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The Correlation between Dietary Compliance and Random Blood Glucose Levels in Patients with Type 2 Diabetes Mellitus

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Abstract: Diabetes mellitus is a chronic disease that is a major problem of morbidity and mortality worldwide. Type 2 diabetes mellitus is caused by several factors, one of which is dietary compliance, which is key to the management of type 2 diabetes mellitus and long-term glycemic control. Research Objective to determine whether or not there is a relationship between the level of dietary compliance with the level of random blood sugar levels of patients with type 2 diabetes mellitus. **Methods:** A quantitative research type with a cross-sectional approach method with a total of 50 respondents. **Results:** Based on the results of statistical tests using Spearman Rho with $\alpha = 0.05$ (5%) between the level of dietary compliance with random blood sugar levels of patients with type 2 diabetes mellitus in May 2024 showed a significant value of $\rho = 0.008$ (ρ-value <0.05) and the direction of the strength of the relationship with a value of $r = -0.369$ which means it shows the variable is sufficient correlated. **Conclusion**: There is a significant relationship between the level of dietary compliance and random blood sugar levels in patients with type 2 diabetes mellitus.

Keywords: Blood sugar level; Diabetes mellitus; Dietary adherence level

Introduction

Diabetes Mellitus Type 2 is a chronic metabolic disorder distinguished by persistent hyperglycemia and abnormalities in carbohydrate metabolism, frequently arising from the body's diminished capacity to produce or respond to insulin (Zainuddin et al., 2023). An estimated 537 million people suffer from diabetes, and this number is projected to reach 643 million by 2030 and 783 million by 2045. In Indonesia, the prevalence of diabetes mellitus among individuals aged 15 years or older was reported to be 1.5% in 2013. By 2018, this figure had risen to 2%, indicating an increase in the diabetic population within the country (Natania et al., 2020). According to data from the Institute for Health Metrics and Evaluation, diabetes mellitus was the third leading cause of death in Indonesia in 2019, with approximately 57.42 deaths per 100,000 population. According to the results of the Riskesdas (2018), the prevalence of diabetes mellitus in Indonesia reached 2.0%, with the highest prevalence in DKI Jakarta at 3.4%, East Kalimantan and Yogyakarta at 3.1%, North Sulawesi at 3.0%, and East Java at 2.6% (Sutanegara & Budhiarta, 2000; Wahidin et al., 2024). Indonesia is among the top 10 countries with the highest prevalence of Type 2 Diabetes Mellitus at 10.8% (Soeatmadji et al., 2023).

One of the most common cases of diabetes is type 2 diabetes mellitus (Wati & Sriwahyuni, 2023). Type 2 diabetes mellitus is caused by several factors, including non-modifiable factors such as genetics, ethnicity, and family history, as well as modifiable risk factors such as obesity, low physical activity, and unhealthy eating patterns (ElSayed et al., 2024). Dietary management for

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type 2 diabetes patients includes regulating the amount, type, and schedule of meals throughout the day. The quantity should be tailored to individual needs, while the food types should meet dietary requirements for diabetes patients—low in simple carbohydrates, high in fiber, and having a low glycemic index. This is crucial for controlling cholesterol and blood glucose levels effectively (Gortzi et al., 2024). Non-adherence to a diabetic diet can result in uncontrolled blood sugar levels, increasing the risk of complications such as cardiovascular disease, kidney disease, nerve damage, and eye damage (Sabarathinam, 2023). Compliance with dietary recommendations is vital for diabetes patients to manage their blood sugar levels.

This research provides a novel contribution by specifically examining the relationship between dietary compliance and random blood glucose levels in patients with Type 2 Diabetes Mellitus (T2DM) at Bhayangkara Hospital, Surabaya, an area where studies on this topic remain limited. Unlike previous studies that generally assess dietary adherence in diabetes management, this research focuses on real-world patient data within a specific healthcare setting, offering localized insights into dietary patterns and glycemic control.

Dietary compliance is pivotal in managing blood glucose levels in individuals with type 2 diabetes mellitus. It encompasses adhering to a structured eating plan that emphasizes portion control, balanced macronutrient intake, and the avoidance of high-glycemic index foods (Gortzi et al., 2024). The cornerstone of diabetes management is medical nutrition therapy, which emphasizes individualized meal plans, lifestyle changes, and self-management education. Self-management education empowers patients to make informed decisions regarding their diet, physical activity, and medication adherence, enabling them to achieve optimal glycemic control and mitigate the risk of long-term complications (Kumah et al., 2021). Management of T2DM includes lifestyle modifications, such as improving dietary habits and exercise, as well as appropriate medications (Pulungan et al., 2018).

Method

This study is an observational study with a cross-sectional research design, which is conducted to observe the relationship between variables at a specific point in time without follow-up. The researcher employed a non-probability sampling technique using purposive sampling to select participants based on predetermined inclusion and exclusion criteria. The study was carried out at the Internal Medicine Clinic of Bhayangkara Hospital Surabaya over three weeks (May–June 2024). The study population consisted of outpatients aged over 40 years who had been diagnosed with type 2 diabetes mellitus and visited the hospital during the research period. A total of 50 respondents met the inclusion criteria. Data were collected using the Self-Management Dietary Behavior Questionnaire (SMDBQ), which consists of 16 questions, and blood glucose levels were measured using a glucometer by medical personnel.

Result and Discussion

Based on the Table 1, respondents over 65 years of age had the highest percentage (24.0%), with 12 people, while the age group with the lowest percentage was 40-45 years, with 4 people. Based on the research results, it was found that the majority of Type 2 DM patients at Bhayangkara Hospital Surabaya were over 65 years old, with 12 out of 50 respondents (24%) falling into this age group. The average age of respondents was 64.5 years, with the youngest being 40 years old and the oldest 82 years old.

Table 1. Age Frequency Distribution

Age	Freq	%	Cumulative %
40-45	4	8.0	8.0
46-50	5	10.0	18.0
51-55	9	18.0	36.0
56-60	10	20.0	56.0
61-65	10	20.0	76.0
>65	12	24.0	100.0

Individuals with diabetes mellitus who are over 60 years old tend to have blood glucose levels above normal. This is due to the natural decline in organ function with age, leading to decreased insulin sensitivity. As a result, older adults are more susceptible to insulin resistance. This is compounded by the fact that the frequency of type 2 diabetes increases with age (Pokharel et al., 2012). The increased prevalence of diabetes and impaired glycemia in older age groups underscores the need for targeted interventions and healthcare strategies (Leung et al., 2018). Lifestyle factors such as physical activity and dietary habits also play a crucial role, and changes in these areas can significantly impact blood glucose control in older adults. Goals of care need to be individualized for the elderly patient with diabetes (Kalyani & Egan, 2013). Blood glucose control plays a crucial role to prevent complications arising from DM (Natania et al., 2020).

The data on table 2, showed that most of the respondents were female, with 31 people, while 19

respondents were male. The research results indicate that more than half of the respondents were female, totaling 31 individuals (62%), while the remaining 19 respondents (38%) were male. Women are more frequently diagnosed with diabetes, which may be influenced by several factors, including genetic predisposition and hormonal factors such as estrogen and progesterone, as well as early menarche and irregular menstrual cycles.

Table 2. Gender Frequency Distribution

Gender	Freq	%	Cumulative %
Male	19	38.0	38.0
Female	31	62.0	100.0

Lifestyle factors such as physical activity, smoking habits, and dietary patterns also contribute to the development of diabetes. In East Asia, being male was once considered a sustained risk factor for T2DM with aging, but after the age range of 50–59, the number of diabetic women increased significantly (Yuan et al., 2018). More attention should be given to the blood glucose monitoring of middle–aged men and elderly women (Yuan et al., 2018). The prevalence of diabetes in older adults is a significant and growing public health problem (Kirkman et al., 2015). Additionally, men in the 30–50 age range are more likely to develop type 2 diabetes, but after 50–59 years old, the number of diabetic women increases significantly (Yuan et al., 2018). The proportion of females ranged from 49.20% to 81.65%, and the mean age varied from 18 to 76 years in other studies (Akhtar et al., 2019).

Table 3. Educational Level Frequency Distribution

Level Education	Freq	%	Cumulative %
Elementary school	8	16.0	16.0
Junior high school	3	6.0	22.0
Senior High School	20	40.0	62.0
College	19	19.0	100.0

Based on the Table 3, the majority of respondents graduated from high school, with 20 people, while the smallest number of respondents graduated from junior high school, with 3 people. The study results indicate that the majority of respondents had a high school education level, totaling 20 individuals (40%), followed by 19 individuals (38%) with a college education, while the remainder had elementary, middle school, and higher education levels. Education level is closely related to one's knowledge. Individuals with higher education levels tend to have more information and easily understand health information, including information about diabetes mellitus and its management, thereby increasing their level of dietary compliance (Kirkman et al., 2015; Pani et al., 2008). Higher education levels are associated with better knowledge compared to those with lower education levels. Individuals with higher education tend to have better self-control, proper thinking, and experience in dealing with problems. Therefore, it can be concluded that a good education can influence behavior and lifestyle changes (Hahn & Truman, 2015).

Table 4. Type of work Frequency Distribution

Type of work	Freq	%	Cumulative %
Housewife	22	44.0	44.0
Self-employed	8	16.0	60.0
Retired/doesn't work	6	12.0	72.0
PNS/POLRI/TNI	14	28.0	100.0

The table 4 illustrates the frequency distribution of job types among the respondents. The majority were housewives, comprising 22 respondents, followed by civil servants/police/military personnel (PNS/POLRI/TNI) with 14 respondents. The research results indicate that the majority of respondents were housewives, totaling 22 individuals. This suggests that housewives may have more time to manage their diet and overall health compared to individuals with demanding work schedules. Jobs with low physical activity levels lead to reduced energy expenditure, resulting in excess energy being stored as fat in the body. This can lead to obesity, which is one of the risk factors for diabetes. Socio-economic status affects the patients' abilities to have access to proper management modalities (Aljulifi, 2021).

Table 5. Duration of Diabetes Mellitus Frequency Distribution

Duration	Freq	%	Cumulative %
<1 yr	6	12.0	12.0
2-4 yr	15	30.0	42.0
5-8 yr	17	34.0	76.0
>10yr	12	24.0	100.0

Based on the table 5, most of the respondents had suffered from diabetes mellitus for 5-8 years, with 17 people, while the smallest number of respondents had suffered from diabetes mellitus for less than 1 year, with 6 people. The research results indicate that the majority of respondents have a history of suffering from diabetes mellitus for more than 10 years, totaling 17 individuals (34%). The longer a person has diabetes, the more likely they are to feel bored and fatigued with a monotonous and continuous diet regimen. In many regions, a substantial proportion of individuals with type 2 diabetes have had the condition for less than 5 years (Bukhsh et al., 2019).

Based on the table 6, the distribution of dietary adherence levels showed that most respondents had

moderate adherence, with 35 people, and none of the respondents had low adherence. The study indicated that the majority of respondents had moderate adherence to their prescribed diet, with 35 out of 50 participants falling into this category, while complete adherence to both medication and dietary treatment was also observed among some respondents (Emmanuel & Otovwe, 2015).

Table 6. Frequencies of Level of Diet Adherence

Diet Adherence	Freq	%	Cumulative %
High Adherence	15	30.0	30.0
Moderate Adherence	35	70.0	100.0
Low Adherence	0	0.0	100.0

According to the research results, nearly half of the respondents exhibited high dietary compliance behavior, while the other half demonstrated moderate dietary compliance behavior, with none showing low dietary compliance. These results reveal that the majority of type 2 diabetes mellitus patients at Bhayangkara Hospital Surabaya are aware of the importance of dietary compliance in controlling their blood glucose levels. This suggests that while many patients understand the importance of dietary management, consistently adhering to dietary recommendations can be challenging. Adherence to a diabetic diet is influenced by several factors, including individual knowledge, beliefs, and attitudes toward food and health. Cultural and social factors also play a significant role, as dietary habits are often deeply ingrained in traditions and family practices. Furthermore, the availability and accessibility of healthy food choices can significantly impact adherence to dietary recommendations. Patients' beliefs about their illness, treatment, and prognosis also impact adherence. The challenges of adherence are further compounded by factors such as the complexity of medication regimens, potential side effects like weight gain or hypoglycemia, and the cost of medications, all of which can negatively impact a patient's willingness or ability to adhere to their prescribed treatment plan (García-Pérez et al., 2013).

Addressing these barriers requires a multifaceted approach that includes simplifying treatment regimens, providing comprehensive education and support, and addressing financial constraints (Kassahun et al., 2016). Self-discipline was identified by respondents as a key factor in improving adherence to treatment, while lack of awareness regarding the seriousness of the disease was noted as a major challenge. Effective communication between healthcare providers and patients is crucial for enhancing treatment adherence and improving health outcomes in individuals with type 2 diabetes (García-Pérez et al., 2013).

The distribution of random blood sugar levels among the respondents indicated that nearly half had normal levels (23 respondents), while 16 respondents were in the pre-diabetes range, and 11 respondents had diabetes The results of this study also show that 33 respondents had uncontrolled random blood glucose levels, while 17 respondents had controlled random blood glucose levels. This study is in line with research, where the majority of Type 2 DM patients had uncontrolled blood glucose levels (Fang et al., 2021). Uncontrolled blood glucose levels can be caused by several factors, such as low medication adherence, poor dietary patterns, lack of physical activity, and high stress levels (Bin Rakhis et al., 2022). Adherence to therapies, including medication and lifestyle modifications, is essential for maintaining glycemic control and reducing the risk of cardiovascular complications in patients with type 2 diabetes (García-Pérez et al., 2013).

Table 7. Frequencies of Random Blood Glucose Levels

Random Blood Glucose(mg/dL)	Freq	%	Cumulative %
Normal (<140 mg/dL)	23	46.0	46.0
Pre-diabetes (140-199 mg/dL)	16	32.0	78.0
Diabetes (>200 mg/dL	11	22.0	100.0

Digital health interventions are effective tools to help people with type 2 diabetes mellitus to increase their physical activity, follow dietary guidelines and improve their self-management skills (Nguyen et al., 2024). These interventions provide personalized support and guidance, tailored to individual needs and preferences, and empower individuals to take an active role in managing their condition. Strategies to improve adherence should address factors such as regimen complexity, patient education, and communication (García-Pérez et al., 2013). Further research is needed to explore the effectiveness of different intervention strategies and identify the most effective approaches for improving adherence and achieving optimal glycemic control in patients with type 2 diabetes (Emmanuel & Otovwe, 2015; García-Pérez et al., 2013; Polonsky & Henry, 2016). Providers should also be aware that patients who seem uncomplicated might need more support to overcome barriers to adherence, including accepting the reality of having a chronic illness (Kirkman et al., 2015).

Based on the table 8 The higher the score, the better the dietary compliance behavior in diabetes mellitus (DM), while the lower the score, the poorer the dietary compliance behavior. The questionnaire assessment is divided into three levels: high dietary compliance behavior (score 49-64), moderate dietary

compliance behavior (score 32-48), and low dietary compliance behavior (<32).

Table 8. Cross-Tabulation of the Relationship Between Dietary Adherence Levels and Random Blood Glucose Levels in Type 2 Diabetes Patients

Level of Diet Adherence	Random Blood Glucose Levels (mg/dL)						Total	
	Normal		Pre-DM		DM			
	f	%	f	%	f	%	f	%
High	7		7	14	1	2	15	
Moderate	16		9				35	
Low	0	0	0	0	0	0	0	0
Total	23						50	

Spearman's rho α = 0.05 obtained ρ = 0.008 and r = -0.369.

Based on the table above, respondents with a high level of dietary compliance and normal random blood glucose levels accounted for 7 people (14%). Additionally, respondents with high dietary compliance and pre-diabetes blood glucose levels totaled 7 people (14%), while those with high dietary compliance and diabetes blood glucose levels amounted to 1 person (2%), making a total of 15 people (30%). For the moderate dietary compliance category, 16 respondents (32%) had normal blood glucose levels, 9 respondents (18%) had pre-diabetes blood glucose levels, and 10 respondents (20%) had diabetes blood glucose levels, with a total of 35 respondents (70%).

Statistical analysis using the Spearman Rho test with α = 0.05 (5%) showed a significant value of ρ = 0.008 (ρ-value < 0.05) and a coefficient of r = -0.369. Thus, it can be concluded that the hypothesis is accepted, indicating a statistically significant and moderately correlated relationship between dietary compliance levels and random blood glucose levels in type 2 diabetes mellitus patients at Bhayangkara Hospital Surabaya. The negative correlation coefficient indicates an inverse relationship, meaning that the higher the level of dietary compliance, the lower the random blood glucose level, and vice versa. The importance of adherence to treatment plans, including medication and diet, is underscored by the potential for improved health outcomes (DiBonaventura et al., 2014).

The research indicates a significant inverse relationship between dietary adherence and random blood glucose levels in patients with type 2 diabetes mellitus, highlighting the critical role of dietary management in glycemic control (Antes et al., 2020). Nonadherence to treatment regimens, including dietary guidelines, has been linked to increased physician visits, emergency room visits, and hospitalizations, emphasizing the broader healthcare implications of poor adherence (DiBonaventura et al., 2014). It is essential to consider patient-specific factors, such as the use of traditional medicine and the overconsumption of certain foods, which may contribute to nonadherence (Emmanuel & Otovwe, 2015).

The results of the Spearman's Rho correlation test showed a significance value of 0.010 (p < 0.05), indicating a significant relationship between dietary adherence and random blood glucose levels in Type 2 diabetes mellitus patients at Bhayangkara Hospital Surabaya. The higher the level of dietary adherence, the more controlled the patient's random blood glucose levels. The results of this study align with findings that there is a significant correlation between adherence to a diabetic diet and blood sugar levels (Wulandari et al., 2021). This highlights the importance of dietary compliance in controlling blood glucose levels in individuals with type 2 diabetes mellitus.

Good dietary adherence helps regulate blood glucose levels, preventing potential complications associated with diabetes mellitus (Gortzi et al., 2024). Maintaining glycemic levels within physiological levels can reduce or minimize the risk of diabetic complications in the long term for patients with type 1 and type 2 diabetes. Shorter-term blood sugar control can also have a significant impact on health outcomes, with significantly higher or lower readings resulting in significant morbidity, mortality, and healthcare utilization. This highlights the importance of managing glycemic control, not only for long-term health but also for immediate well-being and healthcare costs. This correlation underscores the importance of dietary interventions in managing blood glucose levels in individuals with type 2 diabetes. Appropriate modification and monitoring of food intake can assist with weight management as well as with the control of both blood glucose and lipid levels. The findings underscore the critical role of nutrition therapy in both the development and management of diabetes.

Conclusion

The study concludes that there is a significant relationship between dietary adherence and random blood glucose levels among patients with type 2 diabetes mellitus at Bhayangkara Hospital Surabaya. The study emphasizes the importance of dietary adherence in managing blood glucose levels and preventing complications in patients with type 2 diabetes mellitus, suggesting that healthcare providers should focus on promoting and supporting dietary adherence as a key component of diabetes management. Future research should explore strategies to improve dietary adherence among patients with type 2 diabetes mellitus.

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