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Blood Glucose Levels in Type II Diabetes Mellitus Patients Who Consumed Carbohydrates and Cholesterol: A Cross-Sectional Study in The Outpatient Setting

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ABSTRACT

Introduction: Diabetes mellitus is a disease caused by disorders related to the insulin hormone. This study aims to determine the results of fasting blood glucose levels in Type II Diabetes Mellitus sufferers who consume carbohydrates and cholesterol in the outpatient Universitas Indonesia Timur Wisata Hospital, Makassar City.
Method: The type of research used is observational with a cross-sectional approach. The sample was 10 outpatients with type II diabetes mellitus at the Wisata Hospital of the Universitas Indonesia Timur. Data were collected using purposive sampling. The research results are made in tabular form and narrated.
Results: The average fasting blood glucose (FBG) level is 129.3 mg/dl, which was included in the diabetes category. The average 2-hour post-prandial blood glucose level (BG2PP) value was 244.1 mg/dl, which was also included in the diabetes category. Carbohydrate and cholesterol consumption had an average value of 255.6 grams and 223.9 mg, respectively.
Conclusion: The average fasting blood glucose and 2-hour post-prandial blood glucose values are included in the diabetes category. Impaired FBG increases the patient's risk of developing diabetes in the future compared to if the patient has impaired blood glucose tolerance.

Key words: Blood glucose levels, carbohydrate intake, cholesterol intake

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Introduction

Diabetes derives from the Greek term "to siphon," while "mellitus" is the Latin term for honey, referencing the sweet taste of urine in affected individuals. Diabetes mellitus is characterized by the excretion of large volumes of urine with a sweet taste. This condition encompasses at least three primary forms: type I diabetes mellitus, type II diabetes mellitus, and gestational diabetes.[1] It is a chronic metabolic disorder marked by hyperglycemia, which involves elevated glucose levels in the bloodstream and specifically affects the body's glucose metabolism.[2]

Diabetes mellitus is a metabolic disorder characterized by abnormalities in insulin secretion, insulin action, or both. This condition can arise from insufficient insulin production due to pancreatic dysfunction or impaired cellular utilization of insulin. Consequently, glucose levels in the bloodstream become dysregulated and may rise significantly. Prolonged hyperglycemia can lead to glucotoxicity, adversely affecting various organs and systems throughout the body.[3]

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia. Patients often remain asymptomatic during the initial stages of the disease, leading to its designation as the "silent killer." Diabetes can affect individuals across all age groups.[4] The diagnosis of diabetes mellitus should be considered in the presence of symptoms such as polyuria, polydipsia, polyphagia, and unexplained weight loss.[5] Chronic manifestations of diabetes may include neuropathic symptoms such as paresthesia, heat sensations, or needle-like pricking in the skin, along with numbness, fatigue, excessive daytime sleepiness, and visual disturbances such as blurred vision.[6]

Diabetes mellitus is a chronic condition that currently cannot be cured; however, effective management of blood glucose levels can be achieved through a combination of dietary modifications, physical activity, and pharmacological interventions.[7] Acute complications may arise from rapid fluctuations in blood glucose levels. Significant decreases in glycemia can occur when a patient adheres to a restrictive diet that does not adequately meet their nutritional needs. Such drastic alterations in blood glucose levels can lead to severe and potentially life-threatening outcomes.[8] If the condition remains unmanaged, long-term complications may develop, including cardiovascular disease, nephropathy, retinopathy, atherosclerosis, and, in extreme cases, the need for limb amputation.[9] To mitigate the risk of these chronic complications, it is critical to implement effective diabetes management strategies, which should aim to achieve the following targets: fasting blood glucose levels of 80-<100 mg/dL, postprandial blood glucose levels (2 hours after eating) of 80-<144 mg/dL,

total cholesterol levels of <200 mg/dL, triglyceride levels of <155 mg/dL, a body mass index (BMI) ranging from 18.5 to 22.9 kg/m², and a blood pressure reading of 130/80 mmHg.[7]

In patients with diabetes mellitus, disruptions in the metabolism of carbohydrates, proteins, and fats occur due to quantitative and qualitative deficiencies in insulin. Elevated blood glucose levels characterize this metabolic dysregulation. When carbohydrate intake exceeds the body's capacity to metabolize them for energy, surplus carbohydrates are converted into triglycerides.[10] The rapid consumption of simple carbohydrates prompts a swift release of insulin, facilitating glucose uptake into muscle and liver cells. When glycogen storage capacity in these tissues is reached, excess glucose is redirected to adipose tissue, where it undergoes lipogenesis to be stored as fat.[11]

Adipose tissue is a primary energy source, and its excessive accumulation can lead to obesity. In individuals with obesity, adipocytes secrete various bioactive substances known as adipocytokines. These adipocytokines contribute to the development of insulin resistance. As a result of insulin resistance, the effective uptake of glucose by peripheral tissues is impaired, leading to elevated blood glucose levels or hyperglycemia.[12] Individuals with diabetes mellitus often experience insulin resistance, leading to elevated blood glucose levels, hypertension, and hyperinsulinemia. These metabolic disturbances are also associated with dyslipidemia, characterized by increased levels of total cholesterol and low-density lipoprotein (LDL) and decreased levels of high-density lipoprotein (HDL). Additionally, there may be an elevation in triglyceride levels, all of which are recognized as independent risk factors for cardiovascular disease.[10]

Cholesterol is a lipophilic substance that circulates in the bloodstream and is synthesized primarily by the liver. It plays a crucial role in various physiological processes in the body. However, excessive cholesterol concentration can lead to pathophysiological issues, particularly in the cardiovascular and cerebrovascular systems. Approximately 80% of blood cholesterol is endogenously produced, while the remaining 20% is derived from dietary sources. Cholesterol can be categorized into two main types: high-density lipoprotein (HDL) and low-density lipoprotein (LDL). Elevated LDL cholesterol levels can result in its deposition on the endothelial lining of blood vessels, promoting atherosclerosis by forming plaques that can occlude vascular lumens. In contrast, HDL cholesterol is responsible for reverse cholesterol transport, facilitating the removal of excess LDL cholesterol from the vasculature. Additionally, triglycerides, esters derived from glycerol and fatty acids, are formed during the metabolic processing of dietary fats and excess carbohydrates and proteins, serving as an energy reserve but potentially contributing to dyslipidemia when present in

elevated concentrations.[13]

Reducing insulin levels can impair glucose metabolism, resulting in hyperglycemia in individuals with DM. When glucose cannot be utilized for energy production, the body compensates by catabolizing alternative substrates such as proteins and fats. This metabolic shift can lead to an increase in cholesterol levels due to enhanced lipolysis. In patients with type II DM, the accumulation of lipids, particularly cholesterol, in cellular membranes can diminish the efficacy and number of insulin receptors. Consequently, this decreases glucose uptake, exacerbating hyperglycemia due to impaired insulin signaling.[14]

In light of the aforementioned details, the investigator expresses a keen interest in conducting a study titled: "Assessment of Blood Glucose Levels in Patients with Type II Diabetes Mellitus Following Carbohydrate and Cholesterol Consumption: A Cross-Sectional Study within an Outpatient Context."

Methods

The research methodology employed in this study is observational, utilizing a cross-sectional approach to examine the research subjects. The study was conducted at the Universitas Indonesia Timur Wisata Hospital Laboratory from August 20 to August 21, 2018. The target population consisted of outpatients diagnosed with type II diabetes mellitus at the aforementioned hospital. Inclusion criteria mandated that participants be diagnosed with type II diabetes, consent to volunteer as respondents, undergo a fasting period of at least 8 hours, possess recorded data on blood glucose levels, and have the capacity for effective verbal communication. Patients who did not meet the fasting requirement or exhibited communication difficulties were excluded from the sample. The sampling technique applied was purposive sampling, whereby subjects who presented at the facility and fulfilled the established criteria were selected as participants until the target sample size of 10 was achieved. The primary variable of interest in this study is blood glucose levels, and the findings will be presented in tabular format for clarity and ease of interpretation.

Result

A study conducted in August 2018 at the Universitas Indonesia Timur Wisata Hospital Laboratory involved 10 samples, with the baseline characteristics summarized in Table 1. The gender distribution among the subjects indicated a higher prevalence of female patients, with four males (40%) and six females (60%). Age distribution among the outpatient cohort with type II diabetes mellitus revealed that two patients (20%) were aged 22-37 years,

three patients (30%) were in the 38-53 year age range, four patients (40%) were aged 54-69 years, and one patient (10%) fell within the 70-85 year category.

Table 1. Baseline characteristics of study samples

Characteristics Respondent (N=10)	Frequency	Percentage (%)
Gender		
Male	4	40.0
Female	6	60.0
Age		
22 – 37	2	20.0
38 – 53	3	30.0
54 – 69	4	40.0
70 – 85	1	10.0

Table 2 presents the distribution of FBG levels and carbohydrate and cholesterol intake among the study participants. The FBG levels demonstrated a minimum value of 79 mg/dL, a maximum of 205 mg/dL, and a mean of 129.3 mg/dL. Based on the mean value, the FBG levels are classified within the diabetic range. The BG2PP levels indicated a minimum value of 158 mg/dL, a maximum of 313 mg/dL, and a mean of 244.1 mg/dL, situating them within the diabetic category based on the average measures. Carbohydrate intake ranged from a minimum of 137 grams to 309 grams, with an average consumption of 255.6 grams. Cholesterol intake varied from 81 to 392 mg, with a mean value of 223.9 mg.

Table 2. Frequency distribution of respondents' knowledge level

Variables	Minimum	Maximum	Mean
FBG (mg/dl)	79	205	129,3
BG2PP (mg/dl)	158	313	244,1
Carbohydrate (gram)	137	309	255,6
Cholesterol (mg)	81	392	223,9

BG2PP: Blodd glucose 2 hour post prandial, FBG: Fasting blood glucose

Discussion

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia and impaired glucose homeostasis. This condition arises from insufficient insulin production by the pancreatic beta cells or an inadequate response to insulin in peripheral tissues. Diabetes mellitus is primarily categorized into two types: Type I diabetes,

characterized by autoimmune destruction of pancreatic beta cells leading to absolute insulin deficiency, and Type II diabetes mellitus, which is associated with insulin resistance and relative insulin deficiency, often linked to obesity and a sedentary lifestyle.[7]

Diabetes Mellitus is a chronic condition that currently lacks a definitive cure; however, it can be effectively managed through appropriate therapeutic interventions. The disease is closely linked to lifestyle factors, making the success of diabetes management largely contingent upon the patient's capability to regulate their condition and maintain optimal blood glucose levels.[15]

The measurement of an individual's blood glucose level is contingent upon the timing of the assessment, which may occur randomly, during fasting, or postprandially. Random blood glucose (RBG) reflects the glucose concentration measured at any time, irrespective of recent food intake, with normal values defined as <200 mg/dl. Values exceeding this threshold may indicate a risk for diabetes. Fasting blood glucose is ascertained in a fasting state, requiring the individual to refrain from caloric intake for 8-12 hours, with water permitted. The classification of FBG results is as follows: normal (<100 mg/dl), prediabetes (100-125 mg/dl), and diabetes (≥126 mg/dl). Following the fasting measurement, postprandial blood glucose is evaluated two hours after ingesting a 75-gram glucose solution. Aside from the glucose solution, the patient must restrict any food or medication intake during this period. The categorization of BG2PP is as follows: normal (<140 mg/dl), prediabetes (140-199 mg/dl), and diabetes (≥200 mg/dl).[15]

Fasting Blood Glucose levels exhibit a minimum threshold of 79 mg/dL, a maximum of 205 mg/dL, and an average of 129.3 mg/dL. Given that the average falls within the diabetic range, this indicates that the patient may be classified as having diabetes. The BG2PP measurements show a minimum of 158 mg/dL, a maximum of 313 mg/dL, and an average of 244.1 mg/dL, categorizing this level as diabetic based on the average results. Carbohydrate intake reports demonstrate a minimum of 137 grams, a maximum of 309 grams, and an average of 255.6 grams. Additionally, cholesterol consumption ranges from a minimum of 81 mg to a maximum of 392 mg, with an average intake of 223.9 mg. In clinical practice, if a patient presents with an FBG level between 100-125 mg/dL, this condition is classified as impaired fasting glucose. Conversely, if BG2PP levels are measured between 140-199 mg/dL, this signifies impaired glucose tolerance. It is important to note that impaired FBG is associated with a higher risk of progression to diabetes compared to isolated impaired glucose tolerance.[16]

Research findings indicate that gender significantly impacts blood glucose levels. Women exhibit a higher susceptibility to metabolic disorders than men, particularly after the age of 40, when they transition through menopause. Irregular fluctuations in estrogen and progesterone levels characterize this phase. A decline in estrogen can lead to insulin resistance, resulting in elevated blood glucose levels. Additionally, aging contributes to increased body weight, further influencing glycemic control. According to The Hormone Foundation, older adults undergo alterations in hormone production and secretion, including insulin, rendering them more vulnerable to the development of Diabetes Mellitus.[18]

According to Sukardji, individuals with diabetes are at an elevated risk for cardiovascular disease, including both heart and vascular conditions. It is essential to limit dietary intake of saturated fats and cholesterol, as elevated levels of these substances in the bloodstream can form atheromatous plaques on vascular endothelium, resulting in atherosclerosis. Additionally, food preparation methods should avoid excessive frying, and it is advisable to limit the variety of side dishes to no more than one per meal to manage overall dietary intake effectively.[18]

Diets high in saturated fats, such as those derived from coconut oil and various butters, have been shown to elevate serum cholesterol levels.[6] To promote a healthier dietary pattern, limiting saturated fat intake and prioritizing a balanced consumption of fruits and vegetables is advisable. This approach can reduce LDL cholesterol levels by 5-10% or more, depending on individual metabolic responses and overall dietary composition.[19]

Several factors contribute to elevated blood glucose levels, including a sedentary lifestyle, increased caloric intake, psychological stressors, weight gain, advancing age, and the influence of pharmacological agents such as corticosteroids.[18] Additionally, effective management of blood glucose levels is facilitated by engaging in regular physical activity and adhering to antidiabetic medication regimens as prescribed by healthcare providers.[13]

The study's limitations include insufficient consideration of confounding variables such as the participants' use of antidiabetic medications, their medical history, and the duration of their illness. Factors such as engagement in routine physical activities or sports were not assessed. Furthermore, the accuracy of dietary intake assessments relies heavily on the respondents' recall, which was conducted through interview methods.

Conclusion

The mean fasting blood glucose and 2-hour postprandial blood glucose levels fall within the diagnostic criteria for diabetes mellitus. It is noted that the presence of impaired fasting glucose is associated with a higher risk of developing diabetes in the future when

compared to individuals with impaired glucose tolerance.

Conflicts of Interest

We have no conflicts of interest to disclose

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