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Model Analysis of Balanced Diet Adherence in Type 2 Diabetes Mellitus Patients in Pekanbaru Using the Theory of Planned Behaviour

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ABSTRACT

Introduction: Type 2 diabetes mellitus (T2DM) is a metabolic disorder characterised by insulin resistance, which is frequently influenced by lifestyle factors, including a poor diet and a lack of physical activity. Adherence to a balanced diet is imperative for the management of diabetes; yet, a significant proportion of sufferers do not adhere to the recommended diet.

Aim: The present study aims to analyse the behavioural model of balanced diet adherence in patients with Type 2 Diabetes Mellitus in Pekanbaru, using the theory of planned behaviour as a methodological framework.

Method: This study uses quantitative methods with descriptive and explanatory research designs. Data were collected through questionnaires distributed to 356 respondents selected by purposive sampling from 21 health centres in Pekanbaru. The variables studied included attitude, social support, perception, individual intention, and balanced diet adherence. Data analysis was conducted using Partial Least Squares.

Result: The behavioural model of balanced diet adherence showed that attitude had a significant effect on intention (path coefficient = 0.467), and social support had a significant effect on intention (path coefficient = 0.564) and diet adherence (path coefficient = 0.736). Perception influenced intention (path coefficient = 0.277) but did not directly affect dietary adherence. Intention acted as the main mediator in the relationship between psychological and social factors and dietary adherence.

Discussion: This study concluded that **attitude**, **social support**, and **perception** significantly influence dietary intention and adherence in people with diabetes. Policy recommendations include developing a theory of planned behaviour-based interventions to strengthen positive attitudes and increase social support from family and health workers. Interventions that consider local psychological, social, and cultural factors will be more effective in improving dietary adherence in people with diabetes.

Keywords: *Type 2 Diabetes Mellitus, Diet adherence, Theory of planned behavior, Social support, Intention*

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1. INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder that occurs due to the body's inability to regulate blood glucose levels properly, either due to insulin deficiency or insulin resistance. Type 2 diabetes mellitus (T2DM), characterised by insulin resistance, represents the most prevalent form of diabetes, exhibiting a strong correlation with lifestyle factors, including unhealthy dietary habits, obesity, and insufficient physical activity [1]. Type 2 diabetes is increasingly becoming a major health problem worldwide, with prevalence continuing to rise as people's lifestyles change [2], [3]. Indonesia is facing a significant increase in the number of people with diabetes. In 2021, the prevalence of diabetes in Indonesia was recorded

at 10.6% of the total adult population, with approximately 19.47 million people with diabetes [4]. This number is expected to continue to increase along with changes in lifestyle and an increase in the age of the population. In Riau Province, especially in Pekanbaru City, the number of people with diabetes is increasing. In 2023, Pekanbaru was recorded as the city with the highest number of people with diabetes in Riau Province, with 10,094 people spread across 21 health centres [5].

In the management of type 2 diabetes mellitus, it is imperative to consider the role of dietary adherence in patients. A proper diet is integral to maintaining normal blood glucose levels and preventing serious complications. However, despite the importance of a healthy diet, many people with diabetes do not adhere to the recommended dietary regime. A plethora of studies have demonstrated that dietary adherence is influenced by a multitude of factors. These factors can be categorised into several domains, including socioeconomic and demographic factors [6], [7], [8], [9], psychological and behavioural factors [10], [11], [12], social support and family influence [7], [10], cultural and environmental factors [10], [11], and educational interventions [12].

Socio-economic and demographic factors such as income, education, and occupation have been shown to influence dietary adherence in people with diabetes. For example, research in Ethiopia showed that low income and lower education levels were associated with lower dietary adherence in people with diabetes in developing countries [8]. In Africa, it was found that factors such as age and education level had a significant association with dietary adherence [6]. In addition, psychological and behavioural factors, such as self-control and motivation, also play an important role in dietary adherence. Research in Korea shows that individuals with high levels of self-control are more likely to adhere to healthy dietary guidelines [12]. This study supports findings in Indonesia which found that psychological factors such as self-confidence and motivation play an important role in dietary adherence behaviour [11]. Concurrently, social support is also a pivotal factor. A study conducted in Ghana revealed that individuals with type 2 diabetes who received support from family members, friends, and health professionals demonstrated enhanced dietary adherence [7]. This social support helps to increase the patient's motivation and commitment to the recommended diet.

The Theory of Planned Behaviour (TPB) provides a useful framework for understanding how psychological and social factors interact to shape individuals' intentions to engage in healthy behaviours, including dietary adherence [13], [14]. TPB posits that attitudes, subjective norms, and perceived behavioural control are the three primary factors that influence an individual's intention to engage in a behaviour, such as adhering to a healthy diet in diabetics [15]. TPB The Theory of Planned Behaviour (TPB) has been successfully implemented in various health contexts; however, its application in the management of type 2 Diabetes Mellitus in Indonesia remains limited, particularly with regard to the exploration of deep social factors.

Despite the fact that a considerable number of studies have identified factors that influence dietary adherence in people with diabetes, the majority of these studies tend to focus on a single dimension, such as psychological factors or social support, in isolation. Research that integrates psychological, social, and cultural factors in a more holistic model, particularly using the Theory of Planned Behaviour (TPB), is limited. Furthermore, although the TPB has been applied in various global health contexts, the application of this model in the context of type 2 diabetes management in Indonesia, especially by considering the deeper social context, such as the influence of local culture, family, and social support, is still rare. Further research is required to elucidate the interplay between these factors and their impact on the dietary choices of individuals with diabetes, particularly in regions exhibiting a high prevalence of the condition, such as Pekanbaru.

The present study aims to address this research gap by integrating the Theory of Planned Behaviour (TPB) to analyse the influence of psychological, social and cultural factors on dietary adherence in individuals with type 2 diabetes mellitus in Pekanbaru, Indonesia. This study will provide a more comprehensive insight into the factors that influence dietary adherence in people with diabetes in Indonesia by considering variables such as attitude, social support, perceived behavioural control, and individual intention. This approach will combine individual, social and cultural factors into one integrated model, which has not been widely applied in research in Indonesia, especially in Pekanbaru. It is anticipated that this study will contribute to the development of Theory of Planned Behaviour-based interventions that are more effective in improving dietary adherence in people with diabetes, by taking into account a more specific local context.

2. METHOD

Study Design and Location

This research uses non-experimental quantitative methods with a descriptive analysis approach and explanatory research type. Explanatory research aims to explain the relationship between the variables studied, in this case between attitudes, intentions, social support, perceptions, and adherence to a balanced diet in people with Type 2 Diabetes Mellitus. The method used was a survey, in which data were collected through questionnaires distributed to selected respondents. This study was conducted from June 2024 to December 2024, in all health centres in Pekanbaru, namely 21 health centres that provide health services for people with diabetes. The location of the study in these health centres allowed the collection of representative data from the population of people with Type 2 Diabetes Mellitus spread throughout the Pekanbaru area.

Population and study sample

The population in this study were all patients with Type 2 Diabetes Mellitus registered at 21 health centres in Pekanbaru in 2023, with a total number of 10,094 people. The sample used in this study were patients with Type 2 Diabetes Mellitus who were in the working area of the Pekanbaru health centre. The sampling technique used was non-probability sampling with a purposive sampling approach, where researchers selected samples based on certain criteria.

Sample criteria

The inclusion criteria for this study are as follows: respondents who are willing to participate, individuals diagnosed with Type 2 Diabetes Mellitus, and subjects who are fully conscious and able to provide coherent answers regarding their health conditions. Meanwhile, the exclusion criteria encompassed individuals with hearing or visual impairment, as well as patients undergoing special treatments that could affect their health conditions during the study period. The establishment of these criteria was driven by the necessity to guarantee that the data collected would facilitate the creation of an accurate and representative depiction of individuals diagnosed with Type 2 Diabetes Mellitus in Pekanbaru.

Sample Size

The estimated sample size for this study was calculated using the formula developed by Lameshow et al. (2009), which is frequently employed in health research. The calculation indicated that a sample size of 356 respondents was necessary to achieve the desired level of statistical significance. The calculation was based on a population of 10,094 individuals with Type 2 Diabetes Mellitus in Pekanbaru, with a confidence level of 95% and a margin of error of 5%. The determination of the sample size for each health centre was achieved through the utilisation of the proportional allocation method, a technique that considers the population size of each health centre. Consequently, the distribution of samples from each health centre was calculated according to the proportion of the population in each health centre. The total sample size required for this study was 356 people, which was then divided into 21 health centres in Pekanbaru, with the number of samples per health centre varying based on the population size of each.

Sampling procedure and Data collection

The sampling in this study was conducted by visiting health centres in Pekanbaru. Patients with diabetes mellitus (DM) who met the research criteria were included as samples. Before giving out the questionnaire, the researcher explained the purpose and goals of the study to the participants to ensure they understood. After providing this information and receiving their consent, participants were asked to sign a consent form. Then, the researcher distributed the questionnaire. Once all the data were collected, it was organized for further analysis.

Research Variables

The present study identifies several variables that affect adherence to a balanced diet in patients with Type 2 Diabetes Mellitus. The independent variables that were the focus of this study are outlined below: 1) Attitude: The objective of this study is to utilise the available data to measure the response of individuals diagnosed with Type 2 Diabetes Mellitus to a balanced diet that has been recommended to them. The attitude of an individual towards a given dietary regime has been demonstrated to exert a significant influence on the probability of that individual adhering to the established dietary guidelines. 2) Environmental factors: This variable includes support provided by family, health workers, and friends. Support from this social environment can increase an individual's motivation and commitment to maintain adherence to a balanced diet. 3) Perception: These perceptions refer to the views of people with Type 2 Diabetes Mellitus regarding a balanced diet, including their understanding of the benefits of the diet on their health. Positive perceptions have been demonstrated to encourage individuals to adopt a more committed approach to following a balanced diet. 4) Individual Intention: This variable measures the intention or desire of people with Type 2 Diabetes Mellitus to follow a balanced diet, which is a key factor in determining whether they will carry out the behaviour. The dependent variable in this study is balanced diet adherence behaviour, which reflects the extent to which people with Type 2 Diabetes Mellitus follow the recommended dietary guidelines for the management of their condition.

The measurement of these variables was achieved by means of an ordinal scale questionnaire. The questionnaire was designed to measure attitudes, social support, perceptions, individual intentions, and adherence to a balanced diet. This was achieved by calculating scores based on respondents' answers. Each variable was measured using two categories: one for positive responses (score $\geq$ mean/median) and one for negative responses (score $\leq$ mean/median). It is thus possible to interpret the collected data systematically in order to describe the relationship between factors that influence the dietary adherence of patients with type 2 diabetes mellitus.

Statistical Analysis

Data analysis in this study was conducted using Partial Least Squares (PLS). The first step in the analysis is to measure the structural equation model (SEM) by evaluating the outer loading. Indicators with an outer loading value of more than 0.5 are considered valid. At this stage, all constituent indicators for each variable, both dependent and independent, are evaluated to ensure their validity. If there are indicators that do not meet the validity criteria, they will be removed from

the model and retested. After the valid indicators are identified, the next step is to evaluate the inner model. This evaluation aims to determine how much influence or causal relationship between the variables in the study, namely the relationship between attitude and individual intention, individual intention and compliance behaviour, environmental factors and individual intention, individual intention and compliance, and perception and individual intention. All of these relationships were tested to measure the strength and direction of their influence on balanced diet adherence in people with Type 2 Diabetes Mellitus.

3. RESULTS

Table 1. Characteristics of respondents based on age, education and occupation

Characteristics	n	%
Age		
25-44 years	25	7.0
44-60 years	307	86.2
60-75 years	24	6.7
Education		
Basic Education	26	7.3
Secondary Education	307	86.2
Higher Education	23	6.5
Occupation		
Government Employee	24	6.7
Private Employee	251	70.5
Farmer/Laborer	24	9.6
Housewife	47	13.2
Total	**356**	**100**

Table 1 shows the demographic characteristics of respondents based on age, education, and occupation. The majority of respondents were aged between 44 to 60 years (86.2%), followed by the 25-44 years (7.0%) and 60-75 years (6.7%) age groups. In terms of education, most respondents had a secondary education level (86.2%). In terms of occupation, the majority of respondents worked as private employees (70.5%).

Table 2. Overview of balanced diet adherence, individual intention, attitude, support from family, health workers and friends, and perception

Variables	n	%
Balanced diet adherence		
Non-compliant	168	47.2
Compliant	188	52.8
Individual intentions		
None	166	46.6
Yes	190	53.4
Attitude		
Negative	173	48.6
Positive	183	51.4
Support from family, health		

workers and friends		
None	154	43.3
Available	202	56.7
Perception		
Negative	157	44.1
Positive	199	55.9
Total	**356**	**100**

Table 2 presents an overview of balanced diet adherence, individual intention, attitude, support from family, health workers, friends, and perception of a balanced diet. Most respondents were compliant with a balanced diet (52.8%), while 47.2% were not. Regarding individual intention, 53.4% of respondents had the intention to follow a balanced diet, while 46.6% did not. In terms of attitude, 51.4% of respondents had a positive attitude towards a balanced diet, while 48.6% had a negative attitude. Support from family, health professionals or friends was also reported among more than half of the respondents (56.7%), with 43.3% not receiving such support. Regarding perception towards a balanced diet, most respondents had a positive perception (55.9%), while 44.1% had a negative perception.

Table 3. Results of the inner model of balanced diet adherence based on the Theory of Planned Behaviour in Pekanbaru

Association	*Original sample*	*Sample mean*	*Standard deviation*	*T statistics*	Desc
Intention with balanced diet adherence	0,707	0,707	0,038	18,801	Sig
Attitude with Intention	0,826	0,828	0,033	24,787	Sig
Attitude with balanced diet adherence	0,784	0,585	0,044	19,294	
Family, health worker and friend support with intention	0,873	0,858	0,068	22,567	Sig
Support from family, health workers and friends with balanced diet adherence	0,876	0,882	0,049	24,811	Sig
Perception with Intention	0,702	0,668	0,083	18.762	Sig
Perception with Balanced diet adherence	0,719	0,618	0,059	20,002	Sig

Table 3 shows the results of the inner model test for balanced diet adherence based on Planned Behaviour theory in Pekanbaru. The analysis showed that individual intention had a significant effect on balanced diet adherence (path coefficient = 0.707, t-statistic = 18.801). Attitude was also significantly associated with intention (path coefficient = 0.826, t-statistic = 24.787) and dietary adherence (path coefficient = 0.784, t-statistic = 19.294). Support from family, health workers, and friends played a significant role in increasing intention (path coefficient = 0.873, t-statistic = 22.567) and dietary adherence (path coefficient = 0.876, t-statistic = 24.811). In addition, positive perceptions strengthened intention (path coefficient = 0.702, t-statistic = 18.762) and dietary adherence (path coefficient = 0.719, t-statistic = 20.002).

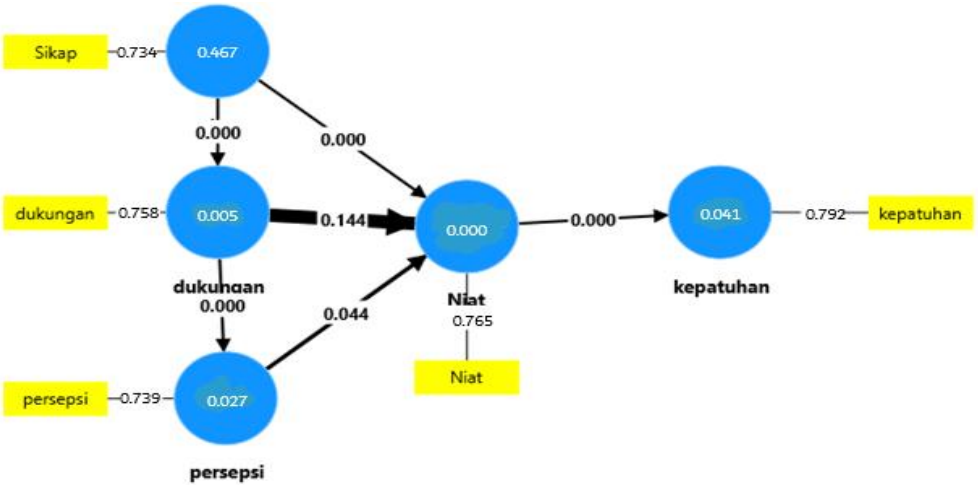

Figure 1. Test results of the Balanced Diet Adherence Behaviour Model for Type 2 Diabetes Mellitus Patients Based on Theory of Planned Behavior in Pekanbaru

As illustrated in Figure 1, the behavioural model of balanced diet adherence in people with Type 2 Diabetes Mellitus is based on the Theory of Planned Behaviour in Pekanbaru. The model delineates the relationship between attitude, support, perception, and individual intention with regard to adherence to a balanced diet. The findings of the analysis demonstrate that attitude exerts a significant influence on intention (path coefficient = 0.467), while support also has a significant influence on intention (path coefficient = 0.564) and dietary adherence (path coefficient = 0.736). Perception showed an influence on intention (path coefficient = 0.277) but did not directly influence dietary adherence. This model illustrates the factors that play a role in shaping dietary adherence in people with diabetes, with intention as the main mediator.

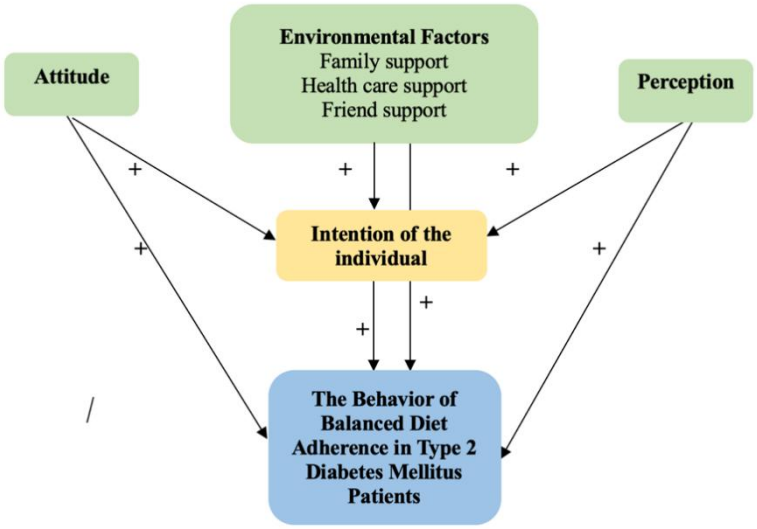

Figure 2. Behavioural Model of Balanced Diet Adherence in Patients with Type 2 Diabetes Mellitus

Figure 2 shows the behavioural model of balanced diet adherence in patients with Type 2 Diabetes Mellitus. This model illustrates the influence of attitude, environmental support (family, health workers, and friends), perception, and individual intention on balanced diet adherence behaviour. These factors interact with each other and contribute to improving balanced diet adherence in people with Type 2 Diabetes Mellitus. The results of this model show that positive attitudes, social support, and good perceptions can increase individuals' intention to have a balanced diet, which in turn will affect their dietary adherence behaviour.

4. DISCUSSION

The findings of the present study demonstrate that attitude exerts a substantial influence on individual intention and the behaviour of adhering to a balanced diet in individuals diagnosed with Type 2 Diabetes Mellitus. A positive attitude towards a balanced diet has been shown to strengthen an individual's intention to adhere to a healthy diet, which in turn increases dietary adherence behaviour. This finding lends support to the Theory of Planned Behavior, which posits that attitudes exert a significant influence on intentions, and, consequently, behaviour. This finding aligns with the extant literature, which has demonstrated that a positive attitude towards diet influences the dietary adherence of individuals with diabetes [16], [17]. Consequently, the enhancement of positive attitudes can serve as an efficacious intervention to improve dietary adherence in individuals diagnosed with diabetes. It has been demonstrated by other studies that attitudes towards a healthy diet, particularly in the context of diabetes, have the capacity to predict intentions to engage in healthy behaviours. This finding serves to reinforce the conclusions of the present study [18].

This finding also confirms that social support, whether from family, health professionals or friends, has a significant influence on individual intentions and adherence to a balanced diet. The support provided by this social environment is of significant importance in encouraging individuals to adhere to a healthy diet and follow the recommended dietary guidelines. This finding indicates that interventions incorporating family and health professional support can enhance the intention and behaviour of individuals with diabetes in maintaining a balanced diet. This finding lends further support to research that reveals the importance of social support in the management of diabetes [19], [20], [21]. Moreover, extant research has demonstrated that social support exerts a significant influence on the reinforcement of the inclination to adhere to a salubrious dietary regime, a finding that is congruent with the observations reported herein [22].

The results also show that positive perceptions of a balanced diet have a significant influence on individual intentions to carry out a balanced diet, which ultimately increases adherence behaviour. Diabetics who have a positive perception of the benefits of dieting tend to be more motivated to adhere to established dietary guidelines. This perception acts as a driving factor that strengthens the intentions and actions of diabetics to lead a healthy lifestyle. This is in accordance with previous

studies showing that perceptions of disease control and dietary benefits strongly influence intentions and actions in diabetes management [23], [24]. In addition, other studies confirm that an individual's perception of diabetes management through healthy behaviours such as diet plays an important role in driving self-care actions [25].

The Theory of Planned Behaviour framework used in this study successfully describes the relationship between attitudes, social support, perceptions, and individual intentions towards balanced diet adherence in people with diabetes. The model suggests that individual intention acts as a key mediator between factors influencing dietary adherence, with the support of family, health workers, and friends playing a significant role in strengthening adherence intention and behaviour. Positive attitudes towards diet and favourable perceptions of diabetes management strengthened the intention to have a balanced diet, suggesting that managing psychological and social factors can be an effective strategy to improve dietary adherence in people with diabetes. In line with these findings, other studies have shown that a TPB-based approach can improve dietary adherence and self-care in patients with type 2 diabetes [26], [27], [28], [29].

This finding has important practical implications for the management of people with diabetes, namely the need to increase social support, especially from family and health workers, and the formation of positive attitudes towards a balanced diet. However, some studies have also shown that other factors, such as economic and cultural factors, may influence dietary adherence more strongly than psychological or social factors. For example, a study in Iran found that limited access to healthy food due to economic factors had a greater impact on dietary adherence of people with diabetes, especially in developing countries [30]. This finding indicates that a TPB-based approach must consider local factors influencing individual behaviour. Furthermore, additional research is required to explore other factors influencing dietary adherence, such as economic factors or education level, to provide a more comprehensive understanding of diabetes management. Researchers further posit the utilisation of Theory of Planned Behaviour-based approaches in interventions to enhance dietary adherence in individuals with diabetes in various contexts. Importance of TPB-based interventions in improving dietary and physical activity adherence among people with diabetes [30], [31], [32].

The main strength of this study is the application of the Theory of Planned Behaviour (TPB) to analyse the influence of attitude, social support and perception on dietary adherence in people with Type 2 Diabetes Mellitus, which makes an important contribution to the related literature. In addition, the large and representative sample size allows for more accurate and reliable results. However, there are some limitations to this study. The use of purposive sampling limits the generalisability of the findings, as only respondents who met certain criteria were selected. In addition, the use of self-report questionnaires has the potential for measurement bias, where respondents may provide answers that match their expectations or perceptions. This study also did not exhaustively examine economic and cultural factors, which can have a significant influence on dietary adherence in diabetics, which need to be considered in future studies.

5. CONCLUSION

This study shows that positive attitudes, social support, and individual perceptions have a significant influence on diet intention and adherence in people with Type 2 Diabetes Mellitus in Pekanbaru. The Theory of Planned Behavior (TPB) model successfully describes the relationship between psychological and social factors that influence dietary adherence behaviour. Individual intention acts as a mediator between psychological and social factors and dietary adherence. Health agencies and related institutions are advised to develop policies that strengthen social support for people with diabetes, both from families and health workers, to improve dietary adherence. Theory of Planned Behaviour (TPB)-based intervention programmes, which focus on strengthening positive attitudes and improving perceptions of the benefits of a healthy diet, should be implemented in health facilities. In addition, it is important to improve access to dietary education and consider local social and cultural factors in designing interventions to promote more effective behaviour change in diabetes management.

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