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Meta-Analysis

Meta-Analysis: Relationship between Alcohol Consumption and Age on Obesity in Adults

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ABSTRACT

Background: Obesity has become a serious public health problem in both developed and developing countries. Excessive alcohol consumption in adults is a global problem that needs further investigation. The adult age group has a high enough risk of being overweight and obese. The purpose of this study was to estimate the relationship between alcohol consumption and age on obesity.
Subjects and Method: This research is a systematic study and meta-analysis. The articles used in this study were obtained from the Pubmed and Google Scholar databases. The articles used are articles that have been published from 2012-2022. The search for articles was carried out by considering the eligibility criteria determined using the PICO model. P= adults, I= alcohol consumption and middle age, C= no alcohol consumption and early adulthood, O= obesity. The keywords to search for articles were as follows: "Alcohol Consumption" OR "Alcohol Intake" AND "Age" AND "Obesity" OR "Body Mass Index" and "aOR". The articles included in this study are full text articles with a cross-sectional research design. Articles were collected using the PRISMA flow chart. Articles were analyzed using the Review Manager 5.3 application.
Results: There are 13 articles consisting of 2 studies from North America (Nicaragua, United States), 1 study from South America (Brazil), 1 study from Europe (Portugal), 7 studies from Africa (Ethiopia, Zimbabwe, Ghana), and 2 studies from Asia (Cambodia, Thailand) were included in this meta-analysis. 7 cross-sectional studies showed that alcohol consumption increased the risk of obesity in adults 2.05 times compared with those who did not consume alcohol (aOR= 2.05; 95% CI= 1.26 to 3.33; p= 0.004). A meta-analysis of 7 cross-sectional studies showed that middle age increased the risk of obesity 2.57 times compared with early adulthood (aOR= 2.57; 95% CI= 1.99 to 3.30; p = 0.001).
Conclusion: Alcohol consumption and age are risk factors for obesity in adults.

Keywords: alcohol consumption, age, obesity, adults

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BACKGROUND

Obesity is a significant risk factor for cardiovascular disease and diabetes mellitus. The World Health Organization (WHO) states that obesity is a global epidemic that contributes 35% to morbidity and 15-20% mortality. According to WHO, 300 million adults were obese in 2010 and it is esti-

mated that more than 700 million people will be obese by 2015. In the United States, one in three people is obese and in the UK 16-17.3%. Indonesia is in the Top 10. The results of the 2013 Basic Health Research (Riskesdas) show that the prevalence of the adult population aged 18 years and over who are obese according to body mass index (BMI) is 19.7%, an increase from 2007 which was only 6.1% (Sudiana et al., 2016).

The prevalence of overweight and obesity is increasing at an alarming rate in many countries. Worldwide, between 1980 and 2014, the proportion of obesity more than doubled. The increasing prevalence of obesity can be explained by behavioral changes that have occurred in recent decades, mainly due to poor eating habits and a sedentary lifestyle. In middle-income countries, surveillance systems have found a time trend for obesity to increase (Zwarcwald and Damacena, 2013). In general, being overweight/obese or underweight greatly affects an individual's health and quality of life, increasing the risk of developing infectious diseases, reducing the ability to work, prolonging hospitalization and increasing the risk of illness and death. Thus, achieving and maintaining an ideal body weight is highly recommended (Sim et al., 2020).

There are many factors that influence overweight and obesity. Lifestyle, cultural activities, socioeconomic factors, physical activity and diet were the main factors found to be associated with overweight and obesity. In addition, environmental factors also play a significant role, one of which is one's lifestyle and diet, such as consumption of alcohol and drinks with high glucose levels. The main cause of obesity is a positive energy balance caused by excessive intake of calories and not being utilized by the body. Additional calories obtained, one of which comes from the consumption of beverages containing alcohol and high glucose. Riskesdas data in 2007 showed that in Indonesia the prevalence of alcohol consumption in the last 12 months was 6.1% and the prevalence of drinking alcohol in the last month was 4.4% (Sudiana et al, 2016).

Excessive alcohol consumption among the world's young adults is a major global public health problem, while rising rates of overweight and obesity among young people are a growing concern. Public health issues caused by harmful alcohol consumption have recently been in focus, as has the global demand for information on alcohol consumption and the harm associated with alcohol/alcohol (Booranasuksakul et al., 2019).

According to the World Health Organization (WHO), in 2014 globally about two billion adult women and men were overweight or obese (Darebo et al., 2019). Along with increasing age, the prevalence of obesity has increased. Increasing age will increase the total body fat content, especially the distribution of central fat. Participants aged 31-59 years were 2.89 times more likely to be overweight and obese when compared to those aged 18-30 years. As a result, it can be seen that overweight and obesity increase significantly with age. This happens because with increasing age, involvement in physical activity decreases which contributes to overweight and obesity. An unhealthy lifestyle and often neglecting health problems exacerbate the risk of weight gain in adulthood. Coupled with a messy eating pattern and lack of attention to nutritional content (Sim et al., 2020).

Based on this background, a comprehensive review of various primary studies is needed on the effect of alcohol consumption and age on the incidence of obesity. This study aims to estimate the magnitude of the influence of alcohol consumption and

age on obesity, with a meta-analysis of the main study conducted by the previous authors.

SUBJECTS AND METHOD

1. Study Design

This research is a systematic research and meta-analysis. The articles used in this study were obtained from several databases, namely Google Scholar and Pubmed, between 2012 and 2022. The selection of articles was carried out using the PRISMA flow chart. The keywords to search for articles were as follows "Alcohol Consumption" OR "Alcohol Intake" AND Age AND Obesity OR Body Mass Index.

2. Inclusion Criteria

The inclusion criteria in this research article are: full text article using a cross-sectional study design, research subjects are adults, research results are obesity, multivariate analysis with Adjusted Odds Ratio (aOR) to measure the estimated effect.

3. Exclusion Criteria

The exclusion criteria in this research article were: articles published in languages other than English, statistical results reported in the form of bivariate analysis, articles before 2012.

4. Operational Definition of Variables

In formulating research problems, researchers use PICO. The population is adults. The intervention was alcohol consumption and middle adulthood, with a comparison of no alcohol consumption and early adulthood and the result was obesity.

Alcohol consumption is a global public health problem that can increase overweight. Increasing energy intake with alcohol use can promote positive energy balance and a contributing factor to weight gain.

Age is the period in years that is calculated from the human being born until the last birthday. The age group used in this study is the young adult age group.

Obesity refers to the abnormal accumulation of fat that can lead to health problems as measured by the Body Mass Index (BMI), which can also be the main indicator of nutritional status in adults.

5. Study Instruments

The study was conducted using the PRISMA flow chart guidelines and the assessment of the quality of research articles using the Critical Appraisal Checklist for Cross-sectional Study (CEBMa, 2014).

6. Data Analysis

The data in this study were analyzed using the RevMan 5.3 application, to calculate the effect size and heterogeneity of the study. The results of data processing are presented in the form of forest plots and funnel plots.

RESULTS

The article search process was carried out using the PRISMA flow chart which can be seen in Figure 1. The total articles obtained were 13 articles consisting of 2 from Asia (Cambodia, Thailand), 2 from North America (Nicaragua, United States), 7 from Africa (Ethiopia, Zimbabwe, Ghana), 1 from South America (Brazil) and 1 from Europe (Portugal). Figure 2 shows the area of the article taken and according to the inclusion criteria.

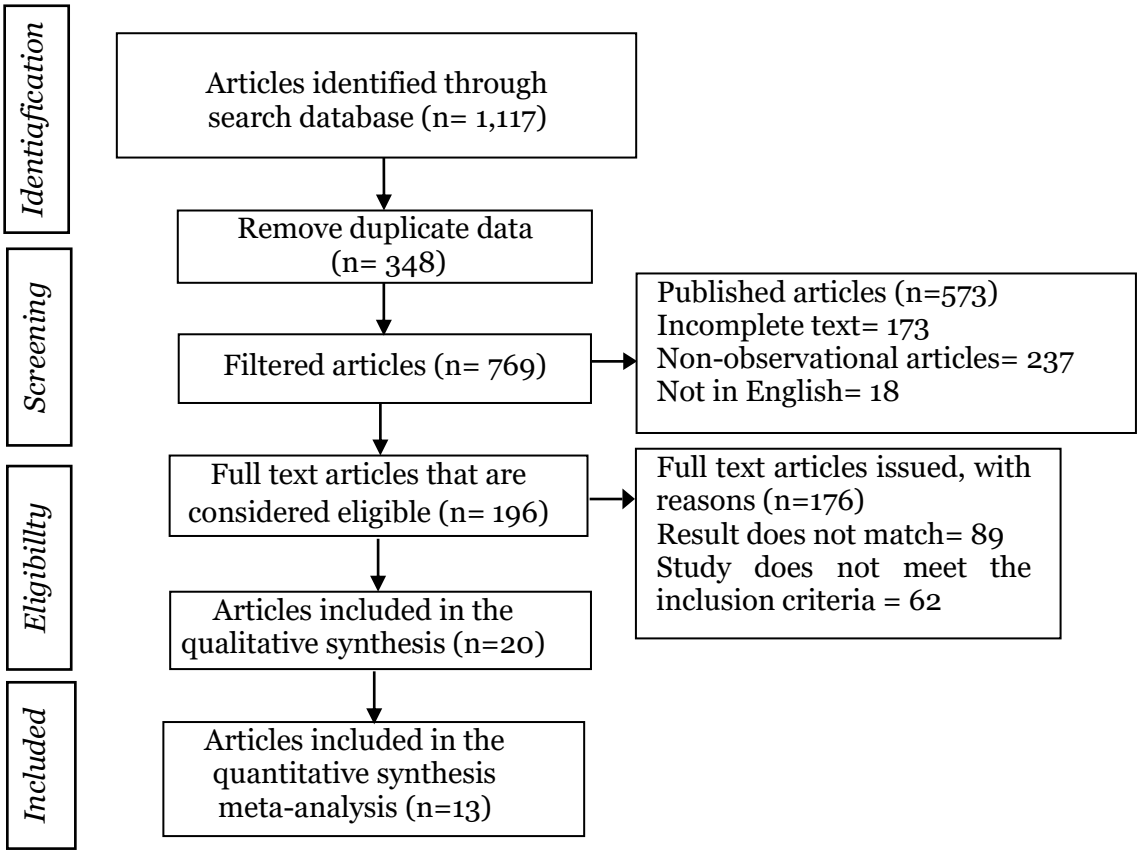

Figure 1. Article Search Diagram of the Relationship

Figure 2. Map of Primary Research Areas by Continent

Research on the quality of primary research was carried out quantitatively and qualitatively which can be seen in Table 1 below. This study was conducted using the Critical Assessment Checklist for Cross-sectional Studies sourced from the Center for Evidence-Based Management (CEBMa, 2014).

Table 1. Quality Assessment of Cross-sectional Study Design Articles

No	Indicators	Publication (Author and Year)					
		Bogale et al. (2019)	Booranasuksa-kul et al. (2019)	Chakraborty (2014)	Ferreira et al. (2019)	Lourenco et al. (2012)	Mogre et al. (2015)
1	Do these objectives clearly address the research focus/problem?	1	1	1	1	1	1
2	Are cross-sectional research methods suitable to answer the research question?	1	1	1	1	1	1
3	Is the research subject selection method clearly written?	1	1	1	1	1	1
4	Is the sampling method free of bias (selection)?	1	0	1	1	1	1
5	Is the research sample taken representative of the designated population?	1	1	1	1	1	1
6	Was the sample size based on pre-study considerations?	1	1	1	1	1	1
7	Was a satisfactory response achieved?	1	1	1	1	1	1
8	Is the research instrument valid and reliable?	1	1	1	1	1	1
9	Was statistical significance assessed?	1	1	1	1	1	1
10	Was a confidence interval given for the main outcome?	1	1	1	1	1	1
11	Have confounding factors been taken into account?	1	0	0	1	1	1
12	Do the results apply to your research?	1	1	1	1	1	1
Total		**12**	**10**	**11**	**12**	**12**	**12**

Description:

1: Yes; 0: No

Table 2. Cont.

No	Indicators	Publication (Author and Year)						
		Sim et al. (2018)	Darebo et al. (2019)	Laux et al. (2012)	Mangemba et al. (2018)	Mutseyekwa et al. (2019)	Tekalegn et al. (2021)	Yesaw et al. (2019)
1	Do these objectives clearly address the research focus/problem?	1	1	1	1	1	1	1
2	Are cross-sectional research methods suitable to answer the research question?	1	1	1	1	1	1	1
3	Is the research subject selection method clearly written?	1	1	1	1	1	1	1
4	Is the sampling method free of bias (selection)?	1	0	1	1	1	1	1
5	Is the research sample taken representative of the designated population?	1	1	1	1	1	1	1
6	Was the sample size based on pre-study considerations?	1	1	1	1	1	1	1
7	Was a satisfactory response achieved?	1	1	1	1	1	1	1
8	Is the research instrument valid and reliable?	1	1	1	1	1	1	1
9	Was statistical significance assessed?	1	1	1	1	1	1	1
10	Was a confidence interval given for the main outcome?	1	1	1	1	1	1	1
11	Have confounding factors been taken into account?	1	1	1	0	1	1	1
12	Do the results apply to your research?	1	1	1	1	1	1	1
Total		**12**	**12**	**11**	**12**	**11**	**12**	**12**

Description:

1: Yes; 0: No

Table 3. Description of the Main Study of the Relationship between Alcohol Consumption and Obesity

Author (year)	Country	Study Design	Sample	P (Population)	I (Intervention)	C (Comparison)	O (Outcome)	aOR (95%CI)
Bogale et al. (2019)	Ethiopia	Cross-sectional	531	Adult Age 25 - 45 years old	Consumption of alcohol with smoking habits and consumption of vegetables	No alcohol consumption, no smoking, and no consumption of vegetables	Obesity	2.27 (1.23 to 4.16)
Booranasuksakul et al. (2019)	Thailand	Cross-sectional	396	Young Adults Ages 19-23	Consumption of alcohol with unhealthy food	No alcohol consumption and healthy food	Obesity	1.64 (0.58 to 4.62)
Chakraborty (2014)	The US	Cross-sectional	9.193	Adult Age 18-81 years old	Alcohol consumption with the availability of social support	No alcohol consumption and no social support	Obesity	2.72 (2.70 to 2.74)
Ferreira et al. (2019)	Brazil	Cross-sectional	59.402	Adult Age 18 - 70 years old	Alcohol consumption with physical activity	No alcohol consumption and no physical activity	Obesity	1.02 (0.83 to 1.26)
Lourenco et al. (2012)	Portugal	Cross-sectional	2.366	Adult Age 18 years old	Current alcohol consumption and lifetime alcohol consumption	No alcohol consumption	Obesity	2.26 (1.17 to 4.35)
Mogre et al. (2015)	Ghana	Cross-sectional	552	Adult Age 30 years old	Alcohol consumption with demographic factors, dietary habits, and strong physical activity	No alcohol consumption, no dietary habits, and moderate physical activity	Obesity	8.20 (2.20 to 31.10)
Sim et al. (2018)	Cambodia	Cross-sectional	749	Adult Age 18-59 years old	Consumption of alcohol and fast food	Do not consume alcohol and fast food	Obesity	1.60 (1.10 to 2.31)

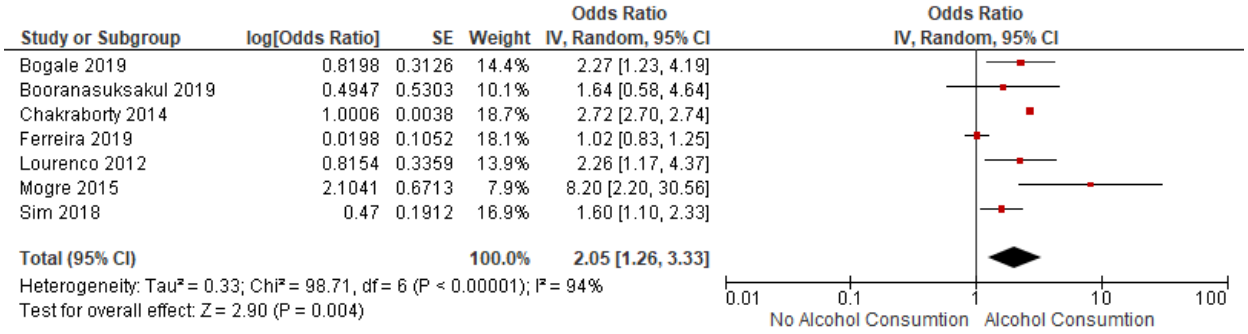

Figure 3. Forest Plot of the relationship between alcohol consumption and obesity

The interpretation of the results of the meta-analysis process can be seen through the forest plot. Figure 3 shows that consumption of alcoholic beverages increases obesity rates in adults. The results of the meta-analysis showed that alcohol consumption increased the risk of obesity in adults 2.05 times compared to not consuming alcohol (aOR= 2.05; 95% CI= 1.26 to 3.33; p= 0.004). The heterogeneity of the research data shows I^2 = 94% so that the distribution of the data is declared heterogeneous (random effect model).

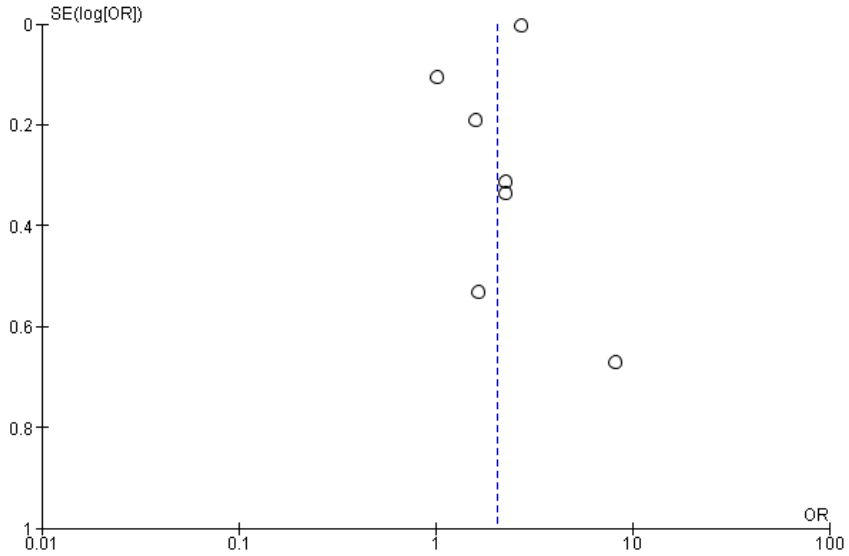

Figure 4. Funnel Plot Relationship between alcohol consumption and obesity

Based on Figure 4, the funnel plot shows an asymmetric distribution of the 7 primary studies, 3 plots on the left and 4 plots on the right, indicating that there is a publication bias that tends to overestimate the true effect. The plot on the left has a standard error between 0 and 0.6, the plot on the right has a standard error between 0 and 0.8.

Table 4. Description of the Main Study of the Relationship between Age and Obesity

Author (year)	Country	Study Design	Sample	P (Population)	I (Intervention)	C (Comparison)	O (Outcome)	aOR (95% CI)
Darebo et al. (2019)	Ethiopia	Cross-sectional	531	Adults aged 18-64 years	Middle Adulthood 35-44 years old	Young Adult 18-24 years old	Obesity	1.28 (0.61 to 2.68)
Tekalegn et al. (2021)	Ethiopia	Cross-sectional	2.259	Male age 15-59 years	Middle Adulthood 30-44 years old	Young Adult 15-29 years old	Obesity	3.10 (2.30 to 4.11)
Yesaw et al. (2019)	Ethiopia	Cross-sectional	10,938	Female aged 15-49 years	Middle Adulthood 35-44 years old	Young Adult 15-24 years old	Obesity	2.79 (1.99 to 3.93)
Laux et al. (2012)	Nikaragua	Cross-sectional	1,355	Adults aged 20-60 years	Middle Adulthood 30-39 years old	Young Adult 20-29 years old	Obesity	1.55 (0.94 to 2.55)
Ferreira et al. (2019)	Brazil	Cross-sectional	59,402	Adult 18 - 70 years old	Middle Adulthood 40-49 years old	Young Adult 18-29 years old	Obesity	2.11 (1.80 to 2.47)
Mangemba et al. (2020)	Zimbabwe	Cross-sectional	8.904	Female aged 15 – 49 years	Middle Adulthood 30-44 years old	Young Adult 15-29 years old	Obesity	3.24 (2.69 to 3.90)
Mutseyekwa et al. (2019)	Zimbabwe	Cross-sectional	9.066	Female aged 15-49 years	Middle Adulthood 35-39 years old	Young Adult 20-24 years old	Obesity	6.06 (2.77 to 13.29)

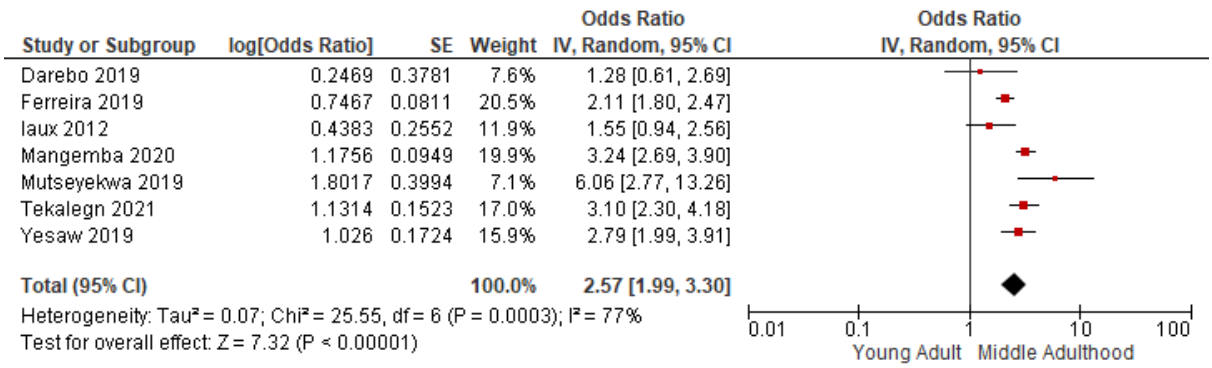

Figure 5. Forest plot of the relationship between age and obesity

The interpretation of the results of the meta-analysis process can be seen through the forest plot. Figure 5 shows that middle age has an effect on obesity. The results of the meta-analysis showed that middle adulthood had a risk of obesity of 2.57 times compared to early adulthood (aOR= 2.57; 95% CI = 1.99 to 3.30; P<0.001).

The heterogeneity of the research data shows I^2= 88% so that the distribution of the data is said to be heterogeneous (random effect model).

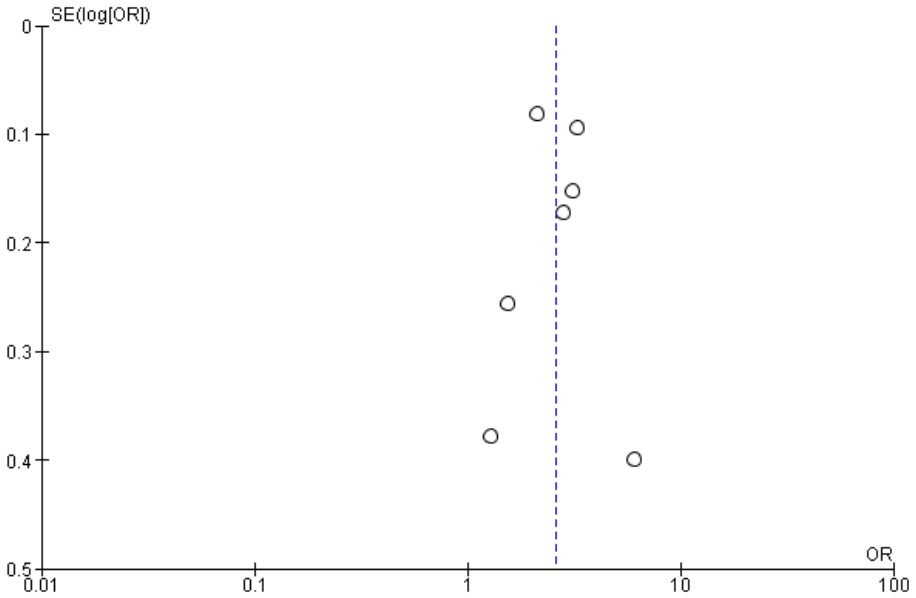

Figure 6. Funnel plot of the relationship between age and obesity

Based on Figure 6, the funnel plot shows an asymmetric distribution of the 7 primary studies, 3 plots on the left and 4 plots on the right, indicating that there is a publication bias that tends to overestimate the true effect. The plot on the left has a standard error between 0.1 and 0.3, the plot on the right has a standard error between 0.1 and 0.4.

DISCUSSION

This systematic review and meta-analysis research raised the theme of the relationship between alcohol consumption and age on obesity in adults. The dependent variable analyzed was obesity. This meta-analysis study uses research sources that control for confounding factors that can be seen from the inclusion requirements of the study, namely using multivariate analysis and the statistical results reported are adjusted odd ratio (aOR). The combined results of the relationship between alcohol consumption and age with obesity in adults were processed using the RevMan 5.3 application, while the results of the systematic review and meta-analysis were presented in forest plots and funnel plots.

1. The relationship between alcohol consumption and obesity

The results of the forest plot study of research articles with an observational cross-sectional design showed that alcohol consumption was 2.05 times more likely to increase obesity in adults than without alcohol consumption (aOR= 2.05; 95% CI= 1.26 to 3.33; p = 0.004).

Oh et al. (2018) in his research stated that alcohol can produce energy that provides 7.1 kcal per 1 gram. Alcohol increases the amount of food consumed rather than being converted to fat on its own, and is converted to acetate by the liver interfering with the breakdown and utilization of fat in tissues. Alcohol is known to increase body fat by various mechanisms. Thus, alcohol consumption is a risk factor for weight gain

This is supported by the research of Bo et al. (2017), that drinking patterns that show significant differences in abdominal obesity in adult men are the frequency of drinking, the amount of drinking, the frequency of binge drinking and heavy drinking. Abdominal obesity according to drinking frequency was significantly lower in the non-drinking group, the drinking group 2-4 times a month with (OR = 0.68; 95% CI = 0.56 to 0.83) and (aOR = 0.74; 95% CI = 0.60 to 0.91).

The research of Sudiana et al (2016), found the incidence of central obesity in adult men in Karangasem of 8, 18%. Variables related to the incidence of central obesity were heavy consumption of palm wine, quantity of palm wine consumption, duration of palm wine consumption, and consumption of other types of alcohol (aOR= 3.86; 95%CI= 1.36 to 10.95). The results of this study are in accordance with the theory of pathogenesis of central obesity which states that alcohol consumption is one of the causes of obesity.

Park et al. (2017) conducted a study with the aim of knowing whether alcohol drinking patterns are associated with abdominal obesity in middle-aged adults with normal weight. Smoking status was included as a covariate because it has been found to be an important confounder of alcohol drinking patterns and abdominal obesity. Compared with normal-weight men who consumed less than 2 drinks per occasion, men who consumed more than 7 drinks were more prone to abdominal obesity (OR= 2.16; 95% CI= 1.23 to 3.77).

Ryu et al. (2010) in his research explained that men aged between 30 and 39 years who consumed alcohol >20 g per day increased the risk of central obesity by (OR= 1.39; 95%CI= 1.15 to 1.68) compared to non-drinkers. This study determined a positive relationship between alcohol and high waist circumference.

2. The relationship between age and obesity

The results of the forest plot study of research articles with an observational cross-sectional design showed that middle age increased obesity 2.57 times compared to

early adulthood (aOR= 2.57; 95% CI= 1.99 to 3.30; p = 0.001).

According to Puspitasari, N. (2018), increasing age causes the prevalence of obesity to increase. Increasing age will also increase the total body fat content, especially the distribution of central fat. The prevalence of obesity increases until the age of 44 years and decreases again at the age of 45-54 years. Obesity can cause health problems, such as type II diabetes mellitus, dyslipidemia, cardiovascular disease, hypertension, cancer, sleep apnea, and metabolic syndrome. Insulin resistance that occurs along with increased levels of fat in the body can also occur due to obesity.

Sim et al. (2019) states that with age, overweight and obesity will increase significantly. This is because with increasing age, involvement in physical activity decreases which contributes to overweight and obesity. Participants aged 31-59 years were 2.89 times more likely to be overweight and obese when compared to those aged 18-30 years.

This is supported by the research of Seidu et al. (2020) which shows that the prevalence of overweight and obesity is 26.9%. The odds of being overweight and obese were high among women aged 40–44 years (aOR=5.94; 95% CI=4.10 to 8.60). The study found a predominance of overweight and obesity among women in Mali. Studies show that age is associated with overweight and obesity among women in Mali

Mekonnen et al. (2020) in his study revealed that the overall prevalence of overweight or obesity among adults in the northwestern region of Ethiopia found that the odds of obesity were 6.06 higher at 37-50 years of age with (aOR=6.06; 95% CI=2.77 to 13.29).

AUTHORS CONTRIBUTION

Ayu Novita Wulandari is the main researcher who selects the topic, searches for and collects research data, Amin Nur Hanida analyzes the data and reviews research documents.

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This study is self-funded.

CONFLICT OF INTEREST

There is no conflict of interest.

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