questionnaire. The final result is said to be frequent if fiber intake, namely fruit and vegetables, is ≥3x/week, while it is said to be rare if <3x/week.

Students who declined to have their height and weight measured, as well as their blood sugar levels checked, and who did not complete the questionnaire were excluded. SPSS version 17 was used to enter data. The variables were represented in terms of mean, standard deviation, and frequency (%).

RESULT
In Malang, 45 students participated in this study. 2 were excluded because of incomplete questionnaire and refused to take weight measurements. All of students were female. The demographic characteristic of subjects is shown in Tabel 1. The mean BMI of all subjects is 25.46±4.98 kg/m2. In table 2 it is found that subjects with healthy weight and rare fiber intake dominate compared to other classifications (27.9%). Table 3 shows that the largest percentage was obtained by subjects with health weight and low physical activity (30.2.%). Table 4 shows that none of the students had a high range of random plasma glucose.

TABLE 1: Demographic Characteristic of Subjects.

Characteristic	All (n=43)	%
Weight (kg)	61.65±13.73	
Height (cm)	155.28±5.13	
BMI (kg/m^2)	25.46±4.98	
abdominal circumference (cm)	82.68±14.12	
upper arm circumference (cm)	27.35±4.50	
Random Blood Sugar (mg/dL)	86.26±14.23	
Often feel thirsty		
No	19	44.18
Yes	24	55.82

Characteristic	All (n=43)	%
Frequent urge to urinate		
No	28	65.12
Yes	15	34,88
Get hungry quickly		
No	25	58,14
Yes	18	41,86
Significant weight loss		
No	35	81,40
Yes	8	18,60

TABLE 2: Distribution of BMI and Fiber Intake.

			FIBER INTAKE		TOTAL
			Frequent (≥3x/week)	Rare (<3x/week)	
BMI	Healthy	Count	11	12	23
		% of Total	25.56%	27.91%	53.47%
	Overweight	Count	3	9	12
		% of Total	6.98%	20.93%	27.91%
	Obese	Count	3	5	8
		% of Total	6.98%	11.64%	18.62%
Total		Count	17	26	43
		% of Total	39.52%	60.48%	100.0%

TABLE 3: Distribution of BMI and Physical Activity.

			PHYSICAL ACTIVITY		TOTAL
			HIGH	LOW	
BMI	Healthy	Count	9	13	22
		% of Total	20.93%	30.23.%	51.16%
	Overweight	Count	4	9	13
		% of Total	9.30%	20.93%	30.23%
	Obese	Count	3	5	8
		% of Total	6.98%	11.63%	18.61%
Total		Count	16	27	43
		% of Total	39.52%	60.48%	100.0%

TABLE 4: Distribution of Random Plasma Glucose.

CATEGORY	TOTAL (N)	PERCENT (%)
Normal (<200 mg/dL)	43	100
High (>200 mg/dL)	0	0

DISCUSSION

This study reveals that the majority of female students had a healthy BMI with rare fiber intake (27.9%) and healthy BMI with low physical activity (30.2%). This study also found that low levels of physical activity were dominant (62.8%). Studies in China found that girls of school age exhibit a comparatively shorter duration of sleep, participate in lower levels of physical activity, and spend less time watching television in comparison to boys [11]. According to a review, there is evidence indicating that the levels of moderate or vigorous physical activities in boys aged 11-12 in the United States are approximately double those of girls in the same age group. Additionally, it has been shown that girls see greater declines in activity levels during adolescence compared to boys [12].

According to a comprehensive analysis of global literature, it has been observed that there is a notable decrease in physical activity levels among adolescents aged 10 to 17. Specifically, the findings indicate a yearly reduction of approximately 2.7% for males and 7.4% for girls [13]. There is a possibility that adolescent females exhibit a higher likelihood, compared to their younger counterparts, of perceiving sports as predominantly associated with males. Despite the prevailing societal inclination towards acknowledging and appreciating the participation of women and girls in sports, a deeply ingrained prejudice persists, suggesting that athletics are incongruous with femininity [14].

Despite engaging in low levels of physical activity, the majority of students exhibit a healthy body mass index (BMI). In a study conducted by Pojskic, it was discovered that there was no significant variance in physical activity levels among girls across various weight groups [15]. This finding may be attributed to the circumstance that our study population resides in a boarding school where, despite the absence of formal physical education courses, students are compelled to engage in frequent physical movements. The design of the school building allows students to spend more energy on daily activity, which requires children to go up and down stairs 4-6 times a day and the obligation to move class locations in each subject. Consequently, these activities may qualify as physical exertion that is not captured by the administered questionnaire.

The majority of students in this study had a tendency to have low fiber intake (60.5%). This result is lower than the study by Groth et al., which showed that approximately 80% of the girls surveyed did not express a clear intention to incorporate fruits and vegetables into their dietary habits [8]. The study conducted by Seljak et al. demonstrated that women had a higher likelihood of inadequate dietary fiber consumption as compared to men [16]. If these intentions demonstrate a predictive relationship with actual dietary intake, it raises significant concerns, as research has shown that adolescent girls tend to reduce their consumption of fruits and vegetables as they age [17].

There is limited evidence to support the effectiveness of physical activity in altering children's weight increase patterns, as observed in various dietary strategies implemented globally. Numerous nations have prioritized the dietary aspect, placing significant emphasis on modifying the food environment within educational institution [18]. This involves the elimination of highly processed food and beverages, enhancing the nutritional value of school meal programs, and supplementing these efforts with regulatory measures at the national or local level [19]. These measures encompass the implementation of taxes on sugar-sweetened beverages and unhealthy food products, the prohibition of marketing specifically aimed at children and adolescents, and the adoption of front-of-the-label profiling. The majority of effective policies have prioritized the reduction of consumption of ultra-processed food and beverages [20].

According to the ADA criterion (>200 mg/dL), none of the students included in this study exhibited a high range of RPG. Around 3 students had RPG >100 mg/dL and the maximum value of RPG was 126 mg/dL in one child. The same research results were obtained in research in Surabaya, where all 95 samples had normal RPG [21]. A study conducted in India revealed that within their research sample, 5.3% of the population of obese children exhibited an increased RPG level over 130 mg/dL [22]. In a research study including a representative sample of the adult population in the United States who did not have a recognized case of diabetes, it was observed that a single random blood glucose (RBG) measurement exceeding 100 mg/dL exhibited a significant association with undiagnosed diabetes. Furthermore, this single RBG measurement emerged as the most influential predictor of undiagnosed diabetes, surpassing other identified risk variables in terms of predictive accuracy [23].

While the results of this study lack sufficient strength to establish a conclusive relationship between a specific health goal and other health-related activities, the findings pertaining to the actions and intentions of adolescent girls are cause for concern.
To the best of our knowledge, this is the first study conducted in Indonesia that demonstrates the role of BMI, fiber consumption, and physical activity in the early identification of diabetes mellitus (DM) in children and adolescents. However, it is important to note that this study was subject to various limitations: Firstly, a limited sample size was employed in this investigation. Secondly, despite the convenience of using BMI as a screening tool for obesity, it does not directly quantify the overall adiposity of an individual. In this study, the researchers employ the use of RPG as a diagnostic tool for dysglycemia, as opposed to utilizing FPG, OGTT, or HbA1c tests.

CONCLUSION

The findings of our study indicate that a majority of adolescents enrolled in a boarding school located in Malang had a healthy weight status, engaged in low physical activity, and had rare fiber intake. All of students had a normal range of plasma glucose. Nevertheless, it is crucial to consistently conduct body mass index (BMI), glucose screening, and other risk factors of DM as a means of early diagnosis of diabetes mellitus (DM). Additional research using larger and more comprehensive datasets is necessary to conduct a more thorough investigation of the relationship between BMI and physical activity and fiber intake as a means of early identification for diabetes mellitus.

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