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Research Article

OBESITY AS A COMMON COMORBIDITY IN PATIENTS WITH DIABETES: OCCURRENCE BASED ON EATING HABITS AND OTHER DETERMINANTS IN WEST JAVA, INDONESIA

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ABSTRACT

Objective: The prevalence of obesity in individuals with diabetes mellitus (DM) is fairly high. It has been shown that obesity worsens insulin resistance and can elevate the risk for complications of diabetes. Therefore, this study aimed to assess the prevalence of obesity and to determine the factors that affect obesity in adults with DM.

Methods: This study used a cross-sectional design and included secondary data from the "Cohort Study of Risk Factors for Non-communicable Diseases." The study was conducted on adults with DM at Kebon Kelapa Village, West Java, in 2017, and the total sample obtained for analysis was 112 respondents.

Results: In this study, 62.5% of adults with DM were overweight or obese (body mass index ≥25 kg/m^2). Factors found to influence the incidence of obesity in adults with DM were sex and macronutrient intakes, namely, "over" energy intake, "over" carbohydrate intake, "over" fat intake, and "normal" protein intake. Risk of obesity was 3.15-fold higher in female than male participants with diabetes. The highest risk for increased obesity level in adults with diabetes was found in those with "over" fat intake (odds ratio, 8.33).

Conclusions: In adults with diabetes, the incidence of obesity is a trigger of complications. Therefore, to improve the quality of life of individuals with diabetes, attention must be given to managing their weight.

Keywords: Diabetes mellitus, Obesity, Prevalence, Risk factor.

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INTRODUCTION

Diabetes mellitus (DM) is a chronic disease that can lead to complications such as stroke, heart attack, nerve damage, kidney failure, vision loss, and leg amputation. People with DM and their families, as well as health systems and national economies, experience substantial economic loss as a result of diabetes and its complications, through direct medical costs and loss of work and wages [1]. According to the International Diabetes Federation, in 2017, among all countries, Indonesia ranked sixth in terms of diabetes prevalence, with a rate of 10 million adults with diabetes [2].

Most patients with type 2 DM are obese [3]. Many studies have confirmed that obesity is associated with an increased risk of developing DM [4]. However, not much research has been conducted in people with DM who become obese. This study is very important because obesity can worsen insulin resistance and increase the development of diabetes complications, such as cardiovascular disease [5,6]. Diabetes with complication is the number one cause of death in Indonesia [7]. The objective of this study is to assess the prevalence of obesity and the factors that affect obesity in adults with DM at Kebon Kelapa Village, West Java.

METHODS

Ethical approvals to conduct the study were obtained from the Research and Community Engagement Ethical Committee, Faculty of Public Health, Universitas Indonesia. This study used a cross-sectional design and used secondary data from the "Cohort Study of Non-communicable Disease Risk Factors" conducted by the National Institute of Health Research and Development, Indonesian Ministry of Health in Kebon Kelapa Village, West Java, in 2017. The population in this study was taken from individuals with diabetes who enrolled in the cohort study in 2017 (n=174; aged >24 years). Respondents who had a history of heart disease and/or stroke (n=19) and whose data were not available at the follow-up (missing data, n=43) were excluded from the study sample. Thus, the total number of individuals included in this study was 112.

Obesity status was considered the dependent variable, assessed through a body mass index (BMI) of 27 kg/m^2 or higher. BMI is the ratio of weight-to-height squared (kg/m^2) and is categorized as follows: Lean (<18.5 kg/m^2), normal (18.5–25.0 kg/m^2), overweight (25.1–27.0 kg/m^2), and obese (≥27 kg/m^2) [8]. The independent variables included sociodemographic characteristics (age, sex, level of education, income, and occupation), medication compliance, smoking habits, mental health status (assessed using a self-report questionnaire), macronutrient intake per day (energy, protein, carbohydrate, and fat), and physical activity (assessed using the Global Physical Activity Questionnaire version 2.0) [9].

Data on macronutrient intake were obtained using 24 h recall. The estimated energy requirements for adults with diabetes differ depending on body weight: 2300–2500 kcal for lean, 1700–2100 kcal for normal, and 1300–1500 kcal for overweight [10]. Other nutritional requirements for adults with diabetes are 10%–20% of total energy from protein, 45% to 65% of total energy from carbohydrates, and 20% to 25% of total energy from fat [11]. We categorized the nutritional intake as "deficit" (<90%), "normal" (90%–119%), and "over" (≥120%) [12]. Chi-square tests were used to analyze data in the bivariate analyses.

RESULTS

Characteristic of adults with DM

The characteristics of adult with DM at Kebon Kelapa Village, West Java, in 2017 present in Tables 1 and 2, it is known that a large proportion (62.5%) of adults with DM were overweight and obese. Most of the individuals with DM were 55–65 years old (42.9%), female sex (67.9%) had low education (60.7%), low income (59.6%),

Table 1: Characteristics based on BMI and sociodemographic

Variable	n	%
BMI		
Lean	5	4.5
Normal	37	33.0
Overweight	26	23.2
Obese	44	39.3
Age (years)		
25–34	2	1.8
35–44	14	12.5
45–54	42	37.5
55–65	48	42.9
>65	6	5.4
Sex		
Male	36	32.1
Female	76	67.9
Education level		
High	44	39.3
Low	68	60.7
Income level		
High (>median)	65	59.6
Low (≤median)	44	40.4
Occupation		
Driver	2	1.8
Domestic workers	51	45.5
College student	2	1.8
Civil servants	6	5.4
Entrepreneur	32	28.6
Private employees	9	8.0
Construction workers	2	1.8
Unemployment	8	7.2

n: Number=112, BMI: Body mass index

Table 2: Characteristics based on nutrition intake and other variables

Variable	n	%
Energy intake (kcal/d)		
Deficit	32	28.6
Normal	34	30.4
Over	46	41.1
Protein intake (g/d)		
Deficit	15	13.4
Normal	89	79.5
Over	8	7.1
Carbohydrate intake (g/d)		
Deficit	21	18.8
Normal	60	53.6
Over	31	27.7
Fat intake (g/d)		
Deficit	11	9.8
Normal	35	31.3
Over	66	58.9
Physical activity		
High	93	83.0
Moderate	16	14.3
Low	3	2.7
Medication compliance		
Not compliance	86	76.8
Compliance	26	23.2
Smoking habit		
Smoking	56	50.0
Not smoking	56	50.0
Mental health status		
Not stressed	94	83.9
Stressed	18	16.1

n: Number=112

and worked as domestic workers (45.5%). Regarding macronutrient intake, 41.1% and 58.9% of the adults with diabetes were found to have "over" energy intake and "over" fat intake, respectively. Results for other characteristics also indicate that 65.2% of adults with diabetes engaged in "high" physical activity, 76.8% were noncompliant with DM medication, and 83.9% of adults with diabetes did not under stress conditions. As for smoking habits, the proportion of participants "not smoking" and those "smoking" was the same (50.0%).

Obesity risk factor in adults with DM

The results of the bivariate analysis show that sex and macronutrient intake were the significant factors that determine the incidence of obesity in adults with diabetes. Risk of obesity was 3.15-fold higher in female than in male participants with diabetes. With regard to macronutrient intake, the highest risk of obesity was found in participants with "over" fat intake, which was 8.3-fold higher than for those with "deficit" fat intake. Table 3 presents the data for the risk factors for obesity among the adults with diabetes in this study.

DISCUSSION

In this study, 62.5% of adults with DM had a BMI ≥25 kg/m^2, indicating that they were overweight or obese. The prevalence of diabetes and obesity is on the rise worldwide. In some countries such as the United Kingdom, around 86% of patients with type 2 DM were found to be overweight or obese (BMI 25–40 kg/m^2). In the United States, a BMI of 25 kg/m^2 was found in 90% of patients with type 2 DM [5,13]. A strong relationship has been found between BMI and diabetes and insulin resistance [3,14,15], but not all overweight or obese people will develop diabetes, and not all diabetic people are overweight or obese. The mechanism for explaining diabetic people become overweight or obese is the decreased glycosuria after improving blood sugar control, inhibition of the catabolism, the anabolic effect of insulin, protein anabolism, suppression of hepatic glucose production and gluconeogenesis, increased food intake, low physical activity, and hypoglycemia [6,16,17].

Factors related to sex also have a strong relationship to the incidence of obesity in adults with diabetes: Women with diabetes are more obese than men with diabetes. Further analysis also reveals that with regard to age, in those <45 years, the incidence of obesity was higher in women with diabetes than in men with diabetes (57.1% and 42.9%, respectively); the same trend was seen in those aged ≥45 years (86.5% and 13.5%, respectively). This clearly shows that body composition and fat deposition in sex differences contribute to diabetes risk. Men generally have more fat-free muscle compared with women. Women after menopause are at an increased risk of developing visceral obesity because the loss of estrogen. Estrogen is important regulators of body weight [18,19].

In relation to macronutrient intake, the analysis shows a strong association between "over" energy intake and obesity in adults with diabetes. The mean energy intake of non-obese adults with diabetes with "over" intake was 2384±376 kcal/d, lower than that for obese adults with diabetes (2921±682 kcal/d). There have been many studies prove that weight gain is driven mainly by energy intake exceeding energy expenditure [20,21].

Protein intake analyses have shown that there is a strong association between daily "normal" protein intake and obesity in adults with diabetes. Mean "normal" protein intake in obese adults with diabetes is 56±16 g/d, which is lower than that of non-obese adults with diabetes (60±19 g/d). On the other hand, "over" protein intake is not significantly related to the incidence of obesity in adults with diabetes. Dietary proteins influence body weight trough satiety, thermogenesis, energy efficiency, and body composition. In the studies lasting up to 1 year have shown the similar result that consumption of higher amounts of protein during dietary treatment for obesity resulted in greater weight loss than did consumption of lower amounts of protein [22,23].

Adults with diabetes with "over" carbohydrate intake have a 3.98-fold higher risk of being obese compared with those with "deficit" carbohydrate intake. This result is in contrast to the results of a

Table 3: Obesity risk factors in adults with DM

Variable	Obese				p value	OR	(95% CI)
	No		Yes				
	n=68	%	n=44	%			
Age (years)							
25–34	1	50.0	1	50.0			
35–44	8	57.1	6	42.9	0.85	0.75	0.04–14.58
45–54	24	57.1	18	42.9	0.84	0.75	0.04–12.82
55–65	31	64.6	17	35.4	0.68	0.55	0.03–9.33
>65	4	66.7	2	33.3	0.68	0.50	0.02–12.0
Sex							
Male	28	77.8	8	22.2	0.02*	3.15	1.27–7.79
Female	40	52.6	36	47.4			
Education level							
High	26	59.1	18	40.9	0.93	0.89	0.41–1.94
Low	42	61.8	26	38.2			
Income level							
High	38	58.5	27	41.5	0.73	0.80	0.37–1.77
Low	28	63.6	16	36.4			
Energy intake (kcal/d)							
Deficit	25	78.1	7	21.9	ref	1	
Normal	21	61.8	13	38.2	0.15	2.21	0.75–6.55
Over	22	47.8	24	52.2	0.01*	3.90	1.41–10.79
Protein intake (g/d)							
Deficit	13	86.7	2	13.3	ref	1	
Normal	50	56.2	39	43.8	0.04*	5.07	1.08–23.80
Over	5	62.5	3	37.5	0.20	3.90	0.49–30.76
Carbohydrate intake (g/d)							
Deficit	17	81.0	4	19.0	ref	1	
Normal	35	58.3	25	41.7	0.07	3.05	0.91–10.12
Over	16	51.6	15	48.4	0.04*	3.98	1.09–14.58
Fat intake (g/d)							
Deficit	10	90.9	1	9.1	ref	1	
Normal	22	62.9	13	37.1	0.11	5.91	0.68–51.60
Over	36	54.5	30	45.5	0.05*	8.33	1.01–68.87
Physical activity							
High	57	61.3	36	38.7	ref	1	
Moderate	10	62.5	6	37.5	0.93	0.95	0.32–2.84
Low	1	33.3	2	66.7	0.35	3.17	0.28–36.20
Smoking habit							
Not smoking	36	64.3	20	35.7	0.56	1.35	0.63–2.89
Smoking	32	57.1	24	42.9			
Mental health status							
Not stressed	58	61.7	36	38.3	0.82	1.29	0.47–3.57
Stress	10	55.6	8	44.4			
Medication compliance							
Not compliance	49	57.0	37	43.0	0.21	0.49	0.19–1.28
Compliance	19	73.1	7	26.9			

DM: Diabetes mellitus, n: Number, OR: Odds ratio, CI: Confidence interval, *Significant at p<0.05

systematic review/meta-analysis study conducted by Sartorius *et al*. that showed that a higher proportion of carbohydrates in unrestricted diets does not increase obesity levels. However, in other studies shown a positive association between certain dietary carbohydrates (such as sugar-sweetened beverages) and weight gain. Further studies that specifically classify types of carbohydrate intake are needed [24-26].

The highest risk of causing obesity in adults with diabetes is "over" fat intake compared with other macronutrients (odds ratio, 8.33). Based on the National Health Survey 2013, West Java is one of the five provinces with the highest consumption of fat and cholesterol and also fried food above the national average. Finding reported that individual consuming fried food which containing trans fatty acid has a higher risk of lipid profile abnormality, which was likely associated with obesity [27,28]. A high-fat diet also is one of the main causes of the development of obesity. Foods high in fat are highly palatable and seem to induce a relatively weak sense of satiety. A high-fat diet also results in altered microbiota composition and enhancement in fat storage [29-31]. Obesity management may be beneficial in the treatment of people with DM. The modest and sustained weight loss will be beneficial not only in terms of glycemic control but also other health benefits associated with complications of diabetes [6,32].

CONCLUSIONS

This study found that the incidence of obesity in adults with DM was high and that the factors with the highest effect on the prevalence of obesity in adults with DM were having a high-fat intake. Therefore, because the incidence of obesity in adults with diabetes is a trigger of complications, to improve the quality of life of people with diabetes, attention must be given to manage their weight.

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AUTHORS' CONTRIBUTIONS

The authors declare that this work was done by the authors named in this article.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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