Community Research

Obesity in urban Indonesia: evidence from the 2007 and 2018 Basic Health Research

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ABSTRACT

BACKGROUND The prevalence of obesity in urbanizing Indonesia is rising, where the double burden of malnutrition poses a significant challenge. This study aimed to examine the prevalence and increment of obesity-related noncommunicable diseases (NCDs) of diabetes and hypertension.

METHODS Secondary data from the latest 2018 Basic Health Research (*RISKESDAS*) were used to analyze the obesity rate and its associations with lifestyle, sociodemographics, and certain comorbidities among urban Indonesians. This study included non-pregnant adults aged ≥18 years who lived in the urban area and whose blood pressure and glucose levels were measured in the survey. Results were compared to a similar study using data from 2007.

RESULTS The proportion of obesity among Indonesia's urban population was more than doubled from 23.0% in 2007 to 50.1% in 2018 for obesity and 28.0% to 57.2% for central obesity. Additionally, females, individuals with higher socioeconomic status, and higher education levels exhibited a higher obesity prevalence.

CONCLUSIONS Urban Indonesia has witnessed a dramatic rise in obesity prevalence. Our findings highlighted the urgent need for policymakers to consider the escalating prevalence of NCDs associated with obesity. Strengthening and concretizing health promotion and prevention policies at the community level are crucial to combat this alarming public health challenge.

KEYWORDS noncommunicable diseases, obesity, urban health

More than half of the global population is projected to reside in cities by 2050, with significant proportions in the Asia-Pacific.[1] Indonesia is a rapidly urbanizing country, with an increasing proportion of its population living in urban areas.[2] As cities face obstacles in maintaining healthy diets for their residents, urbanization has become one of the key drivers of the obesity pandemic.[3] It has caused lifestyle changes, such as decreased physical activity and increased availability of energy-dense meals. Thus, an increase in obesity and other noncommunicable diseases (NCDs) in this country could be expected.

Obesity is an excessive fat accumulation that may impair health.[4] Indonesia is experiencing a severe double burden of rising malnutrition due to obesity and overweight, whereas approximately 20% of children under 5 years old in the country are stunted.[5,6] According to data from the biggest national health survey, the Basic Health Research (*RISKESDAS*), in 2007

and 2018, the prevalence of obesity and central obesity increased by >10%.[7,8]

Basic Health Research is a national survey that portrays health indicators, including obesity and related NCDs and identifies trends in their distribution across different demographics. This community-based health survey evaluates the achievements of health development indicators in Indonesia and is conducted periodically over 5 years. According to Basic Health Research data, diabetes prevalence in the country based on blood glucose measurement has increased from 6.8% (2013) to 8.5% (2018).[7] Similar to Indonesia, hypertension is on the rise globally.[9] Both hypertension and diabetes have been known to be closely related to obesity status.

Studies have examined the mechanisms by which obesity causes hypertension. Being overweight contributes greatly (65–75%) to the occurrence of essential hypertension. The mechanism of obesity in hypertension occurs through impaired renal pressure natriuresis, activation of the renin-angiotensin–aldosterone system, and the sympathetic nervous system,[10] whereas the mechanism by which obesity causes diabetes occurs through insulin resistance. Insulin resistance with impaired β-cell function will cause hyperglycemia and develop into prediabetes and eventually diabetes.[11] Therefore, weight loss is recommended for the treatment of obesity-related hypertension and diabetes. This study aimed to determine the prevalence of obesity and associated factors, such as sociodemographic, lifestyle, and comorbidities, based on the 2018 Basic Health Research data, compared to the 2007 data published by Harbuwono et al.[12] By examining the prevalence across different sociodemographic groups in Indonesia, the results could guide public health policies and programs to tackle the growing obesity epidemic in this country.

METHODS

Study design and population

This cross-sectional study used secondary data from the latest Basic Health Research conducted by the Ministry of Health of the Republic of Indonesia in 2018. Data were collected through interviews, physical measurements, and biomedical examinations. Data were collected in May 2018 from 34 provinces, consisting of 416 regencies and 98 cities in Indonesia. The Basic Health Research included 300,000 households. Probability proportional to size and linear systematic sampling methods were used to select study participants from Indonesia's general population, including adults residing in urban areas. The interview response rate in this survey was 95% of the target households at the national level. Biomedical data, including blood pressure and glucose level, were collected on a subsample basis in 26 provinces from 25,000 households with a 77.7% response rate.[7] The sample included adults aged ≥18 years, selected as the biomedical subsample of 2018 Basic Health Research

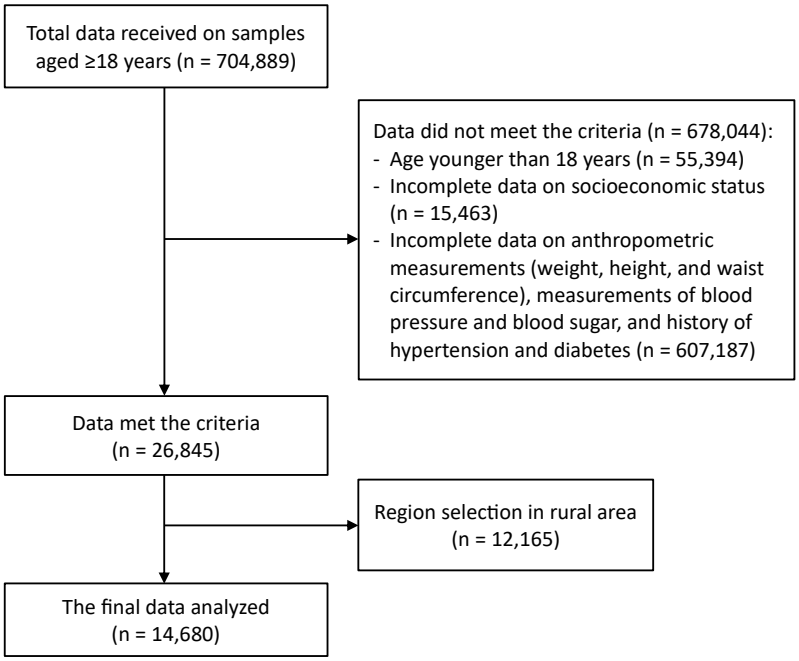

Figure 1. Data selection process

participants, and met the inclusion criteria of being non-pregnant. The data selection process is described in Figure 1.

Variables

All participants were interviewed and physically measured, and blood was collected for survey purposes. The interview included questions on sociodemographic characteristics, disease history, physical activity, and dietary lifestyle. Physical measurements included blood pressure, body weight, height, and waist circumference (WC) measurements. Meanwhile, the blood examinations included blood glucose and glucose tolerance tests. As the aim was to update the situation based on the 2007 Basic Health Research, this study had the same selection of variables as previous study. The dependent variables were hypertension and diabetes. The independent variables were obesity based on the body mass index (BMI), central obesity, dietary profile, physical activity, and smoking status.

Hypertension was defined as having a history of hypertension diagnosed by a health professional or based on blood pressure measurements with a systolic value of ≥140 mmHg and/or a diastolic blood pressure of ≥90 mmHg.[12] In contrast, diabetes was defined as having a history of diabetes diagnosed by a health professional or a blood glucose level of ≥200 mg/dl after a glucose tolerance test.[12]

Obesity is caused by excessive body fat, which increases the risk of various health problems. It is typically classified by BMI and defined as generalized obesity, which may not accurately depict the degree of regional adiposity.[13] Meanwhile, central obesity shows more fat accumulation in the abdominal area measured by abdominal circumference. Compared with obesity, central obesity is associated with metabolic syndrome and the risk of diabetes.[14] Obesity was defined using BMI, using the formula for body weight in kilograms divided by height in meters squared (kg/m^2); BMI ≥25 kg/m^2 have a higher risk of diabetes and lower BMI for cardiovascular diseases in the Asia-Pacific population.[15] Central obesity was defined using WC, where men with >90 cm and women with >80 cm WC are categorized as centrally obese.[7]

Dietary profiles were obtained based on fruit and vegetable consumption. Inadequate intake of fruits and vegetables (less than five servings per day in a week) was categorized as a high-risk dietary profile.[12] The level of physical activity was categorized into "active" and "inactive" based on the modified Global Physical Activity Questionnaire part of the World Health Organization (WHO) STEPwise approach to NCD risk factor surveillance.[7,16]

Smoking status was determined based on individual smoking habits within the month before data collection. Those who smoked daily or occasionally were classified as smokers, individuals who had previously smoked but had stopped were former smokers, and non-smokers were those who had never smoked. The details of the measurement methods for each variable have previously been reported.[17]

In addition to sex and age group, socioeconomic status and educational background were included as sociodemographic variables. Educational background has two categories, "higher" for participants who graduated high school and "basic" for those who never graduated high school. Socioeconomic status was categorized as "low" for participants in the lowest and second lowest wealth quintile and "high" for the rest.[12]

Statistical analysis

Univariate analysis was performed to determine the frequency of each variable. Bivariate analysis was performed to determine the association between the categorical dependent and independent variables using the chi-square test. The relationships between sociodemographic and lifestyle characteristics, obesity, and central obesity were initially analyzed, followed by the prevalence of hypertension and diabetes among groups with obesity and central obesity.

Data were analyzed using SPSS software version 21.0 (IBM Corp., USA). The level of significance for all tests was $p<0.05$. Data access was approved by the Health Development Policy Agency of the Ministry of Health of the Republic of Indonesia through the submission of a proposal for data requests. Basic Health Research ethical approval was issued by the Health Research Ethics Committee, National Institute of Health Research and Development, Ministry of Health of the Republic of Indonesia (No. LB.02.01/2/KE.267/2017). Informed consent was obtained from all participants prior to the interviews. Secondary data were obtained without the respondents' personal information owing to data privacy policies. The analysis results were compared with those of a similar study that used Basic Health Research data from 2007.[12]

RESULTS

This study included 14,680 urban residents participating in the 2018 Basic Health Research biomedical subsample. Meanwhile, the previous analysis of the 2007 Basic Health Research data involved 16,789 participants. Table 1 compares participants' characteristics based on the 2007 and 2018 surveys, showing an increase in participant's sex, age group, and participant in high socioeconomic status. The participants were predominantly female (53.6% in 2007 *versus* 64.9% in 2018). In 2007, the largest percentage was observed in the 18–37 age group, whereas participants in 2018 were mostly ≥48 years old. Participants with high socioeconomic status were increased from 61.0% (2007) to 77.0% (2018). However, most of the participants in 2007 had higher educational backgrounds (61.8%) compared to 2018, where participants mostly had basic educational background (55.9%).

The prevalence figures in 2018 were considerably higher compared to the data from 2007, specifically related to the prevalence of central obesity (28.0% to 57.2%), obesity (23.0% to 50.1%), hypertension (32.7% to 57.3%), and diabetes (6.6% to 55.8%).

Based on the chi-square test, almost all independent variables had statistically significant relationships with obesity and central obesity ($p<0.05$) (Table 2). However, the previous 2007 Basic Health Research study found that educational background, dietary profile, and physical activity were not significantly associated with central obesity.[12]

Obesity and central obesity prevalence in urban Indonesia were higher among females and those with high socioeconomic status. In both years, individuals aged 38–47 years had the highest obesity prevalence, whereas those aged 48–57 years had the highest central obesity prevalence. Obesity was more common among those with higher educational levels, but central obesity was more prevalent among those with basic education.

Regarding lifestyle, the percentage of smokers was lower in 2018 than in 2007 (16.7% *versus* 30.6%). Most participants were non-smokers (72.6%), obese (based on BMI and centrally), and had high-risk diets (92.7%) (Table 1). Participants with high-risk diets had a lower prevalence of both obesity types (49.8% *versus* 54.3% for obesity and 56.7% *versus* 62.8% for central obesity). Approximately one-fifth of participants had

Table 1. Participant characteristics

Characteristics	2007, n (%)	2018 (present study), n (%) (N = 14,680)
Sex (n = 16,789)		
Male	7,788 (46.4)	5,160 (35.1)
Female	9,001 (53.6)	9,520 (64.9)
Age (years) (n = 16,789)		
18–27	5,256 (31.3)	914 (6.2)
28–37	3,964 (23.6)	1,541 (10.5)
38–47	3,432 (20.4)	3,041 (20.7)
48–57	2,230 (13.3)	4,393 (29.9)
≥58	1,907 (11.4)	4,791 (32.6)
Socioeconomic status (n = 16,789)		
Low	6,554 (39.0)	3,376 (23.0)
High	10,235 (61.0)	11,304 (77.0)
Educational background (n = 16,671)		
Basic	6,376 (38.2)	8,213 (55.9)
Higher	10,295 (61.8)	6,467 (44.1)
Obesity based on BMI (n = 16,871)		
Yes	3,882 (23.0)	7,357 (50.1)
No	12,989 (77.0)	7,323 (49.9)
Central obesity (n = 16,536)		
Yes	4,634 (28.0)	8,393 (57.2)
No	11,902 (72.0)	6,287 (42.8)
Hypertension (n = 16,536)		
Yes	5,407 (32.7)	8,411 (57.3)
No	11,129 (67.3)	6,269 (42.7)
Diabetes (n = 16,040)		
Yes	1,058 (6.6)	8,197 (55.8)
No	14,982 (93.4)	6,483 (44.2)
Physical activity (n = 16,789)		
Active	12,264 (73.0)	11,760 (80.1)
Inactive	4,525 (27.0)	2,920 (19.9)
Dietary profile (n = 16,671)		
Low-risk	311 (1.9)	1,067 (7.3)
High-risk	16,360 (98.1)	13,613 (92.7)
Smoking (n = 16,671)		
Smoker	5,109 (30.6)	2,457 (16.7)
Past smoker	728 (4.4)	1,566 (10.7)
Not a smoker	10,834 (65.0)	10,657 (72.6)

BMI=body mass index
Data were obtained from the Basic Health Research (*RISKESDAS*)

Table 2. Associations of sociodemographic and lifestyle characteristics with obesity and central obesity

Characteristics	Obesity based on BMI (BMI ≥25 kg/m^2)				Central obesity			
	2007, n (%) (N = 3,882)	*p*	2018 (present study), n (%) (N = 7,357)	*p*	2007, n (%) (N = 4,634)	*p*	2018 (present study), n (%) (N = 8,393)	*p*
Sex		**≤0.001**		**≤0.001**		**≤0.001**		**≤0.001**
Male	1,313 (33.8)		2,163 (29.4)		924 (19.9)		1,940 (23.1)	
Female	2,569 (66.2)		5,194 (70.6)		3,710 (80.1)		6,453 (76.9)	
Age (years)		**≤0.001**		**≤0.001**		**≤0.001**		**≤0.001**
18–27	507 (13.1)		286 (3.9)		789 (17.0)		267 (3.2)	
28–37	1,098 (28.3)		780 (10.6)		1,150 (24.8)		793 (9.4)	
38–47	1,146 (29.5)		1,819 (24.7)		1,219 (26.3)		1,824 (21.7)	
48–57	731 (18.8)		2,328 (31.6)		837 (18.1)		2,711 (32.3)	
≥58	400 (10.3)		2,144 (29.1)		639 (13.8)		2,798 (33.3)	
Socioeconomic status		**≤0.001**		**≤0.001**		**≤0.001**		**≤0.001**
High	2,553 (65.8)		5,948 (80.8)		2,991 (64.5)		6,750 (80.4)	
Low	1,329 (34.2)		1,409 (19.2)		1,643 (35.5)		1,643 (19.6)	
Educational background*		**≤0.001**		**≤0.001**		**0.003**		**≤0.001**
Basic	1,579 (40.7)		4,011 (54.5)		1,710 (36.9)		4,796 (57.1)	
Higher	2,296 (59.3)		3,346 (45.5)		2,924 (63.1)		3,597 (42.9)	
Dietary profiles*		**≤0.001**		**0.005**		**0.01**		**≤0.001**
Low risk	3,779 (97.5)		579 (7.9)		4,524 (97.6)		670 (8.0)	
High risk	96 (2.5)		6,778 (92.1)		110 (2.4)		7,723 (92.0)	
Physical activity		**≤0.001**		**≤0.001**		0.207		0.047
Active	3,055 (78.7)		6,039 (82.1)		3,548 (76.6)		6,771 (80.7)	
Inactive	827 (21.3)		1,318 (17.9)		1,086 (23.4)		1,622 (19.3)	
Smoking status		**≤0.001**		**≤0.001**		**≤0.001**		**≤0.001**
Smoker	NA		926 (12.6)		NA		865 (10.3)	
Past smoker	NA		756 (10.3)		NA		744 (8.9)	
Not a smoker	NA		5,675 (77.1)		NA		6,784 (80.8)	

BMI=body mass index; NA=not available

Data were obtained from the Basic Health Research (*RISKESDAS*); missing data on: *educational background and dietary profile (n = 7; 0.18%) in obesity based on BMI

an inactive lifestyle (19.9%). There was an increase in the percentage of physically active participants compared with 2007 (73.0% *versus* 80.1%) (Table 1). Physically inactive participants had lower obesity and central obesity prevalence than active participants (17.9% *versus* 21.3% for obesity and 19.3% *versus* 23.4% for central obesity [Table 2]).

Obesity and central obesity are associated with hypertension and diabetes. Hypertension and diabetes prevalence was higher in 2018 than in 2007 (Table 3). Obesity, hypertension, and diabetes were also associated with sex. However, obesity status was not a significant determinant of diabetes among females.

DISCUSSION

This study's findings shed light on the prevalence of obesity, hypertension, and diabetes among urban

Table 3. Prevalence of hypertension and diabetes among participants with obesity and central obesity

Characteristics	2007				2018 (present study)		
	Hypertension, n (%)	Total	Diabetes, n (%)	Total	Hypertension, n (%)	Diabetes, n (%)	Total
Obesity							
Overall							
Yes	1,869 (48.3)	3,869	539 (14.7)	3,660	4,775 (64.9)	4,213 (57.3)	7,357
No	3,568 (28.2)	12,666	514 (4.2)	12,380	3,636 (49.7)	3,984 (54.4)	7,323
Male							
Yes	683 (52.1)	1,310	127 (8.3)	1,537	1,415 (65.4)	1,417 (65.5)	2,163
No	1,797 (28.3)	6,356	297 (4.2)	7,094	1,421 (47.4)	1,718 (57.3)	2,997
Female							
Yes	1,186 (46.3)	2,559	413 (13.3)	3,096	3,360 (64.7)	2,796 (53.8)	5,194
No	1,741 (27.6)	6,310	219 (3.0)	7,218	2,216 (51.2)	2,266 (52.4)	4,326
Central obesity							
Overall							
Yes	2,104 (45.4)	4,634	539 (12.3)	4,394	5,483 (65.3)	5,150 (61.4)	8,393
No	3,303 (27.8)	11,902	514 (4.4)	11,646	2,928 (46.6)	3,047 (48.5)	6,287
Male							
Yes	482 (52.2)	924	127 (11.5)	1,108	1,281 (66)	1,348 (69.5)	1,940
No	1,998 (29.6)	6,743	297 (4.0)	7,399	1,554 (48.3)	1,787 (55.5)	3,220
Female							
Yes	1,622 (43.7)	3,710	413 (9.3)	4,438	4,202 (65.1)	3,802 (58.9)	6,453
No	1,305 (25.3)	5,159	219 (3.8)	5,735	1,374 (44.8)	1,260 (41.1)	3,067

All $p<0.001$; except for diabetes in female with obesity from 2018 data $p = 0.158$
Data were obtained from the Basic Health Research (*RISKESDAS*)

Indonesians by comparing data from the Basic Health Research in 2007 and 2018. The evolving demographic landscape revealed a significant shift toward an aging population in 2018, which influenced the higher prevalence of obesity and health-related conditions. The dramatic increase in obesity and central obesity prevalence exceeded the Basic Health Research 2007 figures.[12] This acceleration in obesity aligns with global trends indicated by the WHO report in May 2022.[18]

This surge in obesity was particularly prominent among females. Hormonal changes, particularly in ovarian hormones, contribute to sex-specific variations in body fat distribution.[19] This trend mirrors observations from global data and in other developing nations, such as India, where urban females exhibit higher obesity rates.[18,20] The study also showed associations between smoking and obesity, with smokers having lower obesity prevalence. However, this relationship is intricate and influenced by various factors.[21,22]

Importantly, age has emerged as a significant determinant of obesity patterns.[23] In 2018, the Indonesian older adult population was much larger than in the previous decade. It is not surprising that the prevalences of obesity, hypertension, and diabetes are also higher. Obesity is more prevalent among those aged >37 years and is potentially influenced by urban dwellers' demanding lifestyles during their peak professional and family responsibilities. However, central obesity peaks among individuals aged >47 years, possibly because of the hormonal changes and metabolic shifts associated with aging.[19,24,25]

Socioeconomic status significantly impacts obesity rates. Individuals with higher socioeconomic backgrounds face challenges linked to dietary choices and sedentary leisure activities, contributing to higher

obesity prevalence.[26] Contributing factors might include access to less healthy but convenient food options and limited physical activity due to long working hours.[27] Interestingly, high-risk diet and physical inactivity appear paradoxically linked to lower obesity rates in urban Indonesia. This could stem from these groups' overall lower caloric intake despite their risky lifestyles. This also demonstrates how epidemiological findings do not always correspond to rational and clinical assumptions.

Regarding food security, being poor in urban areas makes people more vulnerable than in rural settings, because cities have fewer natural resources. A study with a similar design in Columbia has confirmed this issue.[28] Another driver of nutrition insecurity in cities is that increasing numbers of people are developing habits of snacking and buying ready-to-eat meals, coupled with a growing reliance on processed foods, which are typically high in fat, sugar, and salt.[29] Nevertheless, it is essential to acknowledge that the connection between diet and the risk of obesity is complex and can vary depending on various personal and environmental factors.

This study also revealed compelling connections among obesity, hypertension, and diabetes. Hypertension and diabetes prevalence were higher in 2018 than in 2007, highlighting the escalating burden of NCDs over time. This has also been observed in other countries, such as China, Malaysia, Australia, Congo, and the United States.[23,30–33] Both obesity types exhibited strong associations with these conditions, reinforcing the importance of addressing obesity as a significant risk factor for chronic diseases. However, in urban Indonesia, the association between obesity and diabetes was insignificant among females, warranting further exploration due to potential sex-specific physiological differences.[34]

In terms of obesity assessment, this study highlights the relevance of WC as an accurate indicator of metabolic risk. While BMI remains widely used, WC specificity to identify visceral fat accumulation and metabolic abnormalities is crucial for gauging disease risk.[35] Therefore, the incorporation of WC measurement can aid healthcare professionals to better identify and manage obesity-related health risks, particularly in normal BMI individuals with excess visceral fat.

The global burden of disease study identified high systolic blood pressure, tobacco, dietary risks, high fasting plasma glucose, and obesity as key contributors to health loss in Indonesia.[36] Effective interventions are imperative to address the escalating prevalence of obesity-related health issues, which tend to be faster in urban areas. Urban food systems should prioritize providing healthy and balanced diets, ensuring accessibility to all citizens.[37] Furthermore, educational campaigns focusing on obesity prevention, targeting both lifestyle modifications and public awareness, are vital to curb the obesity epidemic.

According to Basic Health Research data, obesity prevalence has increased. Current health policies inadequately address various enabling factors of obesity and NCDs, such as obesogenic urban environments, insufficient regulations regarding foods high in sugar, salt, and fat, and the absence of specific programs for preventing childhood obesity.[38] There is a significant gap between governmental attention and the actual implementation of NCD prevention. Indonesia has various programs for the prevention and monitoring of NCDs, including the healthy living community movement (*Germas*), the national movement to reduce obesity (*Gentas*), a health-promotion program encouraging regular health checks, smoking cessation, physical activity, healthy diet, stress management, and adequate rest (*Cerdik* and *Patuh*), as well as integrated health services (*Posbindu*) dedicated to NCDs and older adult care centers (*Posyandu Lansia*).[38–41] While health programs are well designed at the central level, their effectiveness diminishes locally, necessitating a comprehensive evaluation of implemented policies and programs. Improved planning demands closer collaboration between the central and regional governments, as underscored by multi-sectoral support. It is now time for the Indonesian government to pay significant attention to obesity and NCD prevention.

This study has several limitations. Causality could not be determined due to the cross-sectional nature of the Basic Health Research. As the data in the Basic Health Research was self-reported, there may have been bias due to underreporting and measurement errors. Moreover, this study only focused on urban populations and did not explore the potential differences in obesity prevalence between urban and rural areas. Including such comparisons could provide additional insights into the impact of urbanization on obesity trends.

In conclusion, there was a significant surge in obesity and central obesity prevalence among urban

Indonesians from 2007 to 2018, affecting approximately half of the urban population. This study highlighted elevated obesity rates among females and individuals with high socioeconomic status. Importantly, these results underscore the persistent association between obesity and an increased burden of hypertension and diabetes over time in urban Indonesia. Emphasis on preventing and managing obesity is crucial for alleviating the burden of these conditions. Our findings provide valuable insights for shaping targeted public health policies and programs to address the escalating obesity epidemic. Furthermore, interventions should promote a physically active lifestyle and enhance public awareness of the importance of consuming healthy, unprocessed foods to combat the rising tides of NCDs. Future studies should investigate the underlying factors contributing to the growing prevalence of obesity among Indonesians, including the impact of urbanization, food systems, and socioeconomic status on dietary patterns and physical activity levels. Research should also focus on developing and evaluating effective interventions tailored to the Indonesian context.

Conflict of Interest

The authors affirm no conflict of interest in this study.

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