GENIUS JOURNAL
general nursing science journal
e-ISSN: 2723-7729
Vol. 7 No. 2 PP. 353-361 E-ISSN 2723-7729

Association between Obesity and Type 2 Diabetes Mellitus in Primary Health Care Settings in Eastern Indonesia: A Cross-Sectional Study

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DOI: https://doi.org/10.56359/gj.v7i2.1001

Abstract

Introduction: Type 2 Diabetes Mellitus (T2DM) remains a major non-communicable disease and a growing public health concern globally and in Indonesia. Obesity is widely recognized as a key modifiable risk factor contributing to insulin resistance and the development of T2DM. In primary healthcare and community settings, evidence regarding the association between obesity and T2DM is essential to support effective preventive and promotive nursing interventions.
Objective: This study aimed to analyze the association between obesity and Type 2 Diabetes Mellitus among patients in the working area of Sikumana Public Health Center, Kupang City.
Method: This study employed a quantitative analytic observational design with a cross-sectional approach. The population consisted of 935 adult patients registered at Sikumana Public Health Center. A total of 93 respondents were selected using purposive sampling based on predefined inclusion and exclusion criteria. Obesity status was assessed using Body Mass Index (BMI), while T2DM status was obtained from secondary medical record data. Data were analyzed using univariate analysis and bivariate analysis with the Chi-square test at a significance level of $p \leq 0.05$.
Results: The results showed that 51.6% of respondents were classified as obese. The proportion of obesity was higher among respondents with Type 2 Diabetes Mellitus compared to those without diabetes. Statistical analysis demonstrated a significant association between obesity and Type 2 Diabetes Mellitus ($\chi^2 = 12.081$; $p = 0.001$).
Conclusion: Obesity was significantly associated with Type 2 Diabetes Mellitus among patients in the working area of Sikumana Public Health Center. These findings highlight the importance of obesity prevention and weight management strategies as part of nursing-led health promotion and disease prevention programs to reduce the burden of Type 2 Diabetes Mellitus at the primary healthcare level.

Keywords: body mass index, nursing, obesity, primary health care, type 2 diabetes mellitus

Introduction

Type 2 Diabetes Mellitus (T2DM) is one of the most prevalent non-communicable diseases worldwide and remains a major global public health challenge. T2DM is characterized by chronic hyperglycemia resulting from insulin resistance and progressive pancreatic β-cell dysfunction, leading to long-term complications affecting multiple organ systems, including cardiovascular, renal, neurological, and visual systems (Soelistijo et al., 2021). These complications significantly contribute to disability, reduced quality of life, and premature mortality, particularly among adults in low- and middle-income countries (World Health Organization [WHO], 2023).

The global burden of T2DM continues to rise in parallel with demographic transitions, population ageing, urbanization, unhealthy dietary patterns, physical inactivity, and increasing prevalence of overweight and obesity (WHO, 2023). The World Health Organization identifies diabetes as one of the leading causes of premature death worldwide and emphasizes its substantial impact on health systems, especially in resource-limited settings where long-term disease management remains challenging (WHO, 2023).

According to the International Diabetes Federation (IDF), an estimated 537 million adults aged 20–79 years were living with diabetes globally in 2021, and this number is projected to increase to 643 million by 2030 and 783 million by 2045 if current trends persist (International Diabetes Federation [IDF], 2021). Southeast Asia is among the regions experiencing the fastest growth in diabetes prevalence, reflecting rapid lifestyle and socioeconomic changes. Indonesia is ranked among the countries with the highest number of adults living with diabetes globally, posing a significant challenge for national and local health systems, particularly at the primary healthcare level where prevention, early detection, and long-term management are critical (IDF, 2021).

Obesity has been consistently identified as one of the most important modifiable risk factors for the development of Type 2 Diabetes Mellitus. The World Health Organization defines obesity as abnormal or excessive fat accumulation that presents a risk to health and is commonly assessed using Body Mass Index (BMI) (WHO, 2023). Excess adipose tissue, particularly visceral fat, contributes to insulin resistance through mechanisms involving chronic low-grade inflammation, dysregulated adipokine secretion, and altered glucose and lipid metabolism, ultimately leading to impaired glucose homeostasis (Kahn et al., 2021). These biological mechanisms provide a strong pathophysiological basis for the association between obesity and T2DM.

Epidemiological evidence consistently demonstrates a strong association between increased BMI and the risk of Type 2 Diabetes Mellitus. Longitudinal and population-based studies have shown that individuals with obesity have a substantially higher risk of developing T2DM compared to those with normal body weight (Hu et al., 2020; IDF, 2021). Obesity is also frequently accompanied by other metabolic abnormalities, including hypertension, dyslipidemia, and reduced physical activity, which further exacerbate insulin resistance and complicate glycemic control (Soelistijo et al., 2021). From a public health and nursing perspective, obesity therefore represents a critical target for preventive interventions aimed at reducing the incidence and progression of T2DM.

In Indonesia, the prevalence of obesity and diabetes has shown a steady increase over the past decade. National data from the Ministry of Health indicate rising trends in overweight, obesity, and diabetes among adults, particularly in urban and semi-urban populations (Kementerian Kesehatan Republik Indonesia, 2020). This epidemiological transition reflects lifestyle changes associated with socioeconomic development, including

increased consumption of energy-dense foods and decreased physical activity. The growing burden of diabetes places substantial pressure on primary healthcare services, which serve as the frontline for chronic disease prevention and management.

East Nusa Tenggara Province, including Kupang City, has also experienced a gradual increase in reported cases of Type 2 Diabetes Mellitus in recent years. Although the overall prevalence remains lower than in more urbanized regions of Indonesia, local health office reports indicate a consistent annual increase in diabetes cases, underscoring the need for early, community-based preventive strategies (Dinas Kesehatan Kota Kupang, 2021). The Sikumana Public Health Center, as one of the primary healthcare facilities in Kupang City, has reported an increasing number of patients diagnosed with T2DM, suggesting an escalating local burden of disease.

Previous studies conducted in various regions of Indonesia have demonstrated a significant association between obesity and Type 2 Diabetes Mellitus using cross-sectional and case-control designs (Putri et al., 2022; Suwinawati, 2020). However, regional differences in lifestyle behaviors, socioeconomic conditions, cultural practices, and access to healthcare services may influence the magnitude of this association. Therefore, localized research is essential to generate context-specific evidence that can inform effective nursing interventions and public health strategies tailored to community needs.

Based on the increasing prevalence of obesity and Type 2 Diabetes Mellitus in the working area of Sikumana Public Health Center and the limited availability of local empirical data examining their relationship, this study was conducted to analyze the association between obesity and Type 2 Diabetes Mellitus. The findings are expected to contribute to evidence-based nursing practice and support primary healthcare efforts in reducing the burden of diabetes through effective obesity prevention and weight management strategies.

Objective

To analyze the relationship between obesity and Type 2 Diabetes Mellitus among patients in the working area of Sikumana Public Health Center, Kupang City.

Method

Design and Setting

This study employed a quantitative analytic observational design using a cross-sectional approach. The research was conducted in the working area of Sikumana Public Health Center, Kupang City, East Nusa Tenggara Province, Indonesia, from September to October 2024. The study setting represents a primary healthcare facility responsible for community-based prevention, early detection, management, and follow-up of non-communicable diseases, including Type 2 Diabetes Mellitus.

Population and Sampling

The study population consisted of adult patients registered at Sikumana Public Health Center during the study period. Based on secondary data obtained from the health center, the total number of registered adult patients was 935 individuals. The sample was selected using purposive sampling based on predefined inclusion and exclusion criteria relevant to the study objective. The inclusion criteria were adult patients aged ≥40 years, registered at Sikumana Public Health Center, with complete medical record data on body weight, height, and diabetes status, and willing to participate in the study. The exclusion criteria included

patients with mobility impairments, pregnant women, and patients with severe diabetes-related complications that could affect anthropometric measurements.

The sample size was calculated using the Slovin formula with a margin of error of 10%, resulting in a minimum sample of 93 respondents. This sample size was considered adequate to represent the study population and to perform statistical analysis for assessing the relationship between obesity and Type 2 Diabetes Mellitus.

Instrument and Measurement

Obesity status was assessed using Body Mass Index (BMI), calculated as body weight in kilograms divided by height in meters squared (kg/m²). Body weight and height data were obtained from medical records and anthropometric measurements routinely collected at the health center. Obesity was classified based on BMI values ≥25 kg/m², in accordance with the World Health Organization criteria for Asian populations.

The diagnosis of Type 2 Diabetes Mellitus was determined using secondary medical record data, based on documented clinical diagnoses made by healthcare professionals and supported by blood glucose measurements, including random blood glucose levels ≥200 mg/dL or fasting plasma glucose ≥126 mg/dL, in line with standard clinical guidelines.

Data Collection and Analysis

Data collection was conducted after obtaining formal permission from the management of Sikumana Public Health Center. Respondents were informed about the study objectives, procedures, and confidentiality of data, and informed consent was obtained prior to data collection. Data were collected using secondary sources, including patient medical records and routinely recorded anthropometric data.

Data processing involved editing, coding, cleaning, and tabulating the collected data. Statistical analysis was performed using SPSS version 27. Univariate analysis was used to describe respondents' sociodemographic and clinical characteristics. Bivariate analysis using the Chi-square test was appliedto assess the relationship between obesity and Type 2 Diabetes Mellitus. Statistical significance was determined at a p-value ≤0.05.

Result

Sociodemographic Characteristics of Respondents

Table 1. Age Distribution of Respondents

Age (years)	f	%
40–59	61	65.6
60–74	32	34.4

Table 1 presents the age distribution of respondents in the working area of Sikumana Public Health Center. The majority of respondents were aged 40–59 years (65.6%), while the remaining respondents were aged 60–74 years (34.4%). This finding indicates that most participants were in the middle-aged group, which is a population segment known to have an increased risk of metabolic disorders, including Type 2 Diabetes Mellitus.

Distribution of Obesity and Type 2 Diabetes Mellitus

Table 2. Association Between Obesity and Type 2 Diabetes Mellitus

Obesity Status	T2DM (Yes)	T2DM (No)	Total
Obese	31	18	49
Non-obese	12	32	44

Table 2 illustrates the distribution of Type 2 Diabetes Mellitus based on obesity status. Among respondents classified as obese, 31 individuals were diagnosed with T2DM, while 18 respondents did not have T2DM. In contrast, among non-obese respondents, only 12 individuals had T2DM, whereas 32 respondents were not diagnosed with diabetes. These findings indicate a higher proportion of T2DM among obese respondents compared to those who were not obese.

Bivariate Analysis

The results of the Chi-square test demonstrated a statistically significant association between obesity and Type 2 Diabetes Mellitus ($\chi^2 = 12.081$; df = 1; p = 0.001). This finding indicates that obesity is significantly associated with the occurrence of Type 2 Diabetes Mellitus among patients in the working area of Sikumana Public Health Center.

Discussion

This study demonstrated a statistically significant association between obesity and Type 2 Diabetes Mellitus (T2DM) among patients in the working area of Sikumana Public Health Center ($\chi^2 = 12.081$; p = 0.001). Respondents classified as obese showed a markedly higher prevalence of T2DM compared to non-obese respondents. These findings reinforce obesity as a critical modifiable risk factor for T2DM within primary healthcare and community settings.

The significant association identified in this study is consistent with contemporary pathophysiological evidence linking obesity to insulin resistance and glucose dysregulation. Excess adipose tissue, particularly visceral fat, contributes to chronic low-grade inflammation, dysregulated adipokine secretion, and increased circulating free fatty acids, all of which impair insulin signaling and glucose uptake (Blüher, 2020; Ling & Rönn, 2020; Zheng et al., 2021). These mechanisms accelerate beta-cell dysfunction, ultimately leading to sustained hyperglycemia and the onset of T2DM (American Diabetes Association [ADA], 2024).

Recent metabolic studies have emphasized that obesity-induced insulin resistance is not merely a consequence of increased body mass but is strongly influenced by adipose tissue inflammation and ectopic fat deposition in the liver and skeletal muscle (Afshin et al., 2021; Samuel & Shulman, 2021). This biological evidence provides strong support for the findings observed in the present study and underscores the biological plausibility of obesity in the development of T2DM.

Obesity and T2DM in Primary Healthcare Contexts

From a public health perspective, obesity has been identified as one of the most important drivers of the global diabetes epidemic, particularly in low- and middle-income countries (LMICs) undergoing rapid urbanization and lifestyle transitions (International Diabetes Federation [IDF], 2021; World Health Organization [WHO], 2023). Primary

healthcare facilities, such as Sikumana Public Health Center, play a crucial role in early detection and long-term management of obesity and T2DM.

Recent evidence indicates that adults with obesity are two to five times more likely to develop T2DM compared to individuals with normal body weight (Afshin et al., 2021; Cosentino et al., 2020). Moreover, obesity has been shown to worsen glycemic control and increase the risk of diabetes-related complications, including cardiovascular disease and chronic kidney disease (Cosentino et al., 2020; Nguyen et al., 2021).

The findings of this study are consistent with recent national and international research. A large population-based study in Southeast Asia reported a strong association between elevated Body Mass Index (BMI) and T2DM prevalence, particularly among middle-aged adults (Magliano & Boyko, 2021). Similar results were observed in Indonesian primary healthcare settings, where obesity significantly increased the odds of T2DM after controlling for age and sex (Putri et al., 2022; Suwinawati, 2020).

Globally, longitudinal cohort studies have confirmed that obesity is a dominant predictor of T2DM incidence across diverse populations (Afshin et al., 2021; International Council of Nurses [ICN], 2023). These findings align closely with the results of the present study, strengthening the external validity of the observed association.

Implications for Nursing and Community Health Practice

From a nursing and community health perspective, the results of this study highlight the urgent need to strengthen obesity prevention and management strategies within primary healthcare services. Community and public health nurses are uniquely positioned to implement evidence-based interventions focused on weight management, lifestyle modification, and metabolic risk screening (Jakovljevic et al., 2021; Norris et al., 2020).

Recent intervention studies have demonstrated that nurse-led lifestyle modification programs can significantly reduce body weight, improve glycemic control, and delay the progression of T2DM among high-risk populations (Chan et al., 2021; Norris et al., 2020). Therefore, integrating structured obesity prevention programs into routine primary healthcare services may contribute substantially to reducing the burden of T2DM in the Sikumana Public Health Center catchment area.

Contextual Considerations and Public Health Relevance

The increasing prevalence of obesity and T2DM in the working area of Sikumana Public Health Center may be influenced by local contextual factors, including dietary patterns, reduced physical activity, and socioeconomic changes. Urbanization and lifestyle transitions have been shown to significantly contribute to obesity-related metabolic disorders in similar settings (Popkin et al., 2020; WHO, 2023).

These contextual dynamics emphasize the importance of localized, evidence-based research to inform targeted nursing and public health interventions. Community-specific data, such as those generated in this study, are essential for designing culturally appropriate and sustainable obesity prevention strategies.

Implications for Policy and Practice

The findings of this study support national and global recommendations that prioritize obesity prevention as a central component of diabetes control strategies (ADA, 2024; Kementerian Kesehatan Republik Indonesia, 2022; WHO, 2023). Strengthening obesity screening, health education, and lifestyle intervention programs at the primary healthcare

level may significantly reduce the incidence and progression of T2DM and its associated complications.

Study Limitations

Despite its significant findings, this study has several limitations that should be acknowledged. First, the cross-sectional design limits the ability to establish causal relationships between obesity and Type 2 Diabetes Mellitus. While a significant association was identified, the temporal sequence between obesity and diabetes onset cannot be determined.

Second, the use of purposive sampling and a relatively small sample size may limit the generalizability of the findings to broader populations. The study was conducted in a single primary healthcare center, which may not fully represent other regions with different demographic and socioeconomic characteristics.

Third, the reliance on secondary data from medical records may introduce information bias due to incomplete or inaccurate documentation. Additionally, other potential confounding factors such as dietary intake, physical activity levels, stress, and genetic predisposition were not analyzed in this study, which may influence the relationship between obesity and Type 2 Diabetes Mellitus.

Suggestions for Future Research

Future studies are recommended to use longitudinal or cohort designs to better establish causal relationships between obesity and the development of Type 2 Diabetes Mellitus. Larger sample sizes and multi-center studies involving different regions would improve the generalizability of findings and provide a more comprehensive understanding of the obesity-diabetes relationship.

Further research should also explore additional risk factors, including dietary patterns, physical activity, psychosocial factors, and family history, to better understand the multifactorial nature of Type 2 Diabetes Mellitus. Intervention-based studies evaluating the effectiveness of nursing-led lifestyle modification programs in reducing obesity and improving glycemic control are also strongly recommended.

Conclusion

This study concludes that obesity is significantly associated with Type 2 Diabetes Mellitus among patients in the working area of Sikumana Public Health Center, Kupang City. The findings reaffirm obesity as a major modifiable risk factor contributing to the development of Type 2 Diabetes Mellitus at the community level. These results underscore the importance of early detection of obesity and the implementation of comprehensive, nursing-led preventive strategies focusing on lifestyle modification, weight management, and health promotion to reduce the burden of diabetes. Strengthening obesity prevention programs within primary healthcare services is essential to support effective diabetes control and improve population health outcomes.

Acknowledgement

The authors would like to express their sincere gratitude to the management and healthcare staff of Sikumana Public Health Center for their support and cooperation during data collection. Appreciation is also extended to all respondents who participated in this study.

Author Contribution

All authors contributed substantially to the conception and design of the study. The first author conducted data collection and analysis, while all authors participated in data interpretation, manuscript drafting, critical revision, and final approval of the manuscript.

Conflict of Interest

The authors declare no conflict of interest related to this study.

Ethical Clearance

This study was conducted in accordance with ethical research principles and received ethical approval from the Health Research Ethics Committee. All respondents provided informed consent prior to participation, and confidentiality of participant data was strictly maintained.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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