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Central Obesity and Type 2 Diabetes Mellitus Among Adults Aged 19—64 Years in DKI Jakarta: A Cross-Sectional Study

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Abstract

Background: *Type 2 diabetes mellitus (T2DM) is a metabolic disorder characterised by elevated blood sugar levels due to impaired insulin secretion in the body. Central obesity (CO) has been associated with insulin resistance and may contribute to the occurrence of T2DM. This study aimed to analyse the association between CO and T2DM among adults aged 19–64 years in DKI Jakarta.*

Methods: *A cross-sectional study was conducted using secondary data from the Indonesian Health Survey (IHS) 2023. A total of 7,432 adults aged 19–64 years residing in DKI Jakarta were included. Multivariable logistic regression was performed to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for the association between CO and T2DM.*

Results: *The prevalence of T2DM was 1.8%. CO was significantly associated with T2DM (p=0.001). Adults with CO had higher odds of T2DM compared with those without CO (adjusted POR=7.15; 95% CI: 2.19–23.35). Physical inactivity (adjusted POR=5.26; 95% CI: 1.64–16.90), heavy smoking (adjusted POR=2.34; 95% CI: 1.01–5.42), and hypertension (adjusted POR=3.79; 95% CI: 2.58–5.57) were also independently associated with T2DM. A statistically significant interaction between CO and physical activity was identified.*

Conclusions: *Central obesity was strongly associated with T2DM among adults aged 19–64 years in DKI Jakarta. These findings underscore the importance of obesity and lifestyle-related factors in the epidemiology of T2DM. It is recommended for individuals to adopt a healthy lifestyle and undergo regular health checks to facilitate the early detection of CO and other health conditions.*

Keywords*: Central obesity, Indonesian Health Survey, Type 2 diabetes mellitus.*

INTRODUCTION

Diabetes Mellitus (DM) is one of the major global health challenges, with an increasing prevalence driven by population aging, economic development, and urbanization. These factors contribute to unhealthy lifestyles, including physical inactivity and the excessive consumption of unhealthy foods, both of which are closely linked to the risk of obesity.[1] Indonesia ranks fifth globally in the number of DM cases, with 19.5 million people affected in 2021, a figure projected to rise to 28.6 million by 2045 if no immediate action is taken.[2] DM is classified into several types, including Type 1 DM, T2DM, gestational DM, and other specific types. Among these, T2DM is the most preventable form, as it primarily arises from behavioral and lifestyle factors, accounting for over 90% of all diabetes cases worldwide.

T2DM is a condition characterized by elevated blood sugar levels due to insufficient or ineffective insulin production.[3] This insulin deficiency leads to an accumulation of glucose in the bloodstream, derived from consumed food and beverages. Several risk factors contribute to the development of T2DM, including central obesity (waist circumference), high blood pressure (hypertension), obesity (BMI), lack of physical activity, unhealthy dietary patterns, insufficient fruit and vegetable intake, alcohol consumption, smoking, dyslipidemia, age, gender, and family history of DM.[4] Mental Health issues are also recognized as a risk factor for the development of DM (excluding Type 1 DM) since they influence hormonal regulation and lifestyle behaviors.

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The Ministry of Health of the Republic of Indonesia has emphasized that an unhealthy diet, characterized by high sugar, high salt, high fat, and low fiber intake, significantly increases the risk of developing T2DM.[5]

The mechanism underlying T2DM is complex due to the intricate interplay between various risk factors, particularly modifiable ones. The process begins with an unhealthy lifestyle and dietary habits. When these factors combine, they lead to a calorie imbalance and influence genetic activity within the body. This imbalance marks the onset of central obesity, as excess glucose, when not utilized as energy or stored as glycogen, is converted into fatty acids. Excess insulin then transports these fatty acids into fat cells, leading to central obesity. Central obesity is characterized by excessive fat accumulation around the waist and abdomen, as adipose tissue fails to store surplus energy effectively.[6] If left unaddressed, central obesity contributes to insulin resistance, the hallmark of T2DM. A study by Suwinawati et al.[7] found that individuals with central obesity were 3.423 times more likely to develop T2DM compared to those without central obesity.[7] Given that central obesity is relatively easy to measure, such as through waist circumference assessments, early detection and intervention are crucial to prevent more severe complications.

DKI Jakarta ranks first in the country for both DM prevalence (3.9%) and central obesity (45.7%).[8] As the capital city and Indonesia's largest metropolitan area, DKI Jakarta faces a high risk of these health issues due to unhealthy lifestyle patterns and a lack of physical activity. These behaviors are particularly prevalent among the working-age population, who often struggle to access healthy food and face work-related constraints that limit their physical activity.[9] The productive age group includes individuals aged 19 to 64 years (Indonesia, 2024), with 6,976,175 of DKI Jakarta's residents falling within this category. This demographic dominance underscores the significance of addressing T2DM among DKI Jakarta's working-age population. Failure to do so could lead to declining productivity and a reduction in DKI Jakarta's human capital,[11] ultimately affecting both individual and national economic performance. In addition to economic consequences, unmanaged T2DM can result in severe acute and chronic complications.[12]

This study was conducted in response to the growing need to understand the impact of T2DM and further investigate lifestyle-related risk factors, particularly central obesity. While previous research has explored the link between obesity and DM, most studies have focused on overall obesity rather than central obesity. Moreover, a literature review revealed a lack of studies examining this topic in the population of DKI Jakarta, using the 2023 Indonesian Health Survey (HIS) dataset. Therefore, this study aimed to analyze the association between central obesity and T2DM among adults in DKI Jakarta. The findings are expected to inform public health strategies by highlighting the role of central obesity as a modifiable risk factor that can be easily assessed through abdominal circumference measurement, thereby supporting early detection and prevention efforts.

METHOD

Participants and Study Design

This cross-sectional study was designed to determine the association between central obesity and T2DM among people of productive age in DKI Jakarta, using data from the Indonesian Health Survey (IHS) 2023. The IHS 2023 was is a national-scale survey activity with a cross-sectional study design. The IHS 2023 population survey covered the entire territory of Indonesia, using a household sampling unit. The sample size for the IHS 2023 was 345,000 households from 34,500 census blocks selected as sample targets using the probability proportional to Size (PPS) method, based on the regular census block sample frame from the 2020 population census. The sampling procedure employed a two-stage cluster sampling technique.

The study population comprised all individuals aged 19–64 years who resided in DKI Jakarta. The study sample consisted of individuals within this age range who were included in the IHS 2023 dataset. Participants were eligible if they met the following inclusion criteria: 1) aged 19–64 years and 2) residing in DKI Jakarta. Exclusion criteria were: 1) patients diagnosed with types of DM other than T2DM based on a doctor's diagnosis, and 2) individuals with incomplete data on the dependent or the primary independent variables

After suitability testing with inclusion and exclusion criteria, 7,342 participants were included in the study sample. The minimum sample size was calculated using the Lemeshow formula for hypothesis testing of two population proportions (two-sided test), with an alpha level of 0.5 and a power of 0.84, which is the minimum standard commonly used in public health research. This study employed hypothesis testing for two population proportions, given that it was a two-sample (exposed and unexposed) study with a categorical dependent variable. The minimum sample size was 3,063.

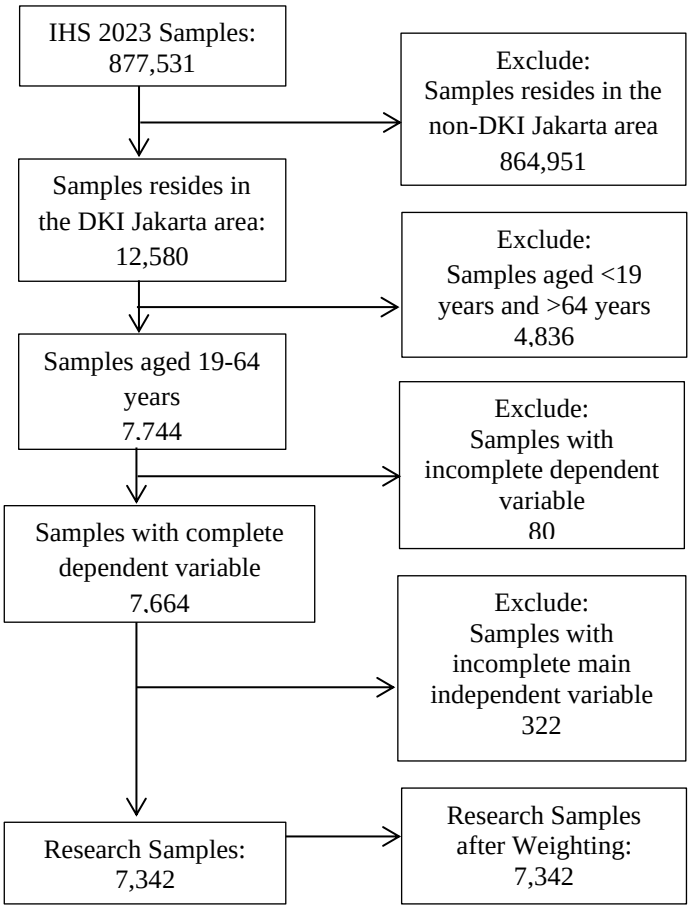

Figure 1. Sampling Flow

Measurements and Procedure

T2DM (T2DM) status was determined from two questions from the IHS 2023 questionnaire. Participants were classified as having T2DM if they reported having been previously diagnosed with DM by a physician and identified their condition as T2DM. Participants who reported a diabetes diagnosis but did not specify the type of diabetes were excluded from the analysis. The primary independent variable was central obesity. Central obesity was defined as the accumulation of excess abdominal fat, assessed using abdominal circumference (AC). Participants were classified as centrally obese if their AC was ≥ 80 cm for women and ≥ 90 cm for men.

Covariates were grouped into three categories: sociodemographic, lifestyle, and health status variables. Sociodemographic variables included age, sex, education level, occupation, and marital status. Age was categorized into early adulthood (19–40 years), middle adulthood (41–60 years) and late adulthood (61–64 years). Lifestyle variables comprised physical activity, fruit and/or vegetable consumption, intake of sweet, salty, and fatty foods, smoking behavior, alcohol consumption, and body mass index (BMI). Physical activity was assessed using the Metabolic Equivalent of Task (MET) minute per week and categorized as sufficient (≥ 600 MET-minute/week) or insufficient (<600 MET-minute/week). Fruit and/or vegetable consumption was determined based on daily intake and weekly frequency. Consumption was classified as sufficient if participants consumed ≥ 5 servings per day on all seven days of the week

All other patterns (i.e. ≥ 5 servings per day on less than seven days of the week; < 5 servings per day on less than seven days of the week; and < 5 servings per day on all seven days of the week) were categorized as insufficient.

Risky dietary consumption variables (sweet, salty, and fatty foods) were constructed as composite variables derived from multiple questionnaire items. Sweet consumption included intake of sweet foods, sugar-sweetened beverages, soft drinks, energy drinks, and added sugar such as syrups and confectionery products. Salty consumption included intake of salty foods and condiments. Meanwhile, fatty consumption encompassed intake of high-fat, fried, and cholesterol-rich foods as well as added fats and oils.

Each item was assessed using a six-point frequency scale: 1) >1 time per day, 2) once per day, 3) 3–6 times per week, 4) 1–2 times per week, 5) <3 times per month, and 6) never. Composite scores were calculated by averaging the responses across relevant items. Risky consumption was defined as a mean score ≤3 (i.e., frequent consumption ≥3 times per week), while a mean score >3 was classified as not risky. Smoking behavior was assessed using the Brinkman index and categorized as non-smoker, light smoker (0–199), moderate smoker (200–599) and heavy smoker (>600). Obesity was defined based on Body Mass Index (BMI) and categorized as non-obese (BMI<27 kg/m^2) and obese (BMI ≥27 kg/m^2).

In addition, health status variables included hypertension and mental health problems. Participants were classified as hypertensive if they answered "yes" to having ever been diagnosed with hypertension. Mental health problems were assessed using the 20-item Self-Reporting Questionnaire (SRQ). Participants were classified as having mental health problems if they reported ≥6 affirmative responses.

Statistical Analysis

A total of 7,342 participants were included in the analysis after applying sampling weights. Univariate analysis was performed to describe the distribution and frequency of each variable. Bivariate analysis was performed to examine the association between the main independent variable (central obesity) and covariates with Type 2 diabetes mellitus (T2DM), using the chi-square test. The strength of association was estimated using prevalence odds ratios (PORs) with a significance level of $\alpha = 0.05$.

Multivariate analysis was conducted using multiple logistic regression to control for potential confounding. Variables with a p-value <0.25 in the bivariate analysis were selected as candidates in the initial model. Interaction terms were assessed at the initial modeling stage by including variables that could substantially interact with the main independent variable (e.g., physical activity). The final model was determined through stepwise evaluation, including the assessment of confounding effects, to obtain the appropriate fixed model.

Confounding was assessed through a stepwise procedure. First, variables were sequentially removed from the initial multivariable model, beginning with the variable with the highest p-value. After each removal, the change in the POR for the main independent variable was evaluated. A variable was considered as a confounder and retained in the model if its removal resulted in a change of more than 10% in the POR of the main independent variable, compared with the initial model. This process was repeated for all candidate variables until the final model was established.

The results are presented as PORs because the outcome prevalence was <10%. Missing data on the dependent and main independent variables were excluded from the analysis, while missing data on the covariate variables remained in the analysis.

RESULTS

A total of 7,342 participants from the IHS 2023 dataset were included in the analysis after applying the inclusion and exclusion criteria. Among these, 182 participants suffered from DM, of whom 129 were classified as having Type 2 diabetes mellitus (T2DM), yielding a prevalence of 1.8% among adults in DKI Jakarta (Table 1). In addition, Table 1 also shows that 50.6% of participants were classified as having central obesity, while 49.4% were non-central obese. Table 2 shows the distribution of covariate variables in this study. Participants aged 19–40 years comprised 52.8% of the sample. Slightly more than half were male (50.3%), and the majority had a high level of education (74.1%). Most participants were employed (65.1%) and married (69.5%). A substantial proportion of participants were classified as physically inactive (65.6%; <600 MET-minutes/week).

Table 1. Prevalence T2DM and Central Obesity among Adults in DKI Jakarta

Variable	n (7,342)	Percentage (%)
T2DM		
No	7,213	98.20
Yes	129	1.80
Central Obesity		
No	3,630	49.40
Yes	3,712	50.60

Regarding dietary patterns, the majority of participants were classified as non-risk for sweet food consumption (82.4%), whereas 77.2% and 61.8% were categorized as at risk for salty and fatty food consumption, respectively. In addition, 77.5% of participants reported insufficient fruit and/or vegetable intake. Most participants were classified as non-smokers (66.4%), and alcohol consumption was rare (1.8%). Meanwhile, 67.7% of participants were non-obese (BMI<27 kg/m^2) and did not have a history of hypertension (89.2%). Furthermore, 97.7% of participants reported no mental health problems.

Table 3 presents the results of the bivariate analysis examining the association between the dependent variable and each independent variable, including the main exposure and covariates. Variables with a p-value <0.25 were considered eligible for inclusion in the multivariable analysis. Of the 16 variables assessed, 12 (one main independent variable and 11 covariates) met this criterion and were included in the multivariable model.

In the bivariate analysis, these 12 variables were significantly associated with T2DM. Following multivariable logistic regression, and after adjusting for potential confounders, smoking behavior and hypertension were identified as confounding variables in the association between central obesity and T2DM. In addition, physical activity was identified as an effect modifier, as indicated by a significant interaction between central obesity and physical activity (Table 4).

DISCUSSION

This study utilized secondary data from the Indonesian Health Survey (IHS) 2023, focusing on participants aged 19–64 years in DKI Jakarta with available data on Type 2 diabetes mellitus (T2DM) status and abdominal circumference measurements. The prevalence of T2DM in this population was 1.8%. According to IHS 2023, the national prevalence of DM was 1.7% for all types, of which 50.2% were T2DM patients. This indicates that T2DM represents a substantial proportion of DM cases, consistent with its association with lifestyle-related factors. [8] The prevalence of T2DM in this study is higher than that reported in the Indonesia Basic Health Survey (IBHR) 2018, which found a T2DM prevalence of 1.5% based on fasting and random blood glucose measurements.[13] Differences in prevalence rates may be attributable to variations in case definitions, measurement methods, and study populations. A previous study by Nina et al. has also indicated that sedentary behaviour and unhealthy dietary patterns are common in urban areas, which may contribute to the observed burden of T2DM.[12]

In this study, 50.6% of participants were classified as having central obesity. This proportion is substantially higher than that reported in the IBHR 2018 (14.1%).[14] As with T2DM prevalence, these differences may reflect variations in measurement approaches, population characteristics, and study settings.

Bivariate analysis was performed to identify variables associated with T2DM, and variables with a p-value <0.25 were selected as candidates for the multivariate analysis. These included central obesity, age, sex, education, occupation, physical activity, sweet food consumption, fruit and/or vegetable consumption, smoking behavior, hypertension, obesity, and mental health status. An interaction term between central obesity and physical activity was also included based on substantive considerations. In the final multivariable model, central obesity, physical activity, smoking behavior, hypertension, and the interaction term were retained.

Table 2. The Distribution of Covariate Variables

Covariate Variables	n = 7,342	Percentage (%)
Socio-Demography		
Age		
Early Adulthood (19–40 Years)	3,880	52.8
Middle Adulthood (41–60 Years)	3,098	42.2
Late Adulthood (61–64 Years)	364	5.0
Sex		
Male	3,693	50.3
Female	3,649	49.7
Education		
High	5,437	74.1
Low	1,905	25.9
Occupation		
Working	4,777	65.1
Not Working/Schooling	2,565	34.9
Marital Status		
Unmarried/Divorced	2,239	30.5
Married	5,103	69.5
Lifestyle Variables		
Physical Activity		
Sufficient (≥ 600 MET-minutes/week)	2,533	34.5
Insufficient (<600 MET-minutes/week)	4,809	65.5
Sweet Food Consumption		
Not Risky	6,051	82.4
Risky	1,291	17.6
Salty Food Consumption		
Not Risky	1,675	22.8
Risky	5,667	77.2
Fatty Food Consumption		
Not Risky	2,806	38.2
Risky	4,536	61.8
Fruit and/or Vegetable Consumption		
Sufficient	1,654	22.5
Insufficient	5,688	77.5
Smoking Behavior		
Non-smoker	4,876	66.4
Light Smoker	1,340	18.3
Moderate Smoker	736	10.0
Heavy Smoker	141	1.9
Missing System	250	3.4
Alcohol Consumption		
No	7,209	98.2
Yes	133	1.8
Obesity (BMI)		
Non-Obese (BMI<27 kg/m^2)	4,972	67.7
Obese (BMI ≥27 kg/m^2).	2,365	32.2
Missing System	5	0.1
Health Status Variables		
Hypertension		
No	6,547	89.2
Yes	795	10.8
Mental Health Issues		
No	7,175	97.7
Yes	149	2.0
Missing System	18	0.3

Table 3. Association between Central Obesity, Covariate Variables, and T2DM

Variables	T2DM				Total		Crude POR	P-value
	No		Yes					
	n	%	n	%	n	%		
Main Independent Variable								
Central Obesity								
No	3,593	99.0	37	1.0	3,630	100.0	Ref	
Yes	3,620	97.5	92	2.5	3,712	100.0	2.47 (1.68–3.62)	<0.001
Covariate Variables								
Age								
Early Adulthood (19–40 Years)	3,853	99.3	27	0.7	3,880	100.0	Ref	
Middle Adulthood (41–60 Years)	3,025	97.6	73	2.4	3,098	100.0	3.45 (2.21–5.38)	<0.001
Late Adulthood (61–64 Years)	335	92.0	29	8.0	364	100.0	12.47 (7.31–21.29)	<0.001
Sex								
Male	3,640	98.6	53	1.4	3,693	100.0	Ref	
Female	3,573	97.9	76	2.1	3,649	100.0	1.45 (1.02–2.07)	0.038
Education								
High	5,359	98.6	78	1.4	5,437	100.0	Ref	
Low	1,853	97.3	51	2.7	1,905	100.0	1.90 (1.32–2.70)	<0.001
Occupation								
Working	4,716	98.7	61	1.3	4,777	100.0	Ref	
Not Working/Schooling	2,497	97.3	69	2.7	2,565	100.0	2.14 (1.51–3.03)	<0.001
Marital Status								
Unmarried/Divorced	2,202	98.3	37	1.7	2,239	100.0	Ref	
Married	5,010	98.2	92	1.8	5,103	100.0	1.09 (0.74–1.60)	0.662
Physical Activity								
Sufficient	2,501	98.7	32	1.3	2,533	100.0	Ref	
Insufficient	4,712	98.0	97	2.0	4,809	100.0	1.61 (1.08–2.41)	0.020
Sweet Food Consumption								
Not Risky	5,938	98.1	113	1.9	6,051	100.0	Ref	
Risky (Mean	1,275	98.7	17	1.3	1,291	100.0	0.68 (0.41–1.15)	0.149
Salty Food Consumption								
Not Risky	1,643	98.1	32	1.9	1,675	100.0	Ref	
Risky	5,570	98.3	97	1.7	5,667	100.0	0.89 (0.59–1.33)	0.565
Fatty Food Consumption								
Not Risky	2,754	98.1	52	1.9	2,806	100.0	Ref	
Risky	4,459	98.3	78	1.7	4,536	100.0	0.92 (0.65–1.31)	0.655
Fruit and/or Vegetable Consumption								
Sufficient	1,610	97.3	44	2.7	1,654	100.0	Ref	
Insufficient	5,603	98.5	86	1.5	5,688	100.0	0.56 (0.39–0.81)	0.002
Smoking Behavior [a]								
Non-smoker	4,784	98.1	92	1.9	4,876	100.0	Ref	
Light Smoker	1,320	98.5	20	1.5	1,340	100.0	0.80 (0.49–1.30)	0.370
Moderate Smoker	728	99.0	7	1.0	736	100.0	0.52 (0.25–1.12)	0.094
Heavy Smoker	134	95.7	6	4.3	141	100.0	2.44 (1.07–5.57)	0.034
Alcohol Consumption								
No	7,082	98.2	127	1.8	7,209	100.0	Ref	
Yes	130	97.7	3	2.3	133	100.0	1.11 (0.32–3.84)	0.868
Obesity (BMI) [b]								
Non-Obese (BMI<27 kg/m^2)	4,903	98.6	69	1.4	4,972	100.0	Ref	
Obese (BMI ≥27 kg/m^2).	2,305	97.4	61	2.6	2,365	100.0	1.87 (1.32–2.65)	<0.001
Hypertension								
No	6,463	98.7	84	1.3	6,547	100.0	Ref	
Yes	750	94.3	45	5.7	795	100.0	4.59 (3.17–6.65)	<0.001
Mental Health Issues [c]								
No	7,053	98.3	122	1.7	7,175	100.0	Ref	
Yes	142	95.3	7	4.7	149	100.0	2.82 (1.28–6.18)	0.010

a. Missing 3.4% b. Missing 0.1% c. Missing 0.3%

Table 4. Association between Central Obesity and T2DM after Adjusted by Covariate Variables

Variables	B	P-value	Adjusted PR (95% CI)
Central Obesity			
No			Ref
Yes	1.967	0.001	7.15 (2.19–23.35)
Physical Activity			
Sufficient			Ref
Insufficient	1.660	0.005	5.26 (1.64–16.90)
Smoking Behavior			
Non-smoker			Ref
Light Smoker	0.072	0.775	1.07 (0.66–1.76)
Moderate Smoker	-0.389	0.319	0.68 (0.32–1.46)
Heavy Smoker	0.848	0.048	2.34 (1.01–5.42)
Hypertension			
No			Ref
Yes	1.332	<0.001	3.79 (2.58–5.57)
Central Obesity*Physical Activity	-1.550	0.015	0.21 (0.06–0.74)

The results of the multivariable analysis indicate that central obesity, as the main independent variable, is significantly associated with T2DM among adults aged 19– 64 years in DKI Jakarta in 2023. After adjusting for physical activity, smoking behavior, hypertension, and the interaction between central obesity and physical activity, the adjusted prevalence odds ratio (aPOR) was 7.15 (95% CI: 2.19–23.35). This finding suggests that individuals with central obesity had 7.15 times the odds of developing T2DM compared with those without central obesity. This association is biologically plausible and supported by the underlying pathophysiology of central obesity. White adipose tissue functions as an energy reservoir by storing triglycerides and releasing free fatty acids when needed. Additionally, it produces hormones such as leptin, which play a role in appetite regulation and metabolism.[15] In central obesity, excessive accumulation of visceral fat disrupts adipose tissue metabolism, resulting in increased release of free fatty acids into the bloodstream. This accumulation triggers the release of pro-inflammatory cytokines, such as tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6), leading to systemic inflammation. These mechanisms contribute to impaired insulin signaling and insulin resistance, which are key processes in the development of T2DM.

These findings are consistent with a study by Dewi, which reported that individuals with central obesity had 3.30 times higher odds of developing T2DM (95% CI: 2.34–4.67) compared with those without central obesity.[16] This is attributed to the impact of excess abdominal fat, which increases the likelihood of insulin resistance, hyperinsulinemia, and glucose intolerance.[15] Additionally, excessive release of free fatty acids and adipokines results in oxidative stress and abnormal endothelial function, contributing to the early stages of T2DM.

Similarly, a cross-sectional study by Lu et al. found that central obesity was associated with higher odds of T2DM (POR = 1.55; 95% CI: 1.08 – 2.24) among adults in China.[17] This study compared the risks associated with different types of obesity in relation to T2DM among the adult population in China. Their study also reported that the prevalence of T2DM was higher among participants with central obesity (8.3%) compared to those classified as obese based on BMI (5.4%). Notably, the overall prevalence of T2DM reported in the Chinese study (5.0%) was higher than that observed in the present study (1.8%). This discrepancy may be due to differences in case ascertainment and measurement methods. The Chinese study used biochemical assessments, such as fasting blood glucose, which are more accurate and able to capture more cases. In contrast, the present study relied on self-reported doctor diagnosis and excluded individuals with unspecified diabetes type, potentially leading to an underestimation of T2DM prevalence.

Theoretically, adipose tissue is generally categorized into subcutaneous fat and visceral fat deposits.[18] Obesity, determined by body mass index (BMI), tends to be often dominated by subcutaneous fat. Given its anatomical location, visceral fat is stored deeper within the abdominal cavity than subcutaneous fat. It surrounds vital organs such as the liver, pancreas, and intestines. Excess visceral

fat is therefore more likely to promote ectopic fat deposition in organs such as the liver, which may result in lipotoxicity and metabolic dysfunction.[19]

The pathophysiology of central obesity is closely related to lifestyle factors such as physical activity and dietary patterns. Central obesity arises from a sustained imbalance between energy intake and expenditure. Excess caloric intake is initially stored as glycogen. When this capacity is exceeded, surplus energy is converted into triglycerides, which are stored in fat cells, leading to adipocyte hypertrophy. This process occurs when excessive consumption of high-risk foods (high in sugar, salt, fat, and low in fiber) is not balanced with sufficient physical activity, causing fat accumulation without being converted into energy, ultimately resulting in central obesity. Lack of physical activity increases the risk of T2DM by affecting blood glucose regulation. During physical activity, the body converts glucose into energy, and as muscle glucose stores deplete, blood glucose is utilized, leading to reduced blood glucose levels.[20] Conversely, insufficient physical activity leads to an increased risk of T2DM due to unutilized blood glucose accumulation.

Smoking behavior is associated with T2DM through lifestyle and psychosocial factors such as poor dietary patterns, alcohol consumption, low income, low education level, and psychosocial stress. These behaviors contribute to metabolic dysregulation, which adversely impacts health. The mechanism linking smoking behavior to T2DM involves its influence on the sympathetic nervous system and hormones that regulate metabolism, food intake, and visceral fat accumulation.[21] T2DM is also closely associated with hypertension, with both conditions commonly coexisting as components of metabolic syndrome.[22] From a pathophysiological perspective, hypertension is part of metabolic syndrome, a cluster of conditions closely associated with clinical manifestations. Besides hypertension, metabolic syndrome comprises a cluster of interrelated conditions, including central obesity, hyperglycemia, dyslipidemia, and insulin resistance. A study by Dewi found that individuals with a history of hypertension had 1.04 times the odds of developing T2DM (95% CI: 1.11-1.76) compared with those without hypertension.[16] Furthermore, the present analysis indicates a potential interaction between central obesity and physical activity (p-value = 0.21), suggesting that the association between central obesity and T2DM may vary according to levels of physical activity.[16]

This study has several strengths. First, the analysis incorporated sampling weights to improve the representativeness of the findings and reduce potential sampling bias. Second, multiple covariate factors were included in the analysis to account for potential confounding, allowing for a more comprehensive assessment of the association between central obesity and T2DM.

However, several limitations should be considered. First, the use of secondary data from the IHS 2023 restricted the analysis to available variables, and important factors, such as genetic predisposition, could not be assessed. Second, data were collected from interviews, a retrospective method that requires respondents to recall past events. This approach is susceptible to recall bias, which may lead to an underestimation or overestimation of the research findings. Consequently, the results may not accurately reflect the true associations between the variables. For instance, physical activity was measured based on participants' recall of frequency and duration, which may be prone to inaccuracy. Third, the cross-sectional design limits the ability to establish temporality and may introduce reverse causation. For example, participants diagnosed with T2DM may have modified their lifestyle behaviors, such as diet or smoking, before data collection, potentially biasing the observed associations.

CONCLUSION

The prevalence of Type 2 diabetes mellitus (T2DM) among adults aged 19–64 years in DKI Jakarta in 2023 was 1.8%. After controlling for confounding variables, central obesity was significantly associated with T2DM (aPOR = 7.15; 95% CI: 2.19–23.35; p = 0.001), indicating that adults with central obesity had 7.15 times the odds of T2DM compared with those without central obesity. These findings underscore the importance of central obesity as a modifiable factor in T2DM prevention. Public health efforts should prioritize early detection through routine monitoring of abdominal circumference and promote lifestyle interventions targeting diet and physical activity. It is also recommended for individuals to adopt a healthy lifestyle and undergo regular health checks to facilitate the early detection of central obesity and other health conditions At the policy level, the Indonesian Ministry of Health is expected to implement stricter policies to reduce the consumption of energy-dense, nutrient-poor food.

ETHICS APPROVAL

This research received ethical approval from the Research Ethics Committee of the Universitas Pembangunan Nasional "Veteran" Jakarta (No. 500/XII/2024/KEP).

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COMPETING INTEREST

All authors declare that there are no conflicts of interest.

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UNDERLYING DATA

The data for this study were sourced from the Indonesia Health Survey 2023 (IHS 2023), a nationally representative health survey employing a cross-sectional design, conducted by the Ministry of Health of the Republic of Indonesia.

DECLARATION OF ARTIFICIAL INTELLIGENCE USE

The author utilized AI Deepl to refine the English phrasing of this article, and no additional AI tools were used

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