June 2024; 15(1): 80-90
Jurnal Kesehatan Reproduksi
DOI: 10.58185/jkr.v15i1.187
ISSN: 2354-8762 (Online)
https://journaliakmitangsel2.iakmi.or.id/index.php/kespro

ASSOCIATION BETWEEN DEMOGRAPHIC FACTORS AND DIETARY INTAKE WITH ABDOMINAL OBESITY AMONG WOMEN OF CHILDBEARING AGE IN INDONESIA

Mukhlidah Hanun Siregar[1]*, Ratu Ayu Dewi Sartika[2], Junengsih[3], Kalinaki Hanifar[4]

[1] Department of Nutrition, Faculty of Medicine and Health Sciences, University of Sultan Ageng Tirtayasa, Indonesia
[2] Department of Nutrition, Faculty of Public Health, University of Indonesia, Indonesia
[3] Politeknik Kesehatan Kemenkes III, Indonesia
[4] Ministry of Health, Jinja District, Uganda

Email: mukhlidah.hanunsiregar@gmail.com
* Corresponding author

Article Info

Keywords:
Abdominal obesity;
Demographic factors;
Fatty foods;
Grilled foods;
Women of childbearing age;

Abstract

Background: There was an increase in the incidence of abdominal obesity among women of childbearing age in Indonesia. Impact on reproductive health such as sub infertility, irregular menstruation, and PCOS. Abdominal obesity also causes problems during pregnancy. **Objective:** This study aimed to analyze the association of demographics and patterns of food consumption with abdominal obesity in women of childbearing age in Indonesia**. Method:** This study used a cross-sectional design. The data used from Basic Health Research 2018. The total sample size was 29,888 respondents. Data analysis was performed by the Chi-Square test. **Results:** The result found the prevalence of abdominal obesity in women of childbearing age was 49.4%. Demographic factors associated with abdominal obesity were age, marital status, education level, and type of region. Patterns of food consumption associated were fatty foods/cholesterol/fried foods and burnt/grilled foods, with a risky frequency of more than 3 times per week. **Conclusion:** One of two women of childbearing age in Indonesia was abdominal obesity so we should make efforts to reduce this incidence with notice in demographic factors and dietary intake. Women of childbearing age need to avoid risky foods to maintain reproductive health and reduce the risk of cardiovascular disease, which increases with age.

Received 02/06/2024 Revised 18/06/2024 Accepted 30/08/2024

How to Cite:

Siregar MH, Sartika RAD, Junengsih, Hanifar K. ASSOCIATION BETWEEN DEMOGRAPHIC FACTORS AND DIETARY INTAKE WITH ABDOMINAL OBESITY AMONG WOMEN OF CHILDBEARING AGE IN INDONESIA. J. Kesehat. Reproduksi [Internet]. 2024 Jun. 30;15(1):80-90. Available from: https://doi.org/10.58185/jkr.v15i1.187

INTRODUCTION

Abdominal obesity is excess fat deposits in the abdominal area and is more closely related to diabetes mellitus and cardiovascular disease.[1,2] Abdominal obesity is measured by the waist/abdominal circumference (WC) at the superior iliac. Abdominal obesity is defined as the waist/abdominal circumference above 90 cm for men and above 80 cm for women.[3]

Global data shows that there is an increasing prevalence of abdominal obesity at various ages, with the highest increase occurring in women. In America, the prevalence of abdominal obesity in women increased 57.58 to 67.33% in 2001-2018.[4] In China, an increasing trend in cases of abdominal obesity occurred in men and women aged >18 years in the period 1993-2011, with the most significant increase in prevalence occurring in women.[5] Results of National Basic Health Research (RISKESDAS) 2018 showed that cases of abdominal obesity are higher in women (46.7%) compared to men (15.7%).[3] Tesfaye's findings showed that women were 1.92 times more likely to experience abdominal obesity than men, and this risk increases with age.[6]

The increasing cases of abdominal obesity in women are a concern for increasing health problems in women. Apart from that, the impact on women of childbearing age is the quality of pregnancy, which will, of course, impact the outcome of the pregnancy itself as a generation of the nation. Women of childbearing age (WCA) are women whose average age is 15 to 49 years, whether married, unmarried, or widowed.[7] In this age range, female reproductive organs mature and function well at the age of 20-45 years. Every married woman plans a pregnancy, and this period is called the preconception period. During the preconception period, every woman must take steps to assess and identify the risks of disease that may be experienced during pregnancy and the outcomes of that pregnancy.[8]

Abdominal obesity in the fertility age is often associated with infertility problems.[9–11] Obesity also affects the reproductive organs by causing irregular menstruation, Polycystic ovary syndrome (PCOS), cancer of the uterus, breast, cervix, and endometriosis.[12] Other adverse effects are during pregnancy. One of them is gestational diabetes mellitus (GDM). GDM experiences impaired glucose homeostasis in the following trimester.[13] GDM requires intervention and counseling to avoid complications during pregnancy or afterward. GDM is associated with macrosomia and over-maternal weight gain and progresses to type 2 diabetes mellitus after delivery.[14]

To reduce cases of abdominal obesity in WCA in Indonesia, it is necessary to carry out an analysis to determine the factors associated with the prevalence of abdominal obesity in WCA. In theory, risk factors are divided into two parts. Namely, the first is based on socio-demographic factors consisting of age[15], marital status[16,17], work[18], education[15,18], and type of region.[2] Older WCA have a higher risk of abdominal obesity because of decreased insulin secretion, hormonal changes, and reduced physical activity. Married women may experience increased energy intake and less physical

DOI: 10.58185/jkr.v15i1.187
ISSN: 2354-8762 (Online)

activity, which can contribute to abdominal obesity.[16] Higher education is associated with a lower risk of abdominal obesity in WCA due to several factors, namely healthier lifestyles, increased awareness, and social pressure to maintain a healthy body image. [19] WCA residents in urban areas have a higher risk of abdominal obesity because the availability to access more food leads to excessive calorie and fat consumption.[20]

The second is based on food consumption. A complex interplay of dietary factors, including energy intake, carbohydrate intake, protein intake, and the consumption of specific food sources, influences the development of abdominal obesity. Excess energy consumption, particularly from high-calorie, nutrient-poor foods, can lead to an imbalance in energy homeostasis, accumulating visceral fat around the abdomen.[21] High intake of refined carbohydrates and added sugars, often found in processed and sweetened foods, has been associated with increased abdominal fat deposition.[22] Alongside macronutrient intake, the type of food sources consumed can also influence the risk of abdominal obesity. The consumption of fatty, sweet, and preserved foods, such as bread, biscuits, and instant foods, has been associated with a higher prevalence of abdominal obesity.[23–25]

Based on this description, researchers analyzed demographic factors and risky food consumption patterns related to the prevalence of abdominal obesity in WCAs in Indonesia based on the results of the 2018 RISKESDAS survey. This research has significantly contributed to our understanding of the factors associated with abdominal obesity among WCAs in Indonesia. The findings of this study can be used to develop more effective interventions to prevent and manage abdominal obesity in women in Indonesia.

METHODS

This research used a cross-sectional study design with data from RISKESDAS 2018 obtained from the National Institute of Health Research and Development (BALITBANGKES), Indonesian Ministry of Health. The inclusion criteria for this study were female respondents aged 15 – 49 years. The exclusion criteria in this study were respondents who used hormonal contraception. BALITBANGKES immediately excluded this criterion, while non-hormonal contraception was still included. The total final respondents for whom data analysis could be carried out were 29,888. This research has undergone an ethical review with number 27/UN25.1.14/KEPK/2021.

The demographic factors studied were age, marital status, employment, education, and type of region. Risky food consumption patterns include sweet foods, sweet drinks, salty foods, fatty/cholesterol/fried foods, processed meat/chicken/fish foods with preservatives, soft drinks or carbonated drinks, energy drinks, instant noodles/and other instant foods. The data set obtained is then classified according to existing standards. Abdominal obesity is categorized if the abdominal circumference is ≥80 cm for women.[3]

DOI: 10.58185/jkr.v15i1.187
ISSN: 2354-8762 (Online)

Married status is divided into living alone (unmarried/divorced) and living with a partner (married).[26] Employment was categorized into unemployed or not working and employment in the data collection process. Education is divided into low (not attending school and or not completing elementary school), medium (completed elementary school/middle school/high school), and high (completed college). Area types are categorized into urban and rural areas.[3] Risky food consumption patterns are categorized based on consumption habits in one week so that consumption pattern data is classified into two categories, namely eating ≥3 times a week and <3 times a week.[26]

Data analysis used the Chi-Square test to see the association between demographic factors and risky food consumption patterns with abdominal obesity. P value ≤0.05 and Confident Interval (95%) will be interpreted as statistically associated.

RESULTS

Based on Table 1, it is known that 49.4% of respondents experienced abdominal obesity; the largest age group of respondents was 26-35 years (50.4%), most were married (95.5%), more than half were working (50.7%), most had a secondary education level (70.8%), and more than half of the respondents live in rural areas (53.1%). More than half of respondents consumed sweet foods (58.5%), sweet drinks (67.5%), and fatty/cholesterol/fried foods (56.8%) with a frequency of more than three times a week. Meanwhile, the majority consumed less than three times per week.

Table 2 shows that the demographic factors associated with abdominal obesity in WCA are age, marital status, education level, and type of region. Table 3 shows that the consumption patterns of risky foods and drinks are related to fatty/cholesterol/fried foods and grilled foods.

DISCUSSION

Women aged 15-49 years experience good reproductive organ maturation, especially at 20-45. Every married woman is ready to plan a pregnancy in this age range. During the preconception period, every woman must take steps to assess and identify the risks of disease that may be experienced during pregnancy and the outcomes of that pregnancy.[8]

This study showed that almost half (49.4%) of respondents experienced abdominal obesity with a stomach circumference of >80 cm. This result is lower than several studies that report the percentage of abdominal obesity in women. Research by Yanto et al. found that 68.0% of homemakers in West Sidomulyo Village experienced abdominal obesity.[27]

This finding is undoubtedly worrying because most studies find that 4-5 out of 10 WCA have abdominal obesity. Abdominal obesity affects the reproductive organs, which can cause irregular menstruation, subfertility, Polycystic ovary syndrome (PCOS), uterine cancer, breast cancer, cervical cancer, and endometriosis. Being overweight (Body Mass Index/BMI and abdominal obesity) also

DOI: 10.58185/jkr.v15i1.187
ISSN: 2354-8762 (Online)

has adverse effects during pregnancy.[13] Mothers who are overweight during pregnancy are at risk of developing GDM. Women with GDM had a high risk for the development of labor abnormalities and complicated labor processes and were more prone to operative deliveries, including cesarean section.[28]

Table 1. Distribution of abdominal obesity, demographic factors, and risky food consumption patterns

Variable	n	Percentage
Abdominal obesity status		
Yes	14,777	49.4
No	15,111	50.6
Demographic Factors		
Age		
36 – 49 years	9,019	30.2
26 – 35 years	15,068	50.4
17 – 25 years	5,172	17.3
15 – 16 years	629	2.1
Marital status		
Married	28,556	95.5
Not married/divorced	1,332	4.5
Employment status		
Not working/unemployed	14,747	49.3
Worker	15,141	50.7
Level of education		
Low	2,892	9.7
Middle	21,147	70.8
High	5,849	19.6
Type of region		
Urban	14,012	46.9
Rural	15,876	53.1
Risky food consumption patterns		
Sweet food consumption patterns		
≥. 3 times a week	17,472	58.5
< 3 times per week	12,416	41.5
Sweet drink consumption patterns		
≥. 3 times a week	20,177	67.5
< 3 times per week	9,711	32.5
Salty food consumption patterns		
≥. 3 times a week	11,883	39.8
< 3 times per week	18,005	60.2
Fatty/cholesterol/fried foods consumption patterns		
≥. 3 times a week	16,981	56.8
< 3 times per week	12,907	43.2
Burnt/grilled food consumption patterns		
≥. 3 times a week	5,069	17.0
< 3 times per week	24,819	83.0
Processed meat/chicken/fish foods with preservative consumption patterns		
≥. 3 times a week	2,701	9.0
< 3 times per week	27,187	91.0
Soft drinks or carbonated drinks consumption patterns		
≥. 3 times a week	933	3.1
< 3 times per week	28,955	96.9
Energy drink consumption patterns		
≥. 3 times a week	606	2.0
< 3 times per week	29,282	98.0
Instant noodles/other instant food consumption patterns		
≥. 3 times a week	7,466	25.0

DOI: 10.58185/jkr.v15i1.187
ISSN: 2354-8762 (Online)

Variable	n	Percentage
< 3 times per week	22,422	75.0
Total	**29,888**	**100**

Table 2. Association between demographic factors and abdominal obesity in WCA

Variables	Abdominal obesity		n	p-value
	Yes	No		
Age				
36 – 49 years	5,342 (59.2)	3,677 (40.8)	9,019	<0.0001
26 – 35 years	7,333 (48.7)	7,735 (51.3)	15,068	
17 – 25 years	1,731 (33.5)	3,441 (66.5)	5,172	
15 – 16 years	371 (59.0)	258(41.0)	629	
Marital status				
Married	14,252 (49.9)	14,304 (50.1)	28,556	<0.0001
Not Married/Divorced	525 (39.4)	807 (60.6)	1,332	
Employment status				
Not working/ unemployed	7,339 (49.8)	7,408 (50.2)	14,747	0.273
Worker	7,438 (49.1)	7,703 (50.9)	15,141	
Level of education				
Low	1,205 (41.7)	1,687 (58.3)	2,892	<0.0001
Middle	10,405 (49.2)	10,742 (50.8)	21,147	
High	3,147 (54.1)	2,682 (45.9)	5,849	
Type of region				
Urban	7,719 (55.1)	6,293 (44.9)	14,012	<0.0001
Rural	7,958 (44.5)	8,818 (55.5)	15,876	
Total			**29,888**	

In addition, abdominal obesity is an indicator of metabolic syndrome and has a strong relationship with the risk of cardiovascular disease. This is associated with an increase in visceral fat tissue, which impacts metabolic conditions such as decreased glucose tolerance, reduced insulin sensitivity, and deviations in lipid profiles (HDL, LDL, and triglycerides).[26,29] The increasing prevalence of abdominal obesity in WCA is a serious concern because it impacts reproductive health and increases the risk of various degenerative diseases.

Age, marital status, education level, and type of region were demographic factors. There were indications of an increase in cases of abdominal obesity with increasing age. The results of this research align with research that has been conducted.[2,15–18] The increase in the prevalence of abdominal obesity is related to the body's metabolic processes, which tend to decrease with age. This condition triggers a decrease in muscle function. At the same time, body fat levels increase, especially in the central parts of the body, namely the stomach, hips, and thighs.[30] This condition is also associated with low physical activity in women aged 30 years and over. Decreasing physical activity and body metabolism with increasing age is one of the factors that increase the prevalence of obesity in women.[30]

Table 3. Association between risky food consumption patterns and abdominal obesity in WCA

Variables	Abdominal obesity		n	p-value
	Yes	No		
Sweet foods				
≥ 3 times per week	8,665 (49.6)	8,807 (50.4)	17,472	0.540
< 3 times per week	6,112 (49.2)	6,304 (50.8)	12416	
Sweet drinks				
≥ 3 times per week	9,914 (49.1)	10,263 (50.9)	20,177	0.130
< 3 times per week	4,863 (50.1)	4,848 (49.9)	9,711	
Salty foods				
≥ 3 times per week	5,875 (49.4)	6,008 (50.6)	11,883	1.000
< 3 times per week	8,902 (49.4)	9,103 (50.6)	18,005	
Fatty/cholesterol/fried foods				
≥3 times per week	8,693 (51.2)	8,288 (48.8)	16,981	<0.0001
< 3 times per week	6,084 (47.1)	6,823 (52.9)	12,907	
Burnt/grilled foods				
≥ 3 times per week	2,599 (51.3)	2,470 (48.7)	5,069	0.004
< 3 times per week	12,178 (49.1)	12,641 (50.9)	24,819	
Processed meat/chicken/fish foods with preservatives				
≥ 3 times per week	1,380 (51.1)	1,321 (48.9)	2,701	0.075
< 3 times per week	13,397 (49.3)	13,790 (50.7)	27,187	
Soft drinks or carbonated drinks				
≥ 3 times per week	485 (52.0)	448 (48.0)	933	0.123
< 3 times per week	14,292 (49.2)	14,663 (50.6)	28,955	
Energy drinks				
≥ 3 times per week	305 (50.3)	301 (49.7)	606	0.688
< 3 times per week	14,472 (49.4)	14,810 (50.6)	29,282	
Instant noodles/other instant foods				
≥ 3 times per week	3,626 (48.6)	3,840 (51.4)	7,466	0.083
< 3 times per week	11,151 (49.7)	11,271 (50.3)	22,422	
Total			**29,888**	

The following risk factor is marital status. Married respondents experienced more abdominal obesity than unmarried/divorced respondents. This research is in line with Kabwama's findings, which stated that marital status is related to the prevalence of abdominal obesity.[16] The high prevalence of abdominal obesity in married respondents is because women, after marriage, tend to adapt to their partners both in terms of lifestyle and food consumption patterns.[31] Married women tend to care less if they gain weight or become fat; unlike before marriage, women maintain their weight to make it easier to find a partner. In addition, increasing body weight during pregnancy increases fat reserves. Women tend to gain weight during their childbearing years.[32] WCA preparing for pregnancy should pay attention to their weight before pregnancy because losing weight after giving birth will be more difficult. Married individuals are doubtful of experiencing a rise in

endorphins due to a lack of exercise, which is an indirect cause of weight gain.[33] In subanalysis, it was found that there was a tendency for married respondents to consume fatty/cholesterol/ fried foods more often than unmarried/divorced respondents. Weight management programs should target married and divorced women, including nutrition counseling and a physical activity plan.

Higher education is associated with a lower risk of abdominal obesity. Several factors are related: healthier lifestyles, increased awareness, and social pressure to maintain a healthy body image.[19] But, in this study, we found that higher education is associated with higher abdominal obesity, especially in completed elementary school, middle school, or high school. We assumed this was due to this group's more significant data distribution. However, this can indicate that WCA with a middle education level in Indonesia have not been exposed to healthy living behaviors and preventing themselves from abdominal obesity.

The type of region also has a significant association with abdominal obesity in WCA. This research aligns with Samadoulougou's findings, which show that the percentage of abdominal obesity is higher in urban areas than in rural areas.[2] Individuals living in urban areas are thought to have easier access to food stores and fast food restaurants, and this is thought to be related to their obesity status. Another thing related to the urban environment is economic growth, urbanization, and the globalization of food stores, which allows people to get food without visiting food stores.[20]

Risky consumption patterns were associated with burnt or grilled and fatty or cholesterol or fried foods. The consumption of burnt or grilled food has not been extensively studied in relation to abdominal obesity. Most research in this area has focused on fatty, cholesterol-rich, or fried foods. In Triyanti's research, it was found that consumption of fried food was the most significant contributor to the prevalence of abdominal obesity in women.[34]

Another type of risky food associated with it was burnt or grilled food. The burning or grilling process is one of the cooking processes that is more recommended than frying. However, the burnt or grilled food is fatty red meat, and when it is burnt or grilled, it is given seasonings inseparable from the source of the fat. Consumption of burnt or grilled foods is significantly associated with the prevalence of metabolic syndrome. Foods that are often consumed are tuna fish satay, grilled chicken iloni (grilled chicken with traditional sauce), and other grilled foods that are soaked in lots of oil. The residue from the burning or grilling process results in free radical contamination in food; this condition can damage the body's cell membranes, especially the pancreas. A damaged pancreas causes the person to be unable to produce insulin, resulting in an energy imbalance in the body and causing type 2 diabetes mellitus.[35]

The research's limitation is that the variables analyzed are based on the data available in the 2018 RISKESDAS; the only food consumption variable available is risky foods in the form of

DOI: 10.58185/jkr.v15i1.187
ISSN: 2354-8762 (Online)

frequency of consumption. So, researchers can only classify it in weeks rather than days. Researchers could not convert it into daily intake and compare it with the recommended nutritional value. Future research could analyze the amount of intake in WCA based on the results of national surveys that collect data on daily intake.

CONCLUSION

The study found that age, marital status, education level, and region were factors associated to abdominal obesity. Consuming burnt, grilled, fatty, cholesterol-rich, or fried foods was also associated with this condition. Therefore, the women of childbearing age recommends avoiding these types of foods, especially for older women, married women, women with higher education, and women living in urban areas.

RECOMMENDATION

WCA should implement balanced nutritional guidelines and consider demographic factors that increase the risk of abdominal obesity. They should also limit their consumption of burnt, grilled, fatty, cholesterol-rich, or fried foods to no more than three times a week. This will help them prevent abdominal obesity.

ACKNOWLEDGEMENT

The author would like to express her appreciation and thanks to the National Institute of Health Research and Development, Ministry of Health, Republic of Indonesia, for permitting the analysis of the 2018 RISKESDAS data.

REFERENCES

1. Zhu Y, Hedderson M, Quesenberry C, Feng J, Ferrara A. Central obesity increases the risk of gestational diabetes partially through increasing insulin resistance. Obesity. 2019;27(1):152–60. 10.1002/oby.22339. https://doi.org/10.1002/oby.22339
2. Samadoulougou S, Diallo M, Cissé K, Ngwasiri C, Aminde LN, Kirakoya-Samadoulogou F. High Urban-Rural Inequities of Abdominal Obesity in Malawi: Insights from the 2009 and 2017 Malawi Noncommunicable Disease Risk Factors Surveys. Int J Environ Res Public Health. 2022;19(11863):1–12. 10.3390/ijerph191911863. https://doi.org/10.3390/ijerph191911863
3. Kemenkes RI. Laporan Hasil Riset Kesehatan Dasar (Riskesdas) Indonesia tahun 2018. 2018. p. 1–628.
4. Sun JY, Huang WJ, Hua Y, Qu Q, Cheng C, Liu HL, et al. Trends in general and abdominal obesity in US adults: Evidence from the National Health and Nutrition Examination Survey (2001–2018). Front Public Heal. 2022;10(925293):1–10. 10.3389/fpubh.2022.925293. https://doi.org/10.3389/fpubh.2022.925293
5. Qian X, Su C, Zhang B, Qin G, Wang H, Wu Z. Changes in distributions of waist circumference, waist-to-hip ratio, and waist-to-height ratio over 18 years among Chinese adults: a longitudinal study using quantile regression. BMC Public Health. 2019 Dec 6;19(700):1–10. 10.1186/s12889-019-6927-6. https://doi.org/10.1186/s12889-019-6927-6
6. Tesfaye TS, Zeleke TM, Alemu W, Argaw D, Bedane TK. Dietary diversity and physical activity are risk factors for abdominal obesity among adults in Dilla town, Ethiopia. PLoS One. 2020;15(7):1–11. 10.1371/journal.pone.0236671. https://doi.org/10.1371/journal.pone.0236671

7. Kemenkes RI. Pedoman Pelayanan Kontrasepsi dan Keluarga Berencana. 1st ed. Jakarta: Kemenkes RI; 2020.
8. Jacob CM, Hanson M. The preconception period is a platform for preventing diabetes and non-communicable diseases. Pract Diabetes. 2022;39(4):14–8. 10.1002/pdi.2404. https://doi.org/10.1002/pdi.2404
9. Tang J, Xu Y, Wang Z, Ji X, Qiu Q, Mai Z, et al. Association between metabolic healthy obesity and female infertility: the national health and nutrition examination survey, 2013–2020. BMC Public Health. 2023;23(1524):1–9. 10.1186/s12889-023-16397-x. https://doi.org/10.1186/s12889-023-16397-x
10. Silvestris E, de Pergola G, Rosania R, Loverro G. Obesity disrupts female fertility. Reprod Biol Endocrinol. 2018;16(1):1–13. 10.1186/s12958-018-0336-z. https://doi.org/10.1186/s12958-018-0336-z
11. Wei W, Zhang X, Zhou B, Ge B, Tian J, Chen J. Effects of female obesity on conception, pregnancy and offspring health. Front Endocrinol (Lausanne). 2022;13(949228):1–5. 10.3389/fendo.2022.949228. https://doi.org/10.3389/fendo.2022.949228
12. Venkatesh SS, Ferreira T, Benonisdottir S, Rahmioglu N, Becker CM, Granne I, et al. Obesity and risk of female reproductive conditions: A Mendelian randomization study. PLoS Med. 2022;19(2):1–30.10.1371/journal.pmed.1003679. https://doi.org/10.1371/journal.pmed.1003679
13. De Souza LR, Berger H, Retnakaran R, Vlachou PA, Maguire JL, Nathens AB, et al. In early pregnancy, hepatic fat and abdominal adiposity predict impaired glucose homeostasis in mid-pregnancy. Nutr Diabetes. 2016 Sep 19;6(9):1–3. 10.1038/nutd.2016.39. https://doi.org/10.1038/nutd.2016.39
14. Carolan-Olah MC. Educational and intervention programs for gestational diabetes mellitus (GDM) management: An integrative review. Collegian. 2016 Mar;23(1):103–14. 10.1016/j.colegn.2015.01.001. https://doi.org/10.1016/j.colegn.2015.01.001
15. Chaudhary M, Sharma P. Abdominal obesity in India: Analysis of the National Family Health Survey-5 (2019–2021) data. Lancet Reg Heal - Southeast Asia. 2023;14(100208):1–10. 10.1016/j.lansea.2023.100208. https://doi.org/10.1016/j.lansea.2023.100208
16. Kabwama SN, Kirunda B, Mutungi G, Wesonga R, Bahendeka SK, Guwatudde D. Prevalence and correlates of abdominal obesity among adults in Uganda: findings from a national cross-sectional, population-based survey 2014. BMC Obes. 2018;5(1):1–9. 10.1186/s40608-018-0217-1. https://doi.org/10.1186/s40608-018-0217-1
17. Kowalkowska J, Poínhos R, Franchini B, Afonso C, Correia F, Pinhão S, et al. General and abdominal adiposity in a representative sample of Portuguese adults: Dependency of measures and socio-demographic factors influence. Br J Nutr. 2016;115(1):185–92. 10.1017/S0007114515004055. https://doi.org/10.1017/S0007114515004055
18. Strauß M, Foshag P, Przybylek B, Horlitz M, Lucia A, Sanchis-Gomar F, et al. Occupation and metabolic syndrome: Is there a correlation? A cross-sectional study in different work activity occupations of German firefighters and office workers. Diabetol Metab Syndr. 2016;8(1):1–8. 10.1186/s13098-016-0174-0. https://doi.org/10.1186/s13098-016-0174-0
19. Harbuwono DS, Pramono LA, Yunir E, Subekti I. Obesity and central obesity in Indonesia: evidence from a national health survey. Med J Indones. 2018 Sep 9;27(2):114–20. 10.13181/mji.v27i2.1512. https://doi.org/10.13181/mji.v27i2.1512
20. Congdon P. Obesity and Urban Environments. Int J Environ Res Public Health. 2019;16(464):1–6. 10.3390/ijerph16030464. https://doi.org/10.3390/ijerph16030464
21. Lee KW, Kang MS, Lee SJ, Kim HR, Jang KA, Shin D. Prospective Associations between Dietary Patterns and Abdominal Obesity in Middle-Aged and Older Korean Adults. Foods. 2023 May 26;12(11):2148. 10.3390/foods12112148. https://doi.org/10.3390/foods12112148
22. Sweetman AK, Carter J, Perez-Cornago A, Gao M, Jebb SA, Piernas C. Dietary pattern adherence in association with changes in body composition and adiposity measurements in the UK Biobank study. Obes Res Clin Pract. 2023 May;17(3):233–41. 10.1016/j.orcp.2023.05.008. https://doi.org/10.1016/j.orcp.2023.05.008

23. Agraib LM, Al Hourani HM, Al-Shami IK, Alkhatib BM, Al-Jawaldeh A. Association between dietary fatty acid patterns and obesity indices in Jordanian adults: A cross-sectional study. Heliyon. 2023;9(e17938):1–13. 10.1016/j.heliyon.2023.e17938. https://doi.org/10.1016/j.heliyon.2023.e17938
24. Dekan AK, Ahmed JT, Issa SS. Association Abdominal Obesity with Dietary Habits and Demographic Variables among Students at Southern Technical University. Univ Thi-Qar J Sci. 2023;10(1):68–76. 10.32792/utq/utjsci/v10i1(si).970. https://doi.org/10.32792/utq/utjsci/v10i1(SI).970
25. Ito T, Kawakami R, Tanisawa K, Miyawaki R, Ishii K, Torii S, et al. Dietary patterns and abdominal obesity in middle-aged and elderly Japanese adults: Waseda Alumni's Sports, Exercise, Daily Activity, Sedentariness and Health Study (WASEDA'S Health Study). Nutrition. 2019;58(July):149–55. 10.1016/j.nut.2018.05.029. https://doi.org/10.1016/j.nut.2018.05.029
26. Siregar MH, Fatmah F, Sartika R. Main factor analysis of abnormal triglyceride levels in the adult population in Indonesia. J Delima Harapan. 2020;7(3):118–27. 10.31935/delima.v7i2.104. https://doi.org/10.31935/delima.v7i2.104
27. Yanto N, Verawati B, Akmalia F. The relationship between nutritional knowledge and fat consumption with central obesity. PREPOTIF J Kesehat Masy. 2019;3(2):103–12. 10.31004/prepotif.v3i2.657
28. Bharatnur S, Acharya PB. Association between maternal obesity and gestational diabetes mellitus and their related outcomes. Int J Reprod Contraception, Obstet Gynecol. 2023;12(10):2993–7. 10.18203/2320-1770.ijrcog20232935. https://doi.org/10.18203/2320-1770.ijrcog20232935
29. Siregar MH, Fatmah F, Sartika R. The Association of Age and Central Obesity with Total Cholesterol Levels of the Indonesian Population. J Ilmu Kesehat Indones. 2020 Dec 7;1(2):1–9. 10.57084/jiksi.v1i2.408. https://doi.org/10.57084/jiksi.v1i2.408
30. Palacios S, Chedraui P, Sánchez-Borrego R, Coronado P, Nappi RE. Obesity and menopause. Gynecol Endocrinol. 2024;40(1):1–6. 10.1080/09513590.2024.2312885. https://doi.org/10.1080/09513590.2024.2312885
31. Puspitasari N. Factors of central obesity incidence in adults. HIGEIA J PUBLIC Heal. 2018;2(2):249–59. 10.15294/higeia.v2i2.21112. https://doi.org/10.15294/higeia.v2i2.21112
32. McKinley MC, Allen-Walker V, McGirr C, Rooney C, Woodside J V. Weight loss after pregnancy: Challenges and opportunities. Nutr Res Rev. 2018;31(2):225–38. 10.1017/S0954422418000070. https://doi.org/10.1017/S0954422418000070
33. Liu J, Garstka MA, Chai Z, Chen Y, Lipkova V, Cooper ME, et al. Marriage contributes to higher obesity risk in China: findings from the China Health and Nutrition Survey. Ann Transl Med. 2021;9(7):564–564. 10.21037/atm-20-4550. https://doi.org/10.21037/atm-20-4550
34. Triyanti T, Ardila P. Fat Intake As A Dominant Factor of Central Obesity Among Women. J Gizi dan Pangan Soedirman. 2020;3(2):133–43. 10.20884/1.jgps.2019.3.2.2053. https://doi.org/10.20884/1.jgps.2019.3.2.2053
35. Jusuf H, Rahma S, Monayo ER. Food consumption behavior and their association with metabolic syndrome : A cross-sectional study of adults in Gorontalo Province, Indonesia. Sys Rev Pharm. 2020;11(5):556–61. 10.31838/srp.2020.5.72

Declarations

Author contribution	:	Mukhlidah contributed to the conceptualization, methodology, data colletion, data analysis, and writing of the manuscript. Ratu was responsible for data analysis and manuscript review. Junengsih provided expertise in statistical analysis and contributed to the interpretation of results. Kalinaki contributed to manuscript review, and provided valuable insights into the field.
Funding statement	:	This research did not receive any funding.
Conflict of interest	:	All of authors declare that they have no competing interests.
Additional information	:	No additional information is available for this paper.