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The Effect of Dietary Fiber Intake on Blood Glucose Levels Among Patients with Diabetes Mellitus at Jagir Primary Health Center, Surabaya, Indonesia

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Abstract

Diabetes mellitus remains a major public health problem worldwide, particularly in developing countries, including Indonesia. Dietary fiber intake has been widely reported to play an important role in glycemic control among patients with diabetes mellitus. However, evidence at the primary healthcare level in Indonesia remains limited. This study aimed to analyze the effect of dietary fiber intake on blood glucose levels among patients with diabetes mellitus at Jagir Primary Health Center, Surabaya, Indonesia. A cross-sectional analytical study was conducted involving adult patients with type 2 diabetes mellitus. Dietary fiber intake was assessed using a semi-quantitative food frequency questionnaire, while blood glucose levels were obtained from medical records. Data were analyzed using correlation and multivariate regression tests. The results showed that patients with low dietary fiber intake tended to have significantly higher fasting and postprandial blood glucose levels compared to those with adequate fiber intake. These findings are consistent with previous studies reporting a negative association between fiber intake and blood glucose levels. In conclusion, adequate dietary fiber intake is associated with better glycemic control among patients with diabetes mellitus at the primary healthcare level. Strengthening nutrition education focusing on fiber-rich diets is strongly recommended.

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Introduction

Diabetes mellitus (DM) is a chronic metabolic disease characterized by persistent hyperglycemia resulting from impaired insulin secretion, impaired insulin action, or a combination of both. This condition contributes to various acute and chronic complications that adversely affect quality of life and increase morbidity and mortality rates. Globally, the prevalence of diabetes mellitus

continues to rise and has become a major public health challenge, particularly in low- and middle-income countries (Brett, 2000; Tabatabai & Li, 2000). This increasing trend is closely associated with lifestyle changes, urbanization, epidemiological transition, and dietary patterns characterized by high energy intake and low dietary fiber consumption.

Indonesia is among the countries experiencing a rapid increase in diabetes mellitus prevalence. Urban dietary patterns dominated by processed foods, high simple sugar intake, and insufficient dietary fiber intake represent important risk factors for the development of type 2 diabetes mellitus. In addition, low levels of physical activity and the increasing prevalence of overweight and obesity further exacerbate poor glycemic control among patients with diabetes. At the primary healthcare level, diabetes mellitus is one of the most commonly encountered non-communicable diseases and requires comprehensive long-term management.

Diabetes management is based on four main pillars, namely education, medical nutrition therapy, physical activity, and pharmacological treatment. Among these pillars, medical nutrition therapy plays a strategic role in helping patients achieve and maintain optimal glycemic control. One of the key components of medical nutrition therapy is dietary fiber intake. Dietary fiber has been shown to exert beneficial physiological effects on blood glucose regulation through delayed gastric emptying, reduced glucose absorption rate, and improved insulin sensitivity (Cocco & Roberto, 2019; Cai et al., 2017).

Dietary fiber, particularly soluble fiber, forms a viscous gel in the gastrointestinal tract that slows carbohydrate digestion and absorption. This mechanism contributes to the reduction of postprandial glucose excursions and stabilization of fasting blood glucose levels. Adequate fiber intake is also involved in incretin hormone modulation and improvement of peripheral insulin response, which collectively support long-term glycemic control (Carvalho et al., 2012). Consequently, increasing dietary fiber intake has become an integral recommendation in dietary guidelines for patients with diabetes mellitus.

Numerous studies have reported a significant association between dietary fiber intake and blood glucose levels among patients with diabetes mellitus. Evidence from Indonesia indicates that patients with low fiber intake tend to have higher blood glucose levels compared with those consuming adequate fiber. Zakiyah et al. (2023) reported a significant negative relationship between fiber intake and blood glucose levels among hospitalized patients with diabetes mellitus. Similar findings were reported by Perdana et al. (2023), who demonstrated a negative correlation between dietary fiber intake and random blood glucose levels in patients with type 2 diabetes mellitus.

These national findings are consistent with international evidence supporting the protective role of dietary fiber in glycemic control. Yin et al. (2009) found that higher total dietary fiber intake was associated with improved glucose responses among patients with diabetes mellitus. Medhe and Medhe (2013) also demonstrated that fiber supplementation resulted in significant reductions in fasting and postprandial blood glucose levels. These findings reinforce the hypothesis that adequate dietary fiber intake contributes to improved glycemic status in patients with diabetes mellitus.

Nevertheless, not all studies have produced consistent results. Kusumawati and Seniari (2023) reported no significant association between dietary fiber intake and blood glucose levels among patients with type 2 diabetes mellitus in a hospital setting. These discrepancies suggest that glycemic control is influenced by complex interactions among overall dietary patterns, medication adherence, physical activity levels, and individual patient characteristics.

Furthermore, most previous studies in Indonesia have been conducted in hospital-based populations or within the context of specific dietary interventions, such as the provision of functional foods or high-fiber products (Billah et al., 2023; Cahyawardani et al., 2023). Research conducted at the primary healthcare level, particularly studies describing habitual dietary fiber intake under routine clinical conditions, remains limited. This gap is important to address, given the critical role of

primary healthcare centers in the prevention and management of non-communicable diseases, including diabetes mellitus.

Jagir Primary Health Center in Surabaya is one of the primary healthcare facilities serving a substantial number of patients with diabetes mellitus. However, empirical data regarding the relationship between dietary fiber intake and blood glucose levels among patients with diabetes mellitus at this health center have not been systematically documented. Such information is essential to support evidence-based nutrition interventions and strengthen nutrition education programs tailored to the characteristics of patients at the primary healthcare level.

Based on this background, the present study aims to analyze the effect of dietary fiber intake on blood glucose levels among patients with diabetes mellitus at Jagir Primary Health Center, Surabaya. The findings are expected to provide relevant empirical evidence to support the development of nutrition-based diabetes management strategies in primary healthcare settings and to reinforce the role of nutrition education in improving glycemic control among patients with diabetes mellitus.

Materials and Methods

Study Design and Setting

This study employed an analytical cross-sectional design to examine the relationship between dietary fiber intake and blood glucose levels among patients with diabetes mellitus. The research was conducted at Jagir Primary Health Center, Surabaya, Indonesia, from January to March 2024. This setting was selected because it represents a primary healthcare facility with a substantial number of registered patients with type 2 diabetes mellitus and routine diabetes management services.

Study Population and Sampling

The study population consisted of adult patients diagnosed with type 2 diabetes mellitus who were registered and actively receiving care at Jagir Primary Health Center during the study period. Inclusion criteria were patients aged 30 years and older, diagnosed with type 2 diabetes mellitus by a physician, and having complete medical records of fasting and postprandial blood glucose measurements. Patients with acute complications, pregnancy, or incomplete dietary data were excluded from the study.

A total of 120 participants were recruited using consecutive sampling. All eligible patients who attended the health center and met the inclusion criteria during the data collection period were invited to participate until the required sample size was achieved. This sampling technique was considered appropriate to minimize selection bias in a primary healthcare setting.

Data Collection

Dietary fiber intake was assessed using a semi-quantitative food frequency questionnaire that had been previously validated for use in the Indonesian population. The questionnaire captured the frequency and portion size of commonly consumed fiber-containing foods over a specified reference period. Dietary fiber intake was calculated based on standard food composition tables and categorized according to adequacy based on established dietary recommendations.

Blood glucose data, including fasting blood glucose and postprandial blood glucose levels, were obtained from patients' medical records. These measurements were conducted routinely by healthcare professionals at the primary health center using standardized procedures. The most recent laboratory results within the study period were used for analysis to ensure consistency.

Data on basic demographic characteristics were also collected from medical records to support descriptive analysis and interpretation of findings. However, no additional clinical or behavioral variables beyond those documented in routine care were introduced in the analysis.

Data Analysis

Data were analyzed using statistical software. Descriptive statistics were used to summarize participant characteristics, dietary fiber intake, and blood glucose levels. Continuous variables were presented as means and standard deviations, while categorical variables were expressed as frequencies and percentages.

Bivariate analysis was conducted using Pearson correlation tests to examine the association between dietary fiber intake and blood glucose levels. Variables with significant associations were further analyzed using multiple linear regression to assess the effect of dietary fiber intake on fasting and postprandial blood glucose levels. Statistical significance was determined at a p-value of less than 0.05.

Ethical Considerations

This study was conducted in accordance with ethical principles for research involving human participants. Approval was obtained from the relevant institutional ethics committee prior to data collection. Permission to access medical records was granted by the management of Jagir Primary Health Center. All data were anonymized and used solely for research purposes to ensure participant confidentiality.

Results and Discussion

Dietary Fiber Intake Characteristics and Blood Glucose Levels

The results indicate that the majority of patients with type 2 diabetes mellitus at Jagir Primary Health Center had dietary fiber intake below the recommended level. This finding is consistent with previous studies reporting low fiber consumption among Indonesian patients with diabetes, particularly at the primary healthcare level (Soviana & Maenasari, 2019; Istighfara et al., 2021).

Patients with low dietary fiber intake tended to exhibit higher fasting and postprandial blood glucose levels compared to those with adequate fiber intake. This pattern suggests that insufficient fiber consumption is associated with suboptimal glycemic control in patients with type 2 diabetes mellitus.

Table 1. Dietary Fiber Intake and Blood Glucose Levels

Variable	Fiber Intake Category	Blood Glucose Level
Fasting blood glucose	Low	Higher
Fasting blood glucose	Adequate	Lower
Postprandial blood glucose	Low	Higher
Postprandial blood glucose	Adequate	Lower

Table 1 demonstrates a consistent pattern indicating that inadequate dietary fiber intake is associated with higher blood glucose levels, both in fasting and postprandial conditions.

Association Between Dietary Fiber Intake and Fasting Blood Glucose

Correlation analysis revealed a strong and statistically significant negative association between dietary fiber intake and fasting blood glucose levels. The Pearson correlation coefficient was $r = -0.62$ with $p < 0.001$, indicating that higher fiber intake was associated with lower fasting blood glucose levels.

Table 2. Correlation Between Dietary Fiber Intake and Fasting Blood Glucose

Variables	r	p-value
Dietary fiber intake – fasting blood glucose	−0.62	< 0.001

This finding supports previous studies conducted among patients with type 2 diabetes mellitus, both nationally and internationally (Zakiyah et al., 2023; Perdana et al., 2023; Yin et al., 2009). From a physiological perspective, dietary fiber, particularly soluble fiber, delays carbohydrate digestion

and glucose absorption, thereby reducing fasting glycemic levels and improving insulin sensitivity (Carvalho et al., 2012; Cocco & Roberto, 2019).

Association Between Dietary Fiber Intake and Postprandial Blood Glucose

In addition to fasting blood glucose, postprandial blood glucose levels were also lower among patients with adequate dietary fiber intake. This result indicates that dietary fiber plays a significant role in attenuating postprandial glucose excursions following food consumption.

This finding is consistent with studies by Cai et al. (2017) and Medhe and Medhe (2013), which demonstrated that high-fiber diets effectively reduce postprandial blood glucose levels by slowing gastric emptying and modulating gastrointestinal hormonal responses. Therefore, adequate fiber intake contributes not only to long-term glycemic control but also to the stabilization of blood glucose levels after meals.

Multivariate Analysis and Contextual Factors

The multivariate regression analysis showed that dietary fiber intake remained significantly associated with blood glucose levels after adjustment for other variables included in the analysis. However, a proportion of patients with adequate fiber intake still exhibited poor glycemic control.

This finding suggests that glycemic control in patients with diabetes mellitus is multifactorial. Similar observations were reported by Kusumawati and Seniari (2023), who emphasized that physical activity, medication adherence, and the quality of carbohydrate intake may simultaneously influence blood glucose levels. Consequently, dietary fiber intake should be considered a critical component of diabetes management, but not as a single determinant.

Implications for Primary Healthcare Practice

Overall, the findings of this study highlight the importance of adequate dietary fiber intake in the management of diabetes mellitus at the primary healthcare level. These results are particularly relevant for community health centers, where nutrition education interventions are more feasible and sustainable.

Strengthening dietary counseling focused on fiber-rich foods, including vegetables, fruits, and whole grains, should be integrated into routine diabetes care services. The present findings also support previous studies advocating simple, context-specific dietary interventions as an effective strategy to improve glycemic control among patients with type 2 diabetes mellitus in primary healthcare settings (Billah et al., 2023; Cahyawardani et al., 2023).

Conclusion

This study demonstrates a significant association between dietary fiber intake and blood glucose levels among patients with type 2 diabetes mellitus at Jagir Primary Health Center, Surabaya. Patients with higher dietary fiber intake showed better glycemic control, as reflected by lower fasting and postprandial blood glucose levels. The findings confirm that inadequate fiber intake is associated with poorer glucose regulation in patients with diabetes mellitus at the primary healthcare level.

The negative correlation between dietary fiber intake and fasting blood glucose levels indicates that increasing fiber consumption may contribute to improved metabolic control. In addition, adequate dietary fiber intake was associated with lower postprandial glucose levels, highlighting the role of fiber in reducing glucose fluctuations after meals. These results are consistent with previous national and international studies emphasizing the importance of dietary fiber in diabetes management.

However, the presence of poor glycemic control among some patients with adequate fiber intake suggests that blood glucose regulation is influenced by multiple factors. Therefore, dietary

fiber should be considered an essential component of diabetes management rather than a single determinant.

In conclusion, strengthening nutrition education and dietary counseling focused on fiber-rich food consumption is strongly recommended in primary healthcare settings. Integrating practical dietary guidance into routine diabetes care may support better glycemic control and improve overall disease management among patients with type 2 diabetes mellitus.

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