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Obesity as a Common Type-2 Diabetes Comorbidity: Eating Behaviors and Other Determinants in Jakarta, Indonesia

Obesitas sebagai Komorbiditas Diabetes Tipe 2: Perilaku Makan dan Determinan Lain pada Pasien Diabetes Tipe 2 di Jakarta, Indonesia

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Abstract

Obesity is a common comorbidity of type-2 diabetes and one of the most modifiable risk factors for preventing other comorbid conditions, such as diabetic nephropathy and cardiovascular disease. Using a cross-sectional design, this study aimed to determine eating behavior, factors related with obesity and the dominant factor of obesity in patients with type-2 diabetes. Data were collected from 133 members of the Chronic Disease Countermeasure Program in Jatinegara Primary Health Care, East Jakarta, that were selected using purposive sampling. Food intake was assessed by 1 × 24-hour food recall and the Food Frequency Questionnaire, Physical activity was assessed by the Global Physical Activity Questionnaire. Results showed that 63.9% of the surveyed type-2 diabetics were obese (body mass index ≥ 25 kg/m^2) and that the respondents consumed more fat than the recommended value (30.77% ± 9.06%) but less energy than the required value (62.06% ± 23.67%). The prevalence of obesity among adults with type-2 diabetes could be associated with nutritional knowledge, education level, and the length of suffering from the disease. Nutritional knowledge was found to be a dominant factor associated with obesity.
Keywords: Adult, diabetes comorbidity, diabetes patients, obesity

Abstrak

Obesitas merupakan salah satu komorbiditas yang banyak terjadi pada pasien diabetes tipe 2 dan salah satu faktor risiko yang dapat diubah dalam pencegahan komorbiditas lain seperti nefropati diabetik dan penyakit kardiovaskular. Menggunakan desain potong lintang, penelitian ini bertujuan mengetahui perilaku makan, faktor-faktor yang berhubungan dengan obesitas dan faktor dominan obesitas pada pasien diabetes tipe 2. Data dikumpulkan dari 133 peserta Program Penanggulangan Penyakit Kronis di Puskesmas Jatinegara, Jakarta Timur, yang dipilih menggunakan metode *purposive sampling*. Asupan makanan diukur melalui wawancara menggunakan kuesioner *food recall* 1 x 24 jam dan *Food Frequency Questionnaire*, dan aktivitas fisik diukur menggunakan kuesioner *Global Physical Activity Questionnaire*. Hasil menunjukkan bahwa 63,9% orang dewasa dengan diabetes tipe 2 yang disurvei mengalami obesitas (indeks massa tubuh (IMT) ≥ 25 kg/m^2), asupan lemak lebih tinggi dibandingkan rekomendasi (30,77 ± 9,06%), tetapi rerata asupan energi kurang dibandingkan energi yang dibutuhkan (62,06 ± 23,67%). Prevalensi obesitas pada orang dewasa dengan diabetes tipe 2 berhubungan dengan pengetahuan tentang gizi, tingkat pendidikan, dan lamanya menderita diabetes tipe 2. Pengetahuan tentang gizi merupakan faktor dominan terhadap obesitas.
Kata kunci: Orang dewasa, komorbiditas diabetes, pasien diabetes, obesitas

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Introduction

Type-2 diabetes is a non-communicable disease that has become a serious concern due to its doubling prevalence within the last three decades, from 4.7% in 1980 to 8.5% in 2014.[1] Type-2 diabetes contributes to 4% of the total mortality caused by non-communicable diseases among patients aged under 70 years.[2] The prevalence of death due to type-2 diabetes can be reduced by preventing the occurrence of comorbidities. Obesity is a common comorbidity among type-2 diabetics that can easily be avoided.[3] Obesity increases the risk of onset of other comorbidities, such as diabetic nephropathy and cardiovascular disease, and can cause poor blood glucose levels, blood lipids, and blood pressure among type-2 diabetics with high body mass index (BMI).[4-6]

Several studies show that over half of all type-2 diabetics suffer from obesity. In 2016, the prevalence of overweight and obesity among diabetics in the United States of America reached 78.2%.[3] Results of a literature study by Colosia *et al*,[7] showed that obesity prevalence rates of 53.8% in Qatar, 83.4% in Saudi Arabia, and 38%–52.7% in Taiwan were type-2 diabetics.[7] The high prevalence of obesity as a comorbidity of type-2 diabetes has also been observed in Indonesia. In 2013, the prevalence of obesity in type-2 diabetics at Tugurejo Hospital of Semarang was 51.4%.[8] The prevalence of this comorbidity is even higher in Jakarta, where 76.5% of the diabetics at Cengkareng Primary Health Care in West Jakarta and 50% of those at Fatmawati Hospital Jakarta were recorded as obese.[9-10] Because of high prevalence of obesity among diabetics in this city, Jakarta was selected as the study location in this study. Efforts made by the government to prevent the occurrence of comorbidities in type-2 diabetics are actualized through the Chronic Disease Countermeasure Programs (*Program Pengelolaan Penyakit Kronis/ PROLANIS*) initiated by National Health Care Security (*BPJS Kesehatan)*. *PROLANIS* aims to encourage patients with chronic diseases (e.g., type-2 diabetes and hypertension) to adopt better lifestyles to avoid disease complications.[11] *PROLANIS* activities comprise medical consulting, health education, and monitoring of one's health status.

Obesity in type-2 diabetics is caused by modifiable factors, such as sedentarism and poor dietary habits and lifestyle choices.[12-14] However, data of diabetics' nutritional intake, eating habits, physical activity, and nutritional knowledge, as well as the relations of these factors to obesity, especially among patients who are members of PROLANIS, are limited. Such data are important in the efforts to adopt countermeasures to prevent the increasing prevalence of obesity in type-2 diabetics. This study is aimed to determine the factors associated type-2 diabetes at Jatinegara Primary Health Care, East Jakarta.

Method

This observational quantitative analytical study applied cross-sectional design. Data collection was carried out at a primary health care in East Jakarta during several *PROLANIS* events at different locations. Prior to its execution, this study obtained ethical clearance from the Ethics Commission of Faculty of Public Health Universitas Indonesia (No. 209/UN2.F10/PPM.00.02/2017).

The study population included adult diabetics aged 25–64 years who visited four primary health cares with the highest numbers of *PROLANIS* members in the Jatinegara area, including Jatinegara, Kampung Melayu, Rawa Bunga, and Cipinang Cempedak Primary Health Care. The inclusion criteria was all *PROLANIS* members actively visiting the primary health cares of interest within the past 6 months prior to data collection; the exclusion criteria were patients with complications of other chronic diseases (e.g., stroke, coronary heart disease, and chronic kidney disease), consumption of alcoholic drinks, use of hormonal contraceptives, and pregnancy. The intended subjects of this study were all eligible subjects who came to the designated primary health care center during the period of data collection. The minimum number of samples was calculated using hypothesis testing of two-proportion differences (obese diabetics vs. non-obese diabetics). The appropriate equation was determined because this study aimed to determine whether significant differences in obesity proportion existed among diabetics based on independent variables. A total of 133 respondents from various primary health cares (Jatinegara = 50; Kampung Melayu = 37; Rawa Bunga = 18; Cipinang Cempedak = 28) were finally included in this study.

The independent variables consisted of demographic and socio-economic variables (e.g., sex, age, marital status, education level, and employment status), nutritional intake (e.g., energy, carbohydrate, protein, and fat), lifestyle (e.g., physical activity, breakfast habit, consumption of fried food, junk food, and sweet food and beverages, and current smoking status), family records (e.g., family obesity and other diseases), knowledge, and length of suffering from type-2 diabetes.

Obesity was determined according to body mass index (BMI) by referring to the cutoff point of WHO Asia–Pacific ($\geq$ 25 kg/m^2), in which Indonesia Endocrinology Association (*Perkumpulan Endokrinologi Indonesia/ PERKENI*) also uses to determine obesity in diabetes patients.[15-16] Data collection was conducted by 10 college students with an educational background in nutrition after an appropriate training. Weight and height were anthropometrically measured using calibrated devices.[17]

Intake was defined as the amount of food consumed daily and noted by using 1 × 24-hour food recall.

Table 1. Proportions of Obesity Based on Several Variables among Type-2 Diabetics at Jatinegara Primary Health Care in 2017

Variable	Category	Obese		Total (%)	p-Value	OR (95% CI)
		Yes (%)	No (%)			
Sex	Female	69 (62.2)	42 (37.8)	111 (83.5)	0,484	0.616 (0.224–1.698)
	Male	16 (72.7)	6 (27.3)	22 (16.5)		
Age	25–44 years old	76 (63.3)	44 (36.7)	120 (90.2)	0.907	0.768 (0.223–2.639)
	45–64 years old	9 (69.2)	4 (30.8)	13 (9.8)		
Marital status	Married	71 (64.5)	39 (35.5)	110 (82.7)	0.739	1.17 (0.465–2.949)
	Single	14 (60.9)	9 (39.1)	23 (17.3)		
Education level	< Junior high school	30 (53.6)	27 (47.4)	57 (42.9)	0.029*	0.440 (0.214–0.919)
	≥ Junior high school	53 (71.6)	21 (28.4)	74 (56.5)		
Employment status	Employed	28 (71.8)	11 (28.2)	39 (29.3)	0.223	1.652 (0.734–3.718)
	Unemployed	57 (60.6)	37 (39.4)	94 (70.7)		
Physical activity	Low	20 (62.5)	12 (37.5)	32 (24.1)	0.193	
	Moderate	24 (54.5)	20 (45.5)	44 (33.1)		1.39 (0.548–3.519)
	High	41 (71.9)	16 (28.1)	57 (42.9)		0.65 (0.259–1.632)
Breakfast habit	Seldom (≤ 5 days/week)	30 (73.2)	11 (26.8)	41 (30.8)	0.138	1.835 (0.819–4.111)
	Often (> 5 days/week)	55 (59.8)	37 (40.2)	92 (69.2)		
Junk food consumption habit	Ever	35 (71.4)	14 (28.6)	49 (36.8)	0.168	1.193 (0.553–2.575)
	Never	50 (59.5)	34 (40.5)	84 (63.2)		
Sweet food and drink consumption habit	≥ once/week	48 (67.6)	23 (32.4)	71 (53.3)	0.342	1.41(0.693–2.869)
	< once/week	37 (59.7)	25 (40.3)	62 (46.7)		
Fried food consumption habit	≥ once/day	28 (66.7)	14 (33.3)	42 (66.9)	0.653	1.19 (0.553–2.575)
	< once/day	57 (62.6)	34 (37.4)	91 (33.1)		
Current smoking status	Not smoking	71 (61.7)	44 (38.3)	115 (86.5)	0.188	0.461 (0.143–1.49)
	Smoking	14 (77.8)	4 (22.2)	18 (13.5)		
Records of family obesity	Present	27 (62.8)	16 (37.2)	43 (33.1)	1.000	0.982 (0.461–2.092)
	Not present	55 (63.2)	32 (36.8)	87 (66.9)		
Records of family disease	Present	26 (70.3)	11 (29.7)	37 (27.8)	0.455	1.482 (0.655–3.352)
	Not Present	59 (61.5)	37 (38.5)	96 (72.2)		
Nutritional knowledge	Poor (score ≤ 8)	71 (68.3)	33 (31.7)	104 (78.2)	0.047*	2.305 (0.998–5.325)
	Good (score > 8)	14 (48.3)	15 (51.7)	29 (21.8)		
Length of suffering from type-2 Diabetes	< 5 Years	55 (75.3)	18 (24.7)	73 (54.9)	0.010*	
	5–9 Years	16 (51.6)	15 (48.4)	31 (23.3)		2.87(1.19–6.93)
	≥ 10 Years	14 (48.3)	15 (51.7)	29 (21.8)		3.27(1.33–8.07)

Note: OR= Odds ratio; CI= Confidence Interval

Analysis of nutritional content was conducted using 2007 Nutrisurvey software, and the results were compared with individual nutrient requirements based on the 2015 *PERKENI* consensus.[16] Consumption of unhealthy/risky food was measured using the Food Frequency Questionnaire. Fried food consumption was categorized as "≥ once/day" and "< once/day", junk food consumption was categorized as "ever" consume junk food within the last week and "never" consume junkfood within the last week, and sweet food and beverage consumption was categorized at "≥ once/week" and "< once/week".

Physical activity was measured through interviews by using the Global Physical Activity Questionnaire and categorized as "low," "moderate," or "high." Age was categorized as 25–44 years old or 45–64 years old. Education level was categorized as "< junior high school/equal" or "≥ junior high school/equal." Breakfast habits were categorized as "seldom" (≤ 5 days/week) or "often" (> 5 days/week). Family records were categorized as "present" or "not present." Knowledge on nutrition and type-2 diabetes was categorized as "poor" (score ≤ 8) or "good" (score > 8). Length of suffering from type-2 diabetes was categorized as "< 5 years," "5–9 years," or "≥ 10 years."

Univariate, bivariate (chi-squared), and multivariate (double logistic regression) analyses were performed. Multivariate analysis was conducted to determine the dominant factor associated with obesity by excluding variables with p-value > 0.05, starting from the variable with the highest p-value. Modeling was done by considering changes in OR; if the change in OR was > 10%, the variable was returned to the model.

Results

Based on data obtained from 133 respondents, the obesity prevalence among adult type-2 diabetics at Jatinegara Primary Health Care was 63.9% (Obesity class I 39.8%; obesity class II 24.1%). The average BMI was 26.12 ± 3.85 kg/m^2 (mean ± SD). Table 1 describes

the proportions of obesity according to several variables.

The respondents were mostly female (83.5%), aged 45–64 years (90.2%), married (82.7%), "graduated < junior high school/equal" (56.5%), and unemployed (70.7%). Among demographic and socio-economic variables, a significant relationship (p-value < 0.05) was found on variable of the latest education level with obesity (OR = 2.27). Type-2 diabetics with a latest education level of ≥ junior high school/equal had a higher risk of having obesity than those who did not.

This study did not find a significant relationship between obesity and physical activity, breakfast habits, consumption of unhealthy food, and current smoking status. The majority of the respondents reported "moderate" to "high" physical activity (76%), "often ate breakfast" (69.2%), "never" consumed junk food (63.2%), consumed sweet food and beverages ≥ once/week (53.3%), consumed fried food ≥ once/day (66.9%), and did not smoke (86.5%).

This study attempted to determine whether a relation between family record of obesity and other diseases with obesity exists. No significant relationship was found between these variables and obesity. Most of the respondents did not have a family record of obesity or other diseases.

The average knowledge score was 7.7 ± 1.12 points with a range score of 6–10 points. Approximately 78.2% of the respondents had a "poor" level of knowledge (score ≤ 8 points). A significant relationship was derived between knowledge and obesity. Diabetics with a "poor" level of knowledge had a higher risk of developing obesity than those with a high level of knowledge (OR = 2.31).

A significant relationship between length of suffering from type-2 diabetes and obesity was also found. The average length of suffering from type-2 diabetes was 4.79 ± 3.81 years, with a range of 0–15 years. Most of the patients surveyed suffered from type-2 diabetes for < 5 years (54.9%) or 5–10 years (23.3%).

No significant difference in average energy intake was observed among diabetics with (970.07 ± 353.29 kcal) and without (947.10 ± 376.96 kcal) obesity. Similar cases for protein intake (14.68% ± 3.20%; 14.28% ± 3.72%), carbohydrate intake (55.27% ± 9.69%; 55.54% ± 8.80%), and fat intake (30.67% ± 9.28%; 30.95% ± 8.75%) were found.

Multivariate analysis was conducted towards selected variables (p-value < 0.25) related to obesity. The variables included in the first modeling were education level (≥ junior high school), employment status (unemployed), low physical activity, seldom had breakfast, ever consumed junk food in a week, did not smoke, poor nutritional knowledge, and suffered from type-2 diabetes for < 5 years. Variables with p-value > 0.05 were then excluded from the modeling one by one. If a change in OR of > 10% was observed after the variable was excluded, this variable was returned to the model. However, if the change in OR was < 10%, the variable was completely excluded from further modeling (Table 2). After modeling was performed eight times and controlling for education level, length of suffering from type-2 diabetes, physical activity, junk food consumption, and breakfast habits, nutritional knowledge was found to be the dominant factor associated with obesity in adults with type-2 diabetes, as seen in Table 3.

Table 2. Variables with Obesity among Adults with Type-2 Diabetes (Early Modeling)

Variable	p-Value	OR	CI 95%
Education level higher or equal to junior high school	0.002	0.22	0.09–0.59
Unemployed	0.4462	1.44	0.56–3.72
Low physical activity	0.1743	0.69	0.41–1.19
Seldom having breakfast	0.0825	2.30	0.90–5.87
Ever consuming junk food within the last week	0.1344	1.98	0.81–4.82
Not smoking	0.4661	0.60	0.15–2.36
Poor nutritional knowledge	0.001	6.96	2.22–21.81
Length of suffering from type-2 diabetes < 5 years	0.009	2.18	1.21–3.92

Table 3. Variables with Obesity among Adults with Type-2 Diabetes (Final Modeling)

Variable	p-Value	OR	CI 95%
Education level higher or equal to junior high school	0.002	0.22	0.09–0.56
Low physical activity	0.215	0.72	0.42–1.21
Seldom having breakfast	0.074	2.32	0.92–5.84
Ever consuming junk food within the last week	0.114	2.02	0.85–4.85
Poor nutritional knowledge	0.001	6.51	2.13–19.91
Length of suffering from type-2 diabetes < 5 years	0.005	2.27	1.28–4.05

Discussion

Obesity is comorbidity that is common among type-2 diabetics. This study revealed that 63.9% of the adult diabetics who were *PROLANIS* participants at Jatinegara Primary Health Care, East Jakarta, suffered from obesity. This prevalence is lower than that reported among diabetics in the United States of America and Saudi Arabia but only slightly different from the prevalence reported in Qatar and Taiwan.[4,8] The prevalence of obesity in type-2 diabetics at Jatinegara Primary Health Care is not significantly different from the prevalence observed in various health care centers in Semarang and Jakarta.[9,10]

The energy and macronutrient (carbohydrate, protein, and fat) intakes among type-2 diabetics with and without obesity were not significantly different. Obesity results from the accumulation of a chronic energy imbalance; at the time the study was implemented, the diabetic respondents may have already changed their dietary habits by reducing their intakes to control their blood glucose level and prevent complications. Changes in respondents' dietary habits may be a result of becoming a *PROLANIS* participant who had received nutrition education.

Average energy and macronutrient intakes were compared with individual requirements based on the 2015 *PERKENI* consensus.[16] The respondents' average energy intake was inadequate (< 80% of the recommended intake), but their average protein intake met the recommendations of *PERKENI* (e.g., 10%–20% of the total energy intake). Similar to protein intake, the respondents' carbohydrate intake was according to the *PERKENI*-re-commended carbohydrate intake (e.g., 45%–65% of the total energy intake). However, the respondents' average fat intake was higher than that suggested by *PERKENI* (e.g., 20%–25% of the total energy intake). This finding indicates that diabetics practices related to energy and macronutrient intake were not yet appropriate.

Level of education is related to a person's risk of developing obesity.[18-20] This study showed that diabetics who were members of *PROLANIS* and with high levels of education were at great risk of developing obesity. High level of education that indicates better socio-economic means greater capability to select a wide variety of food. In this case, diabetics may tend to choose and consume high fat food. Thus, this group is highly likely to develop obesity.[21]

Nutritional knowledge was found to be the dominant factor influencing the prevalence of obesity in adults with type-2 diabetes. This study reinforces the findings of a previous work showing that knowledge is significantly correlated with obesity.[22-24] Good knowledge of nutrition influences people's behavior; for example, it encourages them to consume more vegetables and eat less fried food.[23,24] A lower level of knowledge results in high fat intake and limited consumption of fruit and vegetables.[23] Further analysis indicated that diabetics with high levels of knowledge have better physical activity compared with those with poor knowledge.

In general, the respondents reported a healthy lifestyle. Most of the respondents had "moderate" to "high" physical activity, "often" had breakfast (> 5 times/week), "never" consumed junk food within the last month, only ate sweet food ≥ once/week, and did "not smoke." These findings coincide with a previous study stating that diabetics tend to have sufficient physical activity.[25] The respondents led a healthy lifestyle because they are *PROLANIS* participants who had obtained education on the benefits of such a lifestyle. Therefore, they were also aware of how healthy behaviors can avoid the complications of other diseases. Despite their positive behaviors, however, majority of the respondents still consumed fried food ≥ once/day, likely because consuming food high in fat does not directly impact increases in blood glucose, and, hence, diabetics have no motivation to reduce their fried food intake.

In contrast to a previous study, this study does not find significant correlations between obesity and a family record of obesity or other diseases.[26] The existing literature concludes that lifestyle factors are more influential than family records in predicting propensity toward obesity.[27] This study found that lifestyle factors are a dominant factor of obesity; thus, although most of the diabetics surveyed did not have a family history of obesity or other diseases, they eventually developed the disease.

According to a previous study, the length of suffering from type-2 diabetes is significantly correlated with obesity.[28] Patients suffering from type-2 diabetes for < 5 years were at the greater risk of developing obesity compared with those suffering from the disease for 5–9 years; in turn, patients suffering from type-2 diabetes for 5–9 years were at a greater risk of developing obesity compared with those suffering for ≥ 10 years. Analysis showed a negative correlation ($r < 0$) between energy and macronutrient intake and the length of suffering from type-2 diabetes, although correlations between both factors were not statistically significant. This study assumed that the longer the patients suffer from type-2 diabetes, and the longer they can be members of the *PROLANIS* program and, therefore, the better their adherence to dietary recommendations.

Conclusion

The nutritional intake of type-2 diabetics that is inappropriate as their energy intake is markedly lower but their fat intake is higher than the recommended values. Despite restrictions on the consumption of sweet

food and beverages, many diabetics continue to frequently consume fried food.

The risk of obesity in type-2 diabetics who are members of PROLANIS at Jatinegara Primary Health Care, Jakarta, Indonesia, is high among patients with high levels of education, low nutritional knowledge, and short duration of suffering from the disease. After controlling education level, length of suffering from diabetes, physical activity, junk food consumption, and breakfast habits, nutritional knowledge is found as the dominant factor influencing obesity in type-2 diabetics.

These results reflect the importance of education on appropriate diets for type-2 diabetics, especially high-risk groups suffering from obesity. Newly diagnosed diabetics, for example, should be encouraged to evaluate their eating behavior and macronutrient intake.

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