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Meta-Analysis

Meta-analysis of the Effect of Excess Waist Circumference on Hypertension Incidence in Adolescents

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ABSTRACT

Background: Hypertension is a condition characterized by blood pressure measurements showing a systolic pressure of >130 mmHg and a diastolic pressure of >80 mmHg. There are so many cases of hypertension in adolescents that begin with being overweight or obese. One way to determine a person's level of obesity is by measuring the Waist to Hip Ratio. This study was aimed to analyze the effect of excess waist circumference on the incidence of hypertension in adolescents.
Subjects and Method: This study is a meta-analysis study with the following PICO, population: adolescents. Intervention: excess waist circumference. Comparison: normal waist circumference. Outcome: hypertension. This study uses PRISMA flowchart guidelines. The article search process was carried out between 2011-2021 using online databases, namely PubMed, Google Scholar, and Science Direct. Based on the database, there were 9 articles that met the inclusion criteria. The analysis was carried out using RevMan 5.3 software.
Results: There are 9 cross-sectional studies originating from 2 continents, namely America and Asia. Based on the data showed that adolescents with excess waist circumference increased the risk of hypertension 1.59 times compared to adolescents with normal waist circumference (aOR= 1.59; 95% CI= 1.00 to 2.52; p= 0.050).
Conclusion: Excess waist circumference increases the risk of hypertension in adolescents.

Keywords: hypertension, waist circumference, teens

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BACKGROUND

Hypertension is a serious medical condition that can increase the risk of heart, brain, kidney and other diseases and is the leading cause of premature death worldwide (WHO, 2021). Hypertension is a condition characterized by blood pressure measurements showing a systolic pressure of >130 mmHg and a diastolic pressure of >80 mmHg. Classification of blood pressure in adolescents is different from blood pressure in adults because blood pressure increases with age. The hypertension that most often occurs in adolescents is essential hypertension, namely hypertension that occurs without symptoms and is mostly detected only during routine examinations (Shaumi and Achmad, 2019). The increase in the prevalence of hypertension occurs in almost all provinces in Indonesia, nationally the prevalence of hypertension in Indonesia

has an increasing trend (Kemenkes RI, 2019).

Generally, hypertension will be experienced in the elderly, but several studies have shown that hypertension can appear since adolescence and its prevalence has increased in recent years. Many do not realize that hypertension experienced in adolescence will allow it to continue into adulthood. Based on the 2003 JNC VII guidelines in the 2013 Riskesdas report, it was found that the prevalence of adolescents with hypertension at the age of 15-17 years nationally was 5.3% (6.0% males and 4.7% females) then the most cases of adolescent hypertension in Indonesia occurred in the age group 18 years and over with a total percentage of 25.80% (Shaumi and Achmad, 2019).

There are so many cases of hypertension in adolescents that begin with being overweight or obese. Obesity can be interpreted as a condition of the body due to an imbalance in the amount of food intake compared to energy expenditure by the body. Obesity is a condition in which fat is stored in excess in the body. Obesity in adolescents is known to have a significant impact on both physical and psychological health. One way to determine a person's obesity level is by measuring the Waist to Hip Ratio (RLPP). RLPP is one of the anthropometric measurement methods that can describe the amount of fat deposits in the abdominal cavity (Dewi, 2015).

Based on the large number of cases of hypertension, researchers are interested in conducting a meta-analysis of the effect of excess waist circumference and low physical activity on the incidence of hypertension in adolescents, with a meta-analysis of previously conducted primary studies.

SUBJECTS AND METHOD

1. Study Design

This research was conducted using a meta-analysis research design with PRISMA flow chart guidelines. Article searches were performed using the following databases: PubMed, Google Scholar, and Science Direct. Some of the keywords used were: “excess waist circumference” AND “hypertension” OR “blood pressure” AND “adolescents”.

2. Inclusion Criteria

The inclusion criteria for this research article were full paper articles with a cross-sectional study design, articles published in English from 2011-2021, in this study the results were reported using the adjusted Odds Ratio (aOR).

3. Exclusion Criteria

The exclusion criteria for this research article were articles with meta-analysis, duplicate articles, and statistical results reported in the form of bivariate analysis.

4. Definition of Operational Variables

The articles included in this study were PICO-adjusted. The article search was carried out by considering the eligibility criteria determined using the following PICO model: Population= Youth. Intervention= Excess waist circumference. Comparison= Normal waist circumference. Outcome= Hypertension.

Excess Waist Circumference is the narrowest horizontal line from the abdomen measured by going around the abdomen using a body tape measurement and expressed in centimeters. The ideal waist circumference for women and men should not be more than 85 cm.

Hypertension is a condition characterized by blood pressure measurements showing a systolic pressure of >130 mmHg and a diastolic pressure of >80 mmHg

5. Study Instruments

The research is guided by the PRISMA flow diagram and the assessment of the quality

of research articles using the Critical Appraisal Checklist for Cross-sectional Study. The 12 questions used are as follows:

1. Does the study formulate the research question (research problem) clearly?
2. Is the research method (study design) appropriate to answer the research question?
3. Is the method for selecting research subjects clearly described?
4. Does the method of obtaining the sample lead to selection bias?
5. Is the sample representative of the research target population?
6. Was the sample size estimated taking into account the results of the initial study of statistical power?
7. Was the minimum response rate achieved?
8. Is the measurement (questionnaire) valid and reliable?
9. Has statistical significance been tested?
10. Did the researcher report confidence intervals?
11. Are there any confounding factors that have not been taken into account?
12. Are the results applicable in practice/ community?

6. Data Analysis

The research articles that have been collected will be processed using the Review Manager application (RevMan 5.3). Data processing in this study calculates the value of heterogeneity. The results of data processing are presented in the form of forest plots and funnel plots.

RESULTS

The article review process using the PRISMA flowchart can be seen in Figure 1. a total of 9 articles were obtained spread over 2 continents, namely the Americas, Asia.

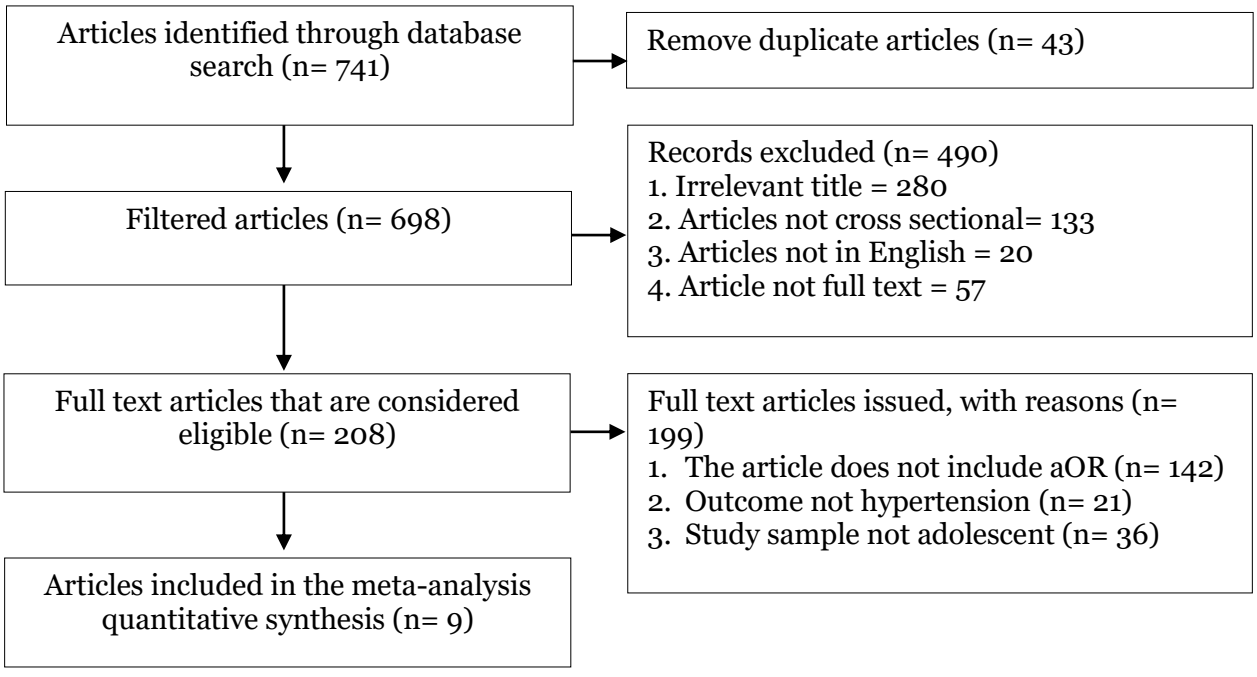

Figure 1. PRISMA flowchart

Table 1. Results of Quality Assessment of Cross-Sectional Studies the Effect of Excess Waist Circumference on the Incidence of Hypertension in Adolescents

No	Indicator	Publication (Author and Year)				
		Bozza et al. (2016)	**Logaraj et al. (2016)**	**Leung et al. (2011)**	**Çam and Ustuner Top (2021)**	**Aristizábal et al. (2018)**
1	Does the study clearly formulate the research question (research problem)?	2	2	2	2	2
2	Is the research method (study design) appropriate to answer the research question?	2	2	2	2	2
3	Are the methods for selecting research subjects clearly described?	2	2	2	2	2
4	Does the method of obtaining the sample lead to selection bias?	2	2	2	2	2
5	Is the sample representative of the research target population?	2	2	2	2	2
6	Was the sample size estimated taking into account the results of the initial study of statistical power?	2	2	2	2	2
7	Was the minimum response rate reached?	2	2	2	2	2
8	Is the measurement (questionnaire) valid and reliable?	2	2	2	2	2
9	Was statistical significance test performed?	2	2	2	2	2
10	Do researchers report confidence intervals?	2	2	2	2	2
11	Are there any confounding factors that have not been taken into account?	2	2	2	2	1
12	Are the results applicable in practice/community?	2	2	2	2	2
	Total	**24**	**24**	**24**	**24**	**23**

Description:

1: Yes; 0: No

Table 2. Continuation

No	Indicator	Publication (Author and Year)			
		Liew et al. (2019)	**Zhao et al. (2019)**	**Shah et al. (2015)**	**Kwak et al. (2018)**
1	Does the study clearly formulate the research question (research problem)?	2	2	2	2
2	Is the research method (study design) appropriate to answer the research question?	2	2	2	2
3	Are the methods for selecting research subjects clearly described?	2	2	2	2
4	Does the method of obtaining the sample lead to selection bias?	2	2	2	2
5	Is the sample representative of the research target population?	2	2	2	2
6	Was the sample size estimated taking into account the results of the initial study of statistical power?	2	2	2	2
7	Was the minimum response rate reached?	2	2	2	2
8	Is the measurement (questionnaire) valid and reliable?	2	2	2	2
9	Was statistical significance test performed?	2	2	2	1
10	Do researchers report confidence intervals?	2	2	2	2
11	Are there any confounding factors that have not been taken into account?	2	2	1	2
12	Are the results applicable in practice/community?	2	2	2	2
	Total	**24**	**24**	**23**	**23**

Description:
1: Yes; 0: No

Table 3. Description of primary studies of excess waist circumference included in the meta-analysis

Author	Country	Study Design	Sample Size	P (Population)	I (Intervention)	C (Comparison)	O (Outcome)	aOR (CI 95%)
Bozza et al. (2016)	Brazil	Cross Sectional	1,242	Teenagers age	Excess Waist Circumference	Normal Waist Circumference	Hypertension	2.10 (1.34 to 3.28)
Logaraj et al. (2016)	India	Cross Sectional	203	11-17 years old	Excess Waist Circumference	Normal Waist Circumference	Hypertension	0.46 (0.24 to 0.87)
Leung et al. (2011)	Hong Kong	Cross Sectional	6,193	School age youth	Excess Waist Circumference	Normal Waist Circumference	Hypertension	2.38 (1.13 to 4.99)
Çam and Top (2021)	Turkey	Cross Sectional	896	Teenager	Excess Waist Circumference	Normal Waist Circumference	Hypertension	0.77 (0.41 to 1.46)
Aristizábal et al. (2018)	Colombia	Cross Sectional	346	Teenagers age	Excess Waist Circumference	Normal Waist Circumference	Hypertension	18.30 (4.01 to 8.34)
Liew et al. (2019)	Malaysia	Cross Sectional	237	14-16 years old	Excess Waist Circumference	Normal Waist Circumference	Hypertension	2.918 (1.17 to 7.27)
Zhao et al. (2019)	China	Cross Sectional	14,956	Teenager	Excess Waist Circumference	Normal Waist Circumference	Hypertension	1.17 (0.79 to 1.73)
Shah et al. (2015)	United Arab Emirates	Cross Sectional	1,375	Teenagers ages 13-17	Excess Waist Circumference	Normal Waist Circumference	Hypertension	1.78 (1.18 to 2.69)
Kwak et al. (2018)	Korea	Cross Sectional	429	Teenagers age	Excess Waist Circumference	Normal Waist Circumference	Hypertension	1.26 (0.27 to 5.90)

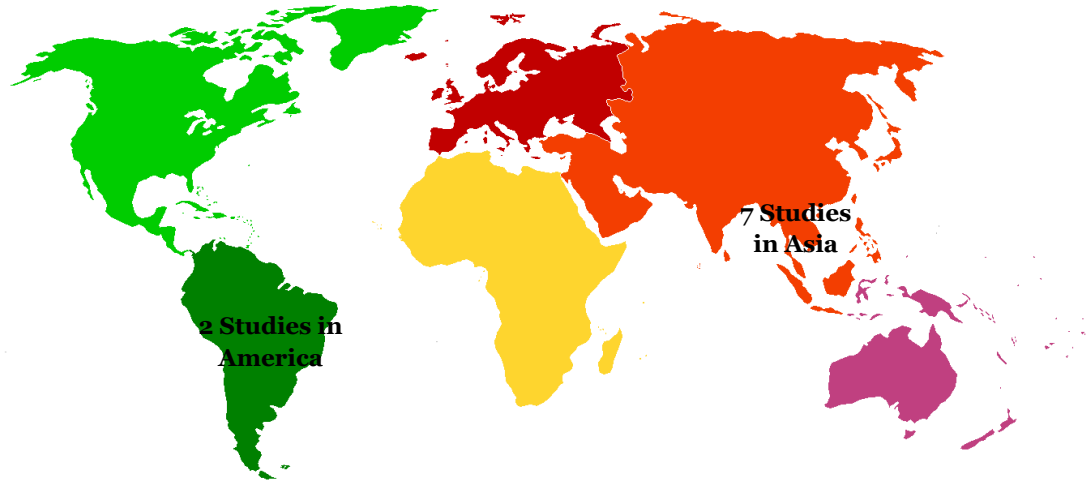

Figure 1. Map of Study Areas

a. Forest plot

The forest plot in Figure 3 shows that there is high heterogeneity (I^2= 78%; p<0.001), so the data analysis in the forest plot uses a random effects model. Based on the results of the forest plot, it can be concluded that adolescents with excess waist circumference 1.59 times increase the risk of hypertension compared to adolescents with normal waist circumference (aOR= 1.59; 95% CI= 1.00 to 2.52; p= 0.050).

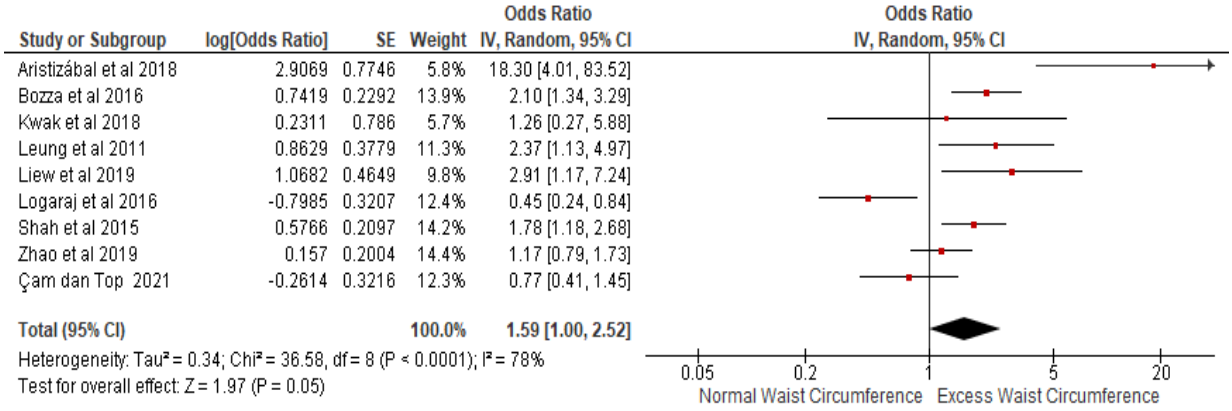

Figure 3. Forest Plot Effect of Excess Waist Circumference on Hypertension Incidence in Adolescents

b. Funnel plot

The funnel plot in Figure 4 shows that there is no publication bias. This is indicated by the symmetrical right and left plots where there are 5 plots on the right and 4 plots on the left. The plot on the left of the graph has a standard error between 0 and 0.8 and the plot on the right has a standard error between 0 and 0.8.

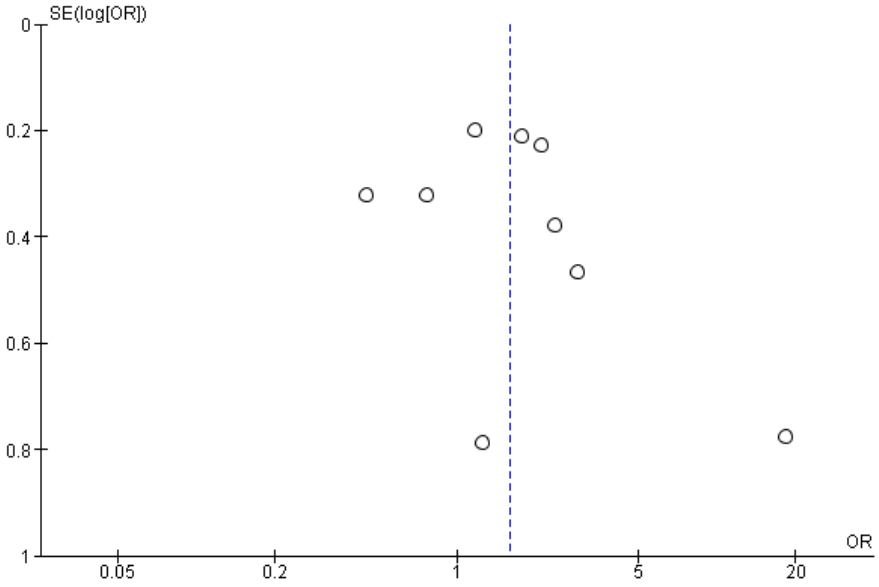

Figure 4. Funnel Plot Waist Circumference Excessive Hypertension Incidence in Adolescents

DISCUSSION

This systematic study and meta-analysis raised the theme of the effect of excess waist circumference on the incidence of hypertension in adolescents. The independent variable analyzed was excess waist circumference. The dependent variable analyzed was hypertension.

The primary studies that met the criteria were 9 articles from 2 continents, 2 from the Americas and 7 from the Asian continent. This study was conducted on boys and girls aged 10-24 years with a total sample of 25,877. This study used aOR statistical results from multivariate analysis, which aimed to control for confounding factors. Confounding factors can cause research results to be invalid because confounding factors also affect the relationship or affect the population being studied.

The study was conducted by looking at the state of excess waist circumference in adolescents. Based on the results of the analysis obtained a significant influence between waist circumference on the incidence of hypertension in adolescents. Adolescents with excess waist circumference have a risk of increasing the incidence of hypertension.

This study showed that excess waist circumference had a slightly greater likelihood of developing hypertension in adolescents, but it was not statistically significant. The forest plot results showed that adolescents with an excess waist circumference of 1.59 times increased the risk of hypertension compared to adolescents with a normal waist circumference. High blood pressure is a health problem that mostly occurs because of the high body mass index in children and adolescents (Noubiap et al., 2017).

Alvarez et al. (2020) in his research stated that a large waist circumference will cause hypertension among adolescent boys and girls in Spain, specifically the excess waist circumference variable shows a factor that is closely related to hypertension, but not statistically significant. Wariri et al. (2018) also stated that excess waist circumference was strongly and positively associated with increased blood pressure among Nigerian adolescents with results (aOR= 15.30; 95%CI= 4.80 to 27.90). The results

of other studies that are also in line are studies conducted in lithuania by Dulskiene et al. (2014) who examined the relationship between obesity and high blood pressure among Lithuanian adolescents, proved that adolescents with excess waist circumference tend to have high blood pressure 7.41 times higher than adolescents with normal weight. The results of the same study also obtained by Dewi et al. (2019) who conducted research on adolescents in Medan, North Sumatra and showed the results that adolescents with excess waist circumference were associated with the incidence of hypertension in adolescents, as evidenced by the results of research showing that adolescents with excess waist circumference were 3.17 times more more likely to have hypertension than those with only teenagers with excess waist circumference. This study is not in line with the research of Wang et al. (2015) which states that normal waist circumference also tends to provide a risk of hypertension in male adolescents in China.

The high prevalence of hypertension in adolescents is still an important problem. Lack of awareness to live a healthy life, such as not maintaining a healthy diet will result in excess waist circumference and obesity, unconsciously this is very risky for hypertension in adolescence. The limitation of this research is the search for articles because in this study the researchers only used 3 databases (PubMed, Google Scholar, and Science Direct) thus ignoring other search sources.

AUTHORS CONTRIBUTION

Ulul Azmi Zuhaira and Viola Fathia Irwan are the main researchers who choose the topic, find and collect research data.

FUNDING AND SPONSORSHIP

This study was self-funded.

CONFLICT OF INTEREST

There was no conflict of interest in this study.

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