



## Review Article



# Risk Factors for Obesity: A Systematic Review

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## ABSTRACT

**Background:** Obesity is excessive fat accumulation due to an imbalance between energy intake and energy use. Between 2010 and 2018, there was an increase in the prevalence of overweight (3.9% annual average) and obesity (8% yearly average) among adults aged over 18. This study aims to overview the factors associated with the incidence of obesity.

**Method:** This systematic literature review generated the data using electronic sources: Google Scholar and PubMed. Articles were selected using keywords: risk factors, obesity, physical activity, and food intake. The inclusion criteria used were free full text published in Bahasa or English between 2018 and 2023. Exclusion criteria: Literature review articles and full text are not freely available.

**Results:** The existence of a high-calorie consumption pattern can increase the incidence of obesity, and lack of physical activity can cause the accumulation of body fat, which contributes to obesity. The findings from this study can be used to determine risk factors for obesity.

**Conclusion:** This systematic literature review article concludes that various factors are associated with obesity, including food intake, physical activity, and smoking.

**Keywords:** Obesity; Risk factors; Food intake; Physical activity

## INTRODUCTION

Non-communicable diseases (NCDs) are one of the leading causes of death and disability in the world. Obesity is one of the main risk factors for non-communicable diseases such as type 2 diabetes, cardiovascular disease, and several types of cancer, as well as lung, digestive, kidney, endocrine, musculoskeletal, neurological, and mental health disorders. In 2019, there were an estimated 5 million deaths from obesity-related NCDs, which is equivalent to 12% of all NCD deaths.<sup>1</sup>

Obesity is when a person has excess fat in the body, so the person has health risks. Body Mass Index (BMI) is an indicator used to determine whether someone is obese.<sup>2</sup> In obesity,



central obesity is also used, a condition of excess fat accompanied by a buildup of visceral fat in the middle abdominal area.<sup>3</sup>

UNICEF, 2022 stated that in 2010-2018, there was an increase in the prevalence of overweight (3.9% annual average) and obesity (8% average annually) among adults aged over 18 years. Overweight and obesity were more common in women than men (15.1 % in women, 12.1 % in men; and 29.3 % in women, 14.5 % in men) and in urban compared to rural areas (14.6 % in urban areas, 12.2 in rural areas; and 25.1 % in urban areas, 17.8 % in rural areas). The rise of industrialization and globalization in the food sector has led to significant shifts in people's eating behaviours. The existing food industry plays a substantial role in influencing dietary patterns, particularly in urban areas.<sup>4</sup> The prevalence of central obesity (defined as a waist circumference > 90 cm for men and > 80 cm for women) based on Indonesia Basic Health Research (RISKESDAS) data for Indonesians aged 15 years and over is also high, with a national average of 31 %, where this figure is higher in women compared to men (46.7 % in women, 15.7 % in men) and higher in urban compared to rural areas (35.1 % in women, 25.9 % in men).<sup>5</sup>

The prevalence of Non-Communicable Diseases (NCDs) tends to increase over time. Referring to RISKESDAS data, by 2013, the obesity rate was 14.8%; in 2018, it was 21.8%. In the prevalence of excess weight, there was a slight increase from 2013 (13.5%) to 2018 (13.6%). Disparities in the prevalence of obesity are seen in several provinces, and these differences differ from the national prevalence values. Apart from that, RISKESDAS data also shows an increase in the prevalence of central obesity in residents aged > 15 years from 26.6% (2013) to 31.0% (2018).<sup>3</sup> As individuals age, they face an increased risk of weight gain due to a decline in metabolic rate and a reduction in muscle mass.<sup>6</sup> Our body functions will decline as we age, leading to decreased physical activity. This can cause an imbalance between the intake of calories and the energy used to perform activities.<sup>7</sup>

Obesity can be found in children, teenagers, and adults. More than 1.4 billion adults are overweight, and more than 500 million adults in the world are obese (WHO, 2008). Obesity is closely related to the incidence of NCDs and causes death in 2.8 million adults each year (WHO, 2013).<sup>8</sup> Sixty-five per cent of the world's population lives in countries where obesity and overweight kill more people than underweight). At least 2.8 million adults die every year due to overweight and obesity. In addition, overweight and obesity have a risk of developing diabetes (44%), ischemic heart disease (23%) and cancer (7%-41%). Factors that influence obesity include genetic factors, environmental factors, and drug/hormonal factors. According to research by Nugraha (2010), 30% of obesity is caused by genetic factors.<sup>3</sup> However, hereditary factors are unclear as the cause of obesity. Chronic excess energy intake can cause overweight and obesity. The existence of a sedentary physical activity pattern (lack of movement) causes the energy expended to be less than optimal, thereby increasing the risk of obesity.<sup>9</sup>

Research in the literature on risk factors for obesity is essential to compare this disease's development over time continuously. This is why this systematic review is conducted to determine the risk factors that cause obesity.

## METHOD

### Study Design

This research was a systematic review that followed PRISMA and PICOS principles during the data collection and analysis. The author uses PICOS (Population, Intervention, Comparison, Outcome, and Study Design) with the following criteria:

1. Population criteria : adult patients (>18 years)
2. Intervention/exposure criteria : BMI
3. Outcome Criteria : Odds Ratio (OR) or *p-value*
4. Study Design Criteria : Cross-sectional
5. Language : The study published in English or Bahasa

The article was obtained from Google Scholar and PMC databases from 2018 to 2023.

### Search Course

The article search process is limited to Google Scholar and PubMed databases. The keywords used are risk factors, obesity, physical activity, and food intake. The inclusion criteria for the articles used were the last 5 years and open access. The exclusion criteria in this study were age < 18 years and the literature review method. The initial article search yielded 1,007 articles. Eight articles were included for analysis after identifying the relevance of the title, theme, and target. The analysis in this article followed Prisma Flow Diagrams (Figure 1)

### Data Collection

The author took relevant data based on the study design. Researchers conducted the entire data collection process, and disagreements will be resolved. The data analyzed in this study used eight articles. The data collected for each article is as follows: Author, year, title, population, sample, type of research, data collection, and significant findings—output in the form of Odds Ratio (OR) with Confidence Interval.

### Assessment of Risk of Bias of Individual Studies and Measurements

The authors used STROBE to evaluate the quality of observational studies. The STROBE tool covers 22 quality assessment domains, including abstract, background, objective, study design, location, participants, variables, data sources, bias, study size, quantitative variables, statistical methods, participants, descriptive data, output data, primary results, other analysis, summary of results, limitations, interpretation, generalization, and funding. The quality of each item assessed will be assessed as complete, incomplete, and incomplete based on each colour. The authors carried out a study assessment. After data extraction, the author obtained the outcome in the form of OR, which was then tabulated in table form.

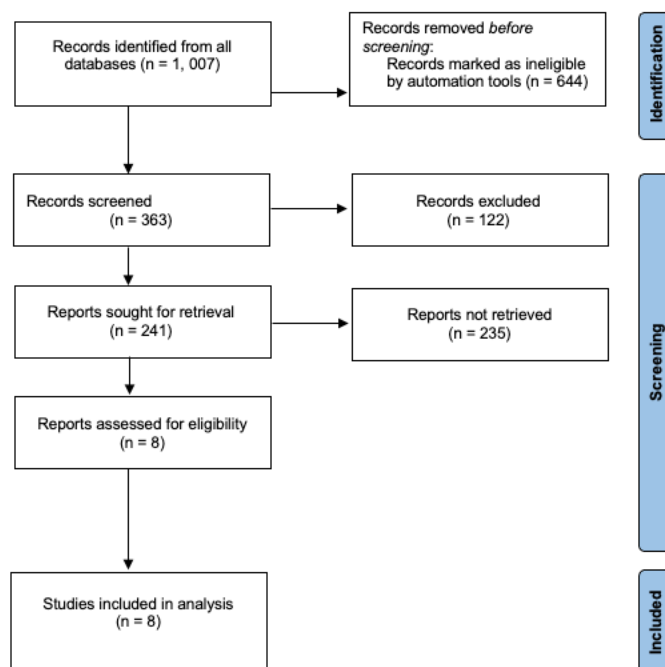


Figure 1. The flowchart of the paper selected in this study

## RESULTS

We yield 1,007 articles from 2 databases, Google Scholar and PubMed. Eight articles were obtained and included in the analysis after identifying the relevance of the title, theme, and target. The article selection results correspond to the Prisma (Figure 1). This systematic review used the STROBE checklist to evaluate the quality of individual studies. Generally, the quality of the studies in this systematic review is good because green dominates the STROBE assessment.

### STROBE Checklist

A summary of the study assessment is shown in Figure 2. The assessment of the quality of this study begins with an assessment of the title and abstract, where a total of 8 studies were obtained that had complete criteria.

Author	STROBE Statement																						
	Title and abstract	Background/reason	Objective	Study Design	Arrangement	Participants	Variable	Data source/measurement	Bias	Study Size	Quantitative Variables	Statistical methods	Participant	Descriptive Data	Results Data	Key Results	Other Analysis	Key results	Limitations	Interpretation	Generalization	Funding	
Thicke et al. (2020)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Gupta et al. (2020)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Bogale et al., (2019)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Zulkamain et al., (2020)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Sumael et al., (2020)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Koryaningsih et al. (2019)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Arifani et al. (2021)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Pakaya et al., (2020)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Information:

- Criteria not met
- Criteria Not Fulfilled
- Criteria Fulfilled

Figure 2. STROBE checklist

## DISCUSSION

This systematic review carried out an analysis of 8 articles in each study. Overall, the quality of the studies carried out in the analysis is of good quality. The author found five articles related to physical activity that supported obesity: articles 8, 9, 10, 11, and 12. Based on these eight articles, the analysis revealed that lack of physical activity was a risk factor for obesity. Physical activity is any body movement that increases energy expenditure. For physical activity to be beneficial, it should be done for 30 minutes a day or 150 minutes every week at moderate intensity. Physical activities can be carried out in various situations and places.<sup>10</sup>

Adults should engage in regular physical activity; doing physical activity is better than no physical activity. There is evidence of a dose-response relationship between the volume of physical activity and several health outcomes, such as death from cardiovascular disease (CVD), as well as the incidence of cancer and diabetes. Health benefits occur when physical activity levels are below recommendations, thus supporting the claim that some physical activity is better than none. More physical activity is better, although the relative benefits tend to decrease at higher levels of physical activity.<sup>11</sup>

Thin ZT et al. (2020) conducted research with a sample size of 100 people aged 18 - 60. It showed that being overweight and obese were related to the habit of consuming fast food in their free time (AOR = 8.93, 95% CI 2.54–31.37). Other results found that overweight and obesity (AOR = 3.55, 95% CI 1.63–7.73) were positively associated with light-intensity physical exercise and sedentary leisure activities in free time (AOR = 3.32, 95% CI 1.22–9.03). From this research, respondents who engage in physical activity tend not to become overweight or obese.<sup>12</sup>

**Table 2.** shows the synthesis of the eight articles included in the analysis. The variables associated with obesity incidence are physical activity.

**Table 2.** Study assessment uses the STROBE Checklist

No	Author Name, Year	Research Title	Sample	Data Collection	Important Findings
1	Thicke <i>et al.</i> (2020)	Association between body mass index and ready-to-eat food consumption among sedentary staff in Nay Pyi Taw union territory, Myanmar	400 respondents	Face-to-face interviews and measurements. Multiple logistic regression analysis to estimate adjusted odds ratios (AOR) and 95% confidence intervals (CI).	Sedentary Staff who consumed RTE meals once or more per month were almost five times more likely to be overweight and obese (AOR = 4.78, 95% CI 1.44-15.85) than those who consumed RTE meals less frequently. In addition, five factors, namely being older than 32 years (AOR = 3.97, 95% CI 1.82-8.69), preference for ready-to-eat foods (AOR = 8.93, 95% CI 2.54-31.37), light physical exercise intensity (AOR = 3.55, 95% CI 1.63-7.73), sedentary leisure activities (AOR = 3.32, 95% CI 1.22-9.03), and smoking (AOR = 5.62, 95% CI 1.06-29.90) were positively associated with overweight and obesity.
2	Gupta <i>et al.</i> (2020)	Association between the frequency of television watching and overweight and obesity among women of reproductive age in Nepal: Analysis of data from the Nepal Demographic and Health Survey 2016	Six thousand thirty-one women aged 15-49	Multilevel logistic regression was performed to find factors associated with overweight and obesity.	Results: Approximately 35% of participants were overweight or obese (overweight: 23.7% and obesity: 11.6%). Watching television at least once a week is associated with overweight and obesity in women of childbearing age living in urban Nepal.
3	Bogale, <i>et al.</i> , (2019)	Determinant factors of overweight/ obesity among federal ministry civil servants in Addis Ababa, Ethiopia: a call for sector-	Employees who work in the ministry. Sample 532 respondents	Data were entered into EPI-INFO version 7 software and analyzed with SPSS version 23. Associated factors were identified using a	In multivariable logistic regression analysis, variables that showed statistically significant associations with obesity and overweight using a $p$ -value < 0.05 were age, income, alcohol consumption, 10 minutes of walking per day, and physical activity (sports).

No	Author Name, Year	Research Title	Sample	Data Collection	Important Findings
		wise occupational health program		multivariable binary logistic regression model	
4	Zulkarnain, <i>et al.</i> , (2020)	The relationship between exercise and smoking habits and abdominal obesity in productive age employees	Sample 103 respondents	A questionnaire using the Chi-Square Test	There is a significant relationship between exercise habits and abdominal obesity, and there is no relationship between smoking and abdominal obesity.
5	Sumael, <i>et al.</i> , (2020)	The Relationship between Physical Activity and the Incidence of Obesity at the Pangolombian Community Health Center	Sample 85 respondents	A questionnaire using the Chi-Square Test	There is a significant relationship between physical activity and the incidence of obesity at the Pangolombian Community Health Center
6	Koryaningsih, <i>et al.</i> , (2019)	The Relationship Between Energy Intake and Physical Activity and Obesity in Female Workers	Sample = 54	Interviews, questionnaires Chi-Square Test	The result showed that <i>p</i> -values for energy, fat and physical activities were 0,366, 0,638, and 0,189, respectively, which means there is no relationship between energy intake, fat intake, physical activity and body mass index. There was no correlation between the intake of energy and fat and physical activity to Body Mass Index.
7	Arifani, <i>et al.</i> , (2021)	Risk Behavior Factors Associated with the Incident of Obesity in Adults in Banten Province in 2018	A sample of 12,718 adults aged 20-60	Interviews, questionnaires Chi-Square Test	There is a relationship between smoking behaviour, risky food consumption behaviour (sweet foods, sugary drinks, soft drinks and instant food) and physical activity with the incidence of obesity, and there is no relationship between fatty food consumption behaviour and the incidence of obesity.
8	Pakaya, <i>et al.</i> , (2020)	The relationship between physical activity and consumption patterns on the incidence of central obesity in public transportation drivers	Sample = 201	Interviews, questionnaires Chi-Square Test	There is a relationship between physical activity and the incidence of central obesity in public transportation drivers in Gorontalo. There is no relationship between carbohydrate consumption and the incidence of central obesity in public transportation drivers in Gorontalo City. There is a relationship between fat consumption and the incidence of central obesity in public transportation drivers in Gorontalo City. There is no relationship between carbohydrate consumption and the incidence of central obesity in public transportation drivers in Gorontalo City.

Research in Ethiopia with a sample size of 525 respondents reported the risk factor for obesity is that adults who do not walk 10 minutes per day are more likely to be overweight and obese [AOR=11.28, 95% CI 5.96–21.36] compared to respondents who walk for 10 minutes every day. Likewise, respondents who did not do physical activity (exercise) [AOR=2.42% 95% CI 1.36–4.30] were 2.42 times more likely to experience overweight/obesity than those who did physical activity. This is because respondents spend more time sitting and less time doing physical work, which causes them to lead a sedentary lifestyle.<sup>13</sup>

Previous research stated that the results of statistical tests using the Chi-Square test obtained a  $p$ -value of 0.02 or  $p$ -value <0.05. So, it can be concluded that there is a significant relationship between physical activity and the incidence of obesity in respondents at the Pangolombian Community Health Center.<sup>14</sup> This research aligns with research conducted by Gupta et al. (2016) that states that lack of physical activity is related to the prevalence of overweight and obesity. Regular physical activity can help control overweight and obesity.<sup>15</sup>

The relationship between food intake and the incidence of obesity using the Chi-Square statistical test obtained a  $p$ -value = 0.038 ( $p$ -value < 0.05), meaning that there is a significant relationship between food intake and the incidence of obesity in female workers at the crab factory in Prapag Kidul Village and Prapag Lor, Losari District, Brebes Regency. The relationship between physical activity and the incidence of obesity in this study obtained a  $p$ -value = 0.017, which means there is a significant relationship between physical activity and the incidence of obesity among female workers in crab factories in Prapag Kidul and Prapag Lor Villages, Losari District, Brebes Regency.<sup>16</sup>

Research in Banten with respondents in this study as many as 12,718 adults aged 20-60 years who were taken using probability proportional to size using the Chi-Square test, which stated that the behaviour of consuming sweet foods, sweet drinks, soft drinks, and instant food have a  $p$ -value <0.05 while fatty foods have a  $p$ -value >0.05. The  $p$ -value means that there is a relationship between the consumption of sweet foods, sweet drinks, soft drinks, and instant food and the incidence of obesity, and there is no relationship between fatty foods and the incidence of obesity. The relationship between physical activity and the incidence of obesity obtained a  $p$ -value of 0.002, which means that there is a relationship between physical activity and the incidence of obesity in research subjects. From the results of the analysis, it is also known that the OR  $p$ -value of physical activity on the incidence of obesity shows that respondents with heavy physical activity can reduce the risk of obesity by 1.15 times greater than respondents who have moderate activity.<sup>17</sup>

The prevalence of overweight and obesity, especially in women, was increasing in Nepal. A previous study in South Asia found television viewing to be a risk factor for overweight and obesity among women of reproductive age. Thirteen urban women who watched television at least once a week were 40% more likely to be overweight or obese than those who did not (AOR: 1.4, 95% CI: 1.1–1.7;  $p$ -value <0.01). In contrast, no significant association between



overweight or obesity and television viewing frequency was observed among rural women. Overall, women who watched television at least once a week were 1.3 times more likely to be overweight or obese than women who never watched television on a diet (AOR: 1.3, 95% CI: 1.0–1.7;  $p$ -value  $< 0.05$ ).<sup>15</sup>

Two other studies support that physical activity affects obesity, but the benchmark is central obesity. Zulkarnain et al. (2020) found a significant relationship between exercise habits and abdominal obesity with a  $p$ -value = 0.037.<sup>18</sup> Lack of physical activity causes the energy expended not to be optimal, which can increase the risk of nutrition, overweight and obesity.<sup>3</sup> Pakaya's research (2020) states a significant relationship exists between physical activity and the incidence of central obesity in public transportation drivers in Gorontalo City in 2020 with a  $p$ -value of  $0.048 < \alpha 0.05$ . Other results stated no relationship between carbohydrate consumption and the incidence of central obesity in public transportation drivers in Gorontalo City with a Fisher's Exact value =  $0.774 > 0.05$ . There is a relationship between fat consumption and the incidence of central obesity in public transportation drivers in Gorontalo City, with  $p$ -value =  $0.00 < 0.05$ . There is no relationship between carbohydrate consumption and the incidence of central obesity in public transportation drivers in Gorontalo City, with a  $p$ -value =  $1 > 0.05$ .<sup>19</sup>

Articles related to smoking habits are articles numbers 1, 4 and 7. Thicke et al. stated that smoking is positively associated with overweight and obesity with a value (AOR = 5.62, 95% CI 1.06–29.90).<sup>12</sup> Research conducted by Arifani shows a relationship between smoking behaviour and obesity incidence with a value ( $p = 0.000$ , OR = 2.660).<sup>17</sup> Other studies show different results, stating that there was no relationship between smoking and abdominal obesity ( $p=0.720$ ).<sup>18</sup> If we are exposed to nicotine from cigarette smoke, it can change the way the brain regulates food by reducing appetite through homeostatic and reward processes. After 7 days of exposure to cigarette smoke, it can cause an energy deficit characterized by decreased food intake and increased energy expenditure. This is associated with weight loss. This effect only occurs when belly fat.<sup>19</sup>

In addition to behavioural factors, obesity is also influenced by genetic factors. Children with obese parents are at 3 times greater risk of obesity as adults and experience an increase of almost 10 times if their parents are obese.<sup>17</sup> Genetic factors consist of hereditary factors that come from their parents. The results of the study stated that children who come from parents with average weight have a 10% risk of obesity. If one of the parents is obese, the risk becomes 40-50%; if both parents are obese, the hereditary factor becomes 70-80%.

## CONCLUSION

Eight articles supported the research, with five appropriate articles. According to the literature, the incidence of obesity can be influenced by several factors, including consumption patterns, physical activity, genetic factors and environmental factors. A consumption pattern that is high in calories can increase the incidence of obesity, and a lack of physical activity can cause the accumulation of body fat, which contributes to obesity.

## **Declarations**

### **Authors' contribution**

AP is mainly in charge of designing, data collection, analysis, and writing articles.

### **Funding statement**

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### **Conflict of interest**

There is no conflict of interest in this research.

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