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Dietary adherence and the associated factors among Indonesian patients with type 2 diabetes: what should we be concerned about?†

Original Article

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Abstract: **Objective:** To identify the level of dietary adherence for particular foods and determine which are challenging for patients with diabetes in Indonesia, as well as the associated factors.

Methods: This study was conducted in a primary health care facility, using a cross-sectional design. Diabetic patients who had received dietary education, agreed to participate, and adult age were invited. All patients with type 1, gestational, and other types of diabetes who did not join regular meetings of *Prolanis* and were reported moving or dying were excluded. The data collection used demographic and perceived dietary adherence questionnaires (PDAQs). Moreover, the height, weight, and blood glucose level were recorded. Data were analyzed using Pearson, point biserial correlation, and one-way analysis of variance (ANOVA) tests.

Results: The respondents were mostly female, married, and non-smoking with a mean age of 60.2 ± 8.48 years. Mean score for dietary adherence was 29.7 ± 8.85 with scores from the specific food groups between 0.72 ± 1.89 and 4.60 ± 2.30. The lower scores of adherence were identified on low-sugar foods, high-fiber foods, fish and foods with high omega-3, and olive/organic oils in cooking. Additionally, people living with diabetes for more than 10 years and not having any comorbidity showed a higher score of dietary adherence.

Conclusions: There were 4 groups of foods that had a low score of adherence. Accordingly, health care providers working in primary health care should be concerned about those 4 food groups during diabetes education and counseling. Public health workers should make more efforts to promote consumption of the healthy diet among patients with diabetes, particularly those who have had diabetes for less than 10 years and other comorbidities.

Keywords: *diabetes • dietary adherence • dietary preference • nutritional care • nutritional therapy*

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1. Introduction

Diabetes mellitus is one of the main causes of death in the world. The International Diabetes Federation (IDF) reported that, every 8 s, 1 person dies due to diabetes.[1] The prevalence of diabetes is currently 425 million cases worldwide and it is predicted to steadily increase every year. The type 2 diabetes mellitus (T2DM) is more frequent among all types of diabetes, accounting for about 90% of diabetes cases.[1,2] Indonesia was ranked sixth among the countries with the highest numbers of diabetes cases, with 10.3 million diabetic patients reported in 2017.[1] Data from the national survey in Indonesia indicated that Yogyakarta is 1 of top 3 areas with the highest prevalence of diabetes.[3]

All people living with diabetes need to do diabetes management to improve their quality of life and reduce the risk of complications.[4,5] The Indonesian Endocrinology Association (known as *Perkeni*) recommends that there are 4 pillars in the management of diabetes: regular education, medical nutritional therapy, physical activity, and pharmacological therapy.[6] To get effective management outcomes, patients with T2DM should maintain an ideal body weight and modify their daily activities into the healthy lifestyle and behaviors.[7–9]

As the main recommendation, dietary management is one of the keys in diabetes management. Typically, the registered dieticians or professional nutritionists provide the medical nutritional therapy.[10] The principle of diet management for diabetes is consumption of the balanced foods according to the daily-required calorie and nutrient intake per each individual to gain metabolic control.[9] People living with diabetes should be aware about the importance of regular eating schedule, ideal types of food, and total caloric needs.[6]

Adherence to diet is problematic and often becomes challenging for diabetic patients. Some patients with diabetes are reported to suffer due to lacking specific knowledge about recommended daily intake.[9] Previous studies investigated various dietary adherence issues among diabetic patients. The results indicated that almost one-half of the patients with diabetes had a low dietary adherence.[11] The lack of adherence following dietary recommendations is caused by difficulty in managing the daily portions of food, barriers in picking recommended foods, and limited social and economic support. Therefore, it is crucial to consider that the dietary adherence among people living with diabetes is a complex issue and requires particular attentiveness. This study aimed to identify the level of dietary adherence and determine which particular foods are challenging for people living with diabetes in Indonesia, as well as the associated factors.

2. Methods

2.1. Research design and samples

This research was a descriptive correlational study with a cross-sectional design in Yogyakarta, Indonesia. Data were collected at a primary health care facility from October to November 2018. All individuals comprising the population of this study were people with diabetes, who were registered as *Prolanis* participants (a support group under the National Health Insurance scheme) at Depok Sleman Public Health Center. Researchers used total sampling techniques as the sampling techniques.

The samples in this study were all from populations that met the inclusion and exclusion criteria. The inclusion criteria were: (1) people with diabetes who had received education pertaining to nutritional medical therapy for at least 1 week before data collection, (2) willingness to be the subjects of research, with this willingness being expressed by the signing of informed consent forms, and (3) adult age (more than or equal to 18 years old). The exclusion criteria were: (1) patients with type 1 diabetes, gestational diabetes, and other types of diabetes based on the medical record reference, (2) did not join the *Prolanis* regular meetings during data collection, and (3) reported to have moved away from the study site or died. Among 101 diabetic members of *Prolanis*, as many as 85 respondents met the criteria for this study.

2.2. Instruments and data collection

The instrument used in this study was the Perceived Dietary Adherence Questionnaire (PDAQ), a specific dietary adherence scale for diabetes developed by Soria-Contreras.[12] This instrument was tested for validity and reliability outcomes in Canada and the results (Cronbach alpha = 0.78, intra-class coefficient = 0.78, and the correlation coefficient with 24 h recall = 0.11–0.46) indicated that it was a valid and reliable tool.[13] The instrument is a packed questionnaire to measure dietary adherence that is typically used for people living with T2DM. The items in the form of questions focus on the adherence to undergo dietary therapy according to recommendations/education for diabetic patients. It covers fruit and vegetable consumption, low glucose level of carbohydrate foods, high-sugar-containing foods, fiber-containing foods, portion of carbohydrate consumption, and omega-3 consumption in the form of organic oils and fats for the current and previous weeks.[12,13] The PDAQ was developed based on food records for the last 7 d, and is further based on the assumption that diabetes patients frequently had a similar diet menu in a week. A total of 9 questions are addressing the frequent

consumption for particular foods/ingredients. All questions start in the following form: "During the past 7 d, how many...". The response answers are a frequency with an 8-point scale, from 0 to 7, that reflects the number of days in a week. To gain the summary, the higher point in each item indicates higher adherence in certain foods/ingredients, except for the item numbers 4 and 9 that have a reverse interpretation. Added with the item numbers 4 and 9 inverted, the other items are summed up to get the total score of dietary adherence. The possible scores range from 0 to 63, with the higher score indicating higher dietary adherence among diabetic patients.[13]

Before data collection, the PDAQ was modified into the Indonesian culture and then translated using the cross-cultural adaptation theory from Beaton to Bahasa Indonesia.[14,15] Multidisciplinary experts assessed the content validity for this instrument and researchers conducted a reliability test among 45 respondents in another public health care facility.[16,17] The scale validity index was obtained as 0.93, the item validity index ranged between 0.80 and 1.00, and the alpha coefficient was 0.723.[18] For the first 10 of 45 respondents, researchers evaluated the readability and understandability.[19,20] All respondents agreed that the questions were easy to understand and readable.

Besides the dietary adherence, the characteristics of respondents were measured, such as age, gender, duration of illness, etc., and thereafter the biological measurements, i.e., height, weight, and blood glucose levels, were carried out. The height and weight were calculated as body mass index (BMI). The blood glucose was checked using a finger prick test and glucometer (GCU Easy Touch®, Taiwan, China). The respondents were identified as either fasting or non-fasting to identify the cut-off points. Random blood glucose >200mg/dL and fasting blood glucose >125 mg/dL indicated uncontrolled diabetes.[21]

2.3. Data analysis

Data analysis used descriptive and correlational analyses with SPSS version 16 (IBM Corp., Armonk, NY, USA). The mean and standard deviation (SD) of each item were presented to identify particular foods/ingredients that were frequently consumed by diabetic patients, as well as the demographic characteristics. The mean of the total score was calculated to recognize the dietary adherence. We tested the data to explore the distribution. The stem-and-leaf plot as well as the Q–Q plots suggested the bell-shape and well-distributed data. Since we had a limited number of samples in our population, the Shapiro–Wilk test was used, with the outcomes suggesting no deviation of normal data distribution ($W = 0.98$, $P = 0.35$). The Pearson and point biserial correlation tests were applied to identify the factors associated with dietary adherence while one-way analysis of variance (ANOVA) was used for categorical data. All the analyses used $P < 0.05$ as the statistically significant level.

3. Results

3.1. Subject characteristics

Based on the data gathered, the respondents were ascertained to have the following characteristics: the average, lowest, and highest ages of the respondents

Variables	*n*	%	Mean (SD)
Age (years)			60.2 (8.48)
35–44	2	0.024	
45–54	23	0.270	
55–64	31	0.365	
≥65	29	0.341	
Living with diabetes (years)			7.3 (6.85)
≤10	69	0.812	
>10	16	0.188	
Random blood glucose (mg/dL), N=78			187.6 (91.60)
<200	51	0.600	
≥200	27	0.318	
Fasting blood glucose (mg/dL), N=12			124.6 (35.56)
<125	6	0.500	
≥125	6	0.500	
BMI (kg/m^2), N=63			25.8 (4.48)
18.5–22.9	18	0.213	
23–24.9	13	0.153	
≥25	32	0.376	
Gender			
Male	20	0.235	
Female	65	0.763	
Married status		0.788	
Married	67	0.212	
Single	18		
Employment status			
Active working	32	0.376	
Unemployed	53	0.624	
Comorbidities			
None	39	0.459	
Comorbid	46	0.541	

Note: BMI, body mass index; n, sample size; SD, standard deviation.

Table 1. Characteristics of respondents ($n = 85$).

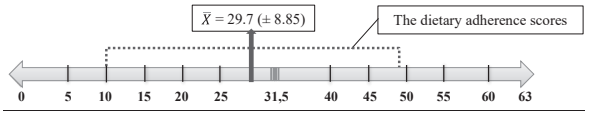


Figure 1. The scores of dietary adherence.

were, respectively, 60 years, 42 years, and 79 years; most respondents were female, married, and non-working; and most respondents had had T2DM for less than 10 years, with an average time of 7 years.

The measurements of blood glucose and BMI were conducted by trained assistants. Blood glucose was based on patients' fasting or random blood sugar levels. Most respondents (n = 78) had random blood sugars with a mean of 187.6 mg/dL, while only 12 respondents reported nothing per oral for fasting blood sugars (mean = 124.6 mg/dL). More than one-third of respondents had a BMI >25 kg/m^2 (37.6%), which is indicated as obesity (Table 1).

No.	Variable	Mean ± SD
1	Adherence to healthy diet suitable for diabetic patient	4.50 ± 2.84
2	Adherence to consume fruits and vegetables	4.60 ± 2.30
3	Adherence to consume low-sugar carbohydrates	2.08 ± 2.40
4	Adherence to limit high-sugar diets	4.41 ± 2.26
5	Adherence to consume high-fibre diets	2.25 ± 2.43
6	Adherence to put an interval in daily carbohydrates intake	4.05 ± 3.23
7	Adherence to consume fish and other diets with high omega-3	2.82 ± 1.86
8	Adherence to fried foods with olive/organic oil	0.72 ± 1.89
9	Adherence to limit high-fat diets	4.28 ± 2.45

Note: PDAQ, Perceived Dietary Adherence Questionnaire; SD, standard deviation.

Table 2. The score of PDAQ instrument.

3.2. Dietary adherence and the associated factors

The PDAQ explores the dietary pattern among diabetic patients. From the 9 questions, the mean score for dietary adherence was 29.7 ± 8.85 (ranges from 10 to 49, Figure 1). Besides the mean score, each item in the PDAQ provided information pertaining to dietary intake among the diabetic patients. The mean scores of each item ranged from 0.72 ± 1.89 to 4.60 ± 2.30. The highest mean score was achieved on fruits and vegetables consumption. Although most of the mean scores were characterized by values of above 4, there were items that had lower scores. The adherence to low-sugar carbohydrates, high-fiber diets, fish and other diets with high omega-3, and foods with olive/organic oil showed low scores (Table 2).

Data in Table 3 indicate the participants' scores of dietary compliance in relation to particular demographic characteristics. The higher dietary adherence score related to the healthy diet was found in the elderly, females, active workers, and married patients. People living with diabetes for more than 10 years and no comorbidity showed higher scores of dietary adherence. The significant associations were identified between dietary adherence, existing comorbidity, and duration of diabetes.

4. Discussion

The respondents mostly had an age of above 55 years, and this finding was in accordance with the results of the Indonesian national survey, in which the prevalence of diabetes is highest at the age of 55–64 years.[3] This is because after the age of 30 years, the aging process causes various deteriorating changes in the human body, both biologically and physiologically. These result in a decreasing of a person's body functions, including in the use of insulin. In addition, at the age of 40–65 years, the incidence of insulin resistance increases and stimulates the diabetes symptoms.[22] The respondents were predominantly female diabetic patients, and this phenomenon can be attributed to the high increase of the lipid levels and fats in the body reserves in women.[23]

The majority of respondents in this study were married and unemployed. This finding was in accordance with the results of the national database for the population living in Yogyakarta.[18,24] Previous research also identified that most diabetic patients were married and not working.[23,25,26] The changes after marriage, i.e., psychological and hormonal changes, energy balance, and eating patterns, potentially affect the fat distribution in the body and the health condition.[25] The advanced age of diabetic patients also affects their activities and productivity, which results in a situation wherein most diabetic patients are not actively working.[23]

As much as one-half of the participants were living with diabetes in conjunction with one or more comorbidities, among which hypertension was the most common comorbidity. A previous study in Yogyakarta also showed a similar trend.[23] Insulin resistance can increase vascular resistance and blood vessel contractility in conjunction with increased norepinephrine and angiotensin II. The renin-angiotensin aldosterone system influences the systemic vascular resistance that affects high blood pressure.[27]

Variables	f (%)	Dietary adherence (M ± SD)	F/r/*P* value
Age (years)			r = 0.111, *P* = ns[a]; F = 0.363, *P* = ns[b]
35–44	2 (2.4)	28 ± 4.24	
45–54	23 (27.0)	29.57 ± 10.05	
55–64	31 (36.5)	29.55 ± 8.95	
>65	29 (34.1)	30.52 ± 8.87	
Gender			r_{pb} = –0.095, *P* = ns[c]
Male	20 (23.5)	28.2 ± 9.21	
Female	65 (76.5)	30.16 ± 7.55	
Employment status			r_{pb} = 0.002, *P* = ns[c]
Active working	32 (37.6)	30.08 ± 8.66	
Unemployment	53 (62.4)	29.56 ± 9.24	
Married status			r_{pb} = –0.002, *P* = ns[c]
Married	67 (78.8)	30.15 ± 8.83	
Single	18 (21.2)	28.94 ± 9.72	
Comorbidities			r_{pb} = –0.208, *P* = 0.056[c]
No comorbidity	39 (45.9)	31.47 ± 8.12	
Comorbid others	46 (54.1)	28.02 ± 9.16	
Living with DM (years)			r = 0.094, *P* = ns[a]; r_{pb} = –0.219, *P* = 0.044[c]
>10	16 (18.8)	31.12 ± 9.17	
<10	69 (81.2)	29.55 ± 8.97	
BMI (kg/m²) (N = 63)			r = –0.008, *P* = ns[a]; F = 0.150, *P* = ns[b]
18.5–22.9	18 (21.3)	30 ± 9.20	
23–24.9	13 (15.3)	31 ± 9.29	
>25	32 (37.6)	29.40 ± 8.54	
Random blood glucose (mg/dL) (N = 78)			r = 0.016, *P* = ns[a]; r_{pb} = 0.010, *P* = ns[c]
<200	51 (60.0)	29.39 ± 9.07	
>200	27 (31.8)	29.75 ± 8.87	
Fasting blood glucose (mg/dL) (N = 12)			r = –0.055, *P* = ns[a]; r_{pb} = 0.268, *P* = ns[c]
<125	6 (50)	26 ± 8.85	
>125	6 (50)	32.83 ± 12.30	

Note: [a]Pearson correlation.
[b]One way ANOVA.
[c]Point biserial correlation.
ANOVA, analysis of variance; BMI, body mass index; DM, diabetes mellitus; M, mean; NS, not significant; SD, standard deviation.

Table 3. The dietary adherence and the associated factors.

The average random blood sugar level obtained was 187.8 mg/dL, showing that glycemic control was in the moderate level among the respondents.[21] From all respondents, there were 60% whose blood sugar levels were below 200 mg/dL, which indicated a controlled blood sugar level, and 31.8% had random blood glucose of more than 200 mg/dL. The moderate glycemic control may relate with the implementation of comprehensive education programs for diabetes in primary health care (known as *Prolanis*). The *Prolanis* activities include medical consultation, home visits, regular monitoring, dietary advice, peer support, and education.[28] A previous study showed that there was a significant association between the compliance in terms of joining *Prolanis* and the stability of the blood glucose level.[26]

The results of the dietary adherence scores indicated that less than half of the respondents had relatively close to minimum score (29.7 + 8.85). Previous research in Canada showed the mean score of dietary adherence was 32.7, whereas it was 31.5 in India.[25,29] Other studies in Jordan found that about 50% of the respondents did not comply with dietary recommendations even though they had received guidance from nutritionists.[30] The reasons were the lack of information about a healthy diet,

frequent eating of foods outside the home, and financial constraints. Some diabetic patients may know how to do dietary management, but many may have limited proper information about consuming a healthy diet or face some barriers in adherence. Most diabetic patients may face a difficulty related to the daily caloric needs and healthy diet choices in their dietary practice. In addition, taking a meal in restaurants or cafés as a common habit may contribute to non-adherence to diet. For some people, consuming a healthy diet means they should allocate more money, which becomes a financial barrier. Overall, the changing of their behaviors could be challenging for diabetic patients.[31]

Based on our data, we identified that the patients with diabetes showed a high score of adherence on fruits and vegetables, limited high-sugar diets, and limited high-fat diets. A previous study indicated that high consumption of fruits and vegetables among the Indonesian population was common in the elderly people.[32] According to our data, most of the diabetic patients comprised in the present study as respondents are elderly (aged more than or equal to 60 years). Accordingly, the consumption of fruits and vegetables for this age population indicated higher adherence. Du et al.[33] reported that consumption of fresh fruits was related to reduction in the risk of death and macrovascular complications. People living with diabetes generally adhere to limited high-sugar and high-fat foods because they received diabetes education on dietary recommendations for diabetes.[21,28] This practice was known to be associated with preventing the diabetes-related cardiovascular complications.[21,34,35] This finding was in accordance with the national data, in which there was a decrease of high-sugar consumption in several previous years.[36] On the other hand, the consumption of high-fat diets is related to high-caloric diets,[37] and the extra calories become potentially trapped in adipose tissues as the body fats. Among people with obesity, there is an increase of fatty substances in the body, such as non-esterified fatty acid (NEFA), glycerol, and cytokines, while some of these are related to insulin resistance.[38]

Besides the identification of the foods with high scores of adherence, there were several foods in which the diabetic patients had a low score of adherence. These foods included low-sugar carbohydrates, high-fiber diets, fish and other diets with omega-3, and olive or organic oils. The low score of adherence on low-sugar foods was due to the lack of dietary information related to those foods, psychological stressors, and limited food products with low-sugar or low caloric foods.[39] High-fiber foods such as oats, whole-grain bread, and cereals are not actually common dishes for our population. Furthermore, the prices of those foods are mostly too expensive for some people. This was one of the main reasons why the results showed lower scores.[40] Consumption of fish and high omega-3 foods such as salmon, sardines, tuna, mackerel, oysters, caviars, chia seeds, and walnuts also indicated lower scores of dietary adherence.[12] It reflects one of the core dietary problems for the Indonesian population, which involves the low consumption in this group of foods. The adherence in the organic or olive oils showed as the lowest score among other recommended foods for diabetes. Olive and virgin coconut oils (VCO) have positive effects on people living with diabetes. They do not settle in the blood circulation and directly convert as energy. In addition, the VCO facilitates blood sugar control through insulin stimulation and secretion.[41] The corn oils also have a similar effect as the VCO in reducing the blood sugar level.[42]

People living with diabetes who did not have complications showed a higher score of dietary adherence. A survey conducted by the Diabetes and Nutrition Study Group of the Spanish Diabetes Association (GSDA) for 6.5 years showed that individuals with diabetes who complied with the dietary recommendation could reduce their risk of complications 3.4–8.2 times in comparison with those of the non-adherent patients.[43] A previous research also identified that a significant correlation was identified between adherence to diabetes management, including the dietary adherence, and the incidence of complications.[44] People living with diabetes who adhere to diabetes management potentially have a good diabetes control and this results in lower risk of complications.

Patients living with diabetes for more than 10 years indicated a higher score of dietary adherence than those living with the same for less than 10 years. These results exhibited a similarity with another finding on medication adherence among patients with diabetes.[28] It was related to their understanding and living the experience of diabetes. People living with diabetes for a longer period tend to have more information and education regarding their diseases. This resulted in better management and control of diabetes.[45]

We identified that our samples were limited due to the prior criteria we set regarding our research. These results are applicable for diabetes patients joining the *Prolanis* program. In fact, the characteristics of our participants are parallel with the characteristics of patients constituted in the diabetes national survey,[3] and thus it is still relevant to Indonesian diabetes patients. Although this limitation may affect the external validity of this research, the findings are practicable for diabetes patients in Indonesia. Future research with higher numbers of *Prolanis* diabetes patients is recommended. Another limitation is related to the food lists in the questionnaire. We used the PDQA tool to identify the adherence of dietary habit and it worked for the food-based groups only (i.e., low-sugar carbs, high-fat diets,

etc.). We were not in a position to assess any detailed lists of food items consumed by the diabetes patients. Therefore, in the next research, we suggest to combine the PDAQ and open-ended questions for participants related to food lists. Thus, researchers could elaborate and analyze the findings, thereby arriving at suggestions for the local-based and culturally sensitive diet for this population.

5. Conclusions

This study identified that the level of dietary adherence among patients with diabetes was still low. Although some foods were recognized as having high adherence to the dietary recommendation for patients with diabetes, there were several foods in relation to which patients reported non-compliance. Those foods included low-sugar products, high-fiber diets, fish and foods-containing high omega-3, and olive/organic oils for frying. Accordingly, nurses and other health care providers employed in a primary health care setting should be concerned about these 4 food groups during diabetes education and counseling. Moreover, patients should receive information related to the healthy foods and alternative products in terms of these 4 food groups. They need to be encouraged to consume these specific types of foods in their daily dietary practice. In addition, this study showed that people living with diabetes for more than 10 years and no other comorbidity indicated a significantly higher dietary adherence. The public health workers should thus make more efforts to promote a healthy diet among people living with diabetes, particularly those patients who have had diabetes for less than 10 years and in conjunction with other comorbidities.

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Ethical approval

The institutional review board of Universitas Gadjah Mada approved this study.

Conflicts of interest

All contributing authors declare no conflicts of interest.

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