JMCH Journal of Maternal and Child Health (2021), 06(06): 678-689
Masters Program in Public Health, Universitas Sebelas Maret
Meta-Analysis

Overweight and Obesity as Risk Factors of Breast Cancer in Premenopausal and Postmenopausal Women: Meta-Analysis

Shofia Nur Fadhila[1)], Bhisma Murti[1)], Vitri Widyaningsih[2)]

[1)]Master's Program in Public Health, Univesitas Sebelas Maret
[2)]Faculty of Medicine, Universitas Sebelas Maret

ABSTRACT

Background: A woman has an increased risk of breast cancer due to increased exposure to the hormone estrogen during her life due to early menarche, late menopause, and/or the absence of childbearing. Epidemiological data show that menopausal status has a risk factor for breast cancer. The aim of this study was to investigate overweight and obesity as risk factors for premenopausal and postmenopausal breast cancer.
Subjects and Method: A systematic review and meta-analysis study was conducted by systematically reviewing articles published from 2010-2021 in the PubMed, Google Scholar, SpringerLink and Science Direct databases with the keywords overweight AND obesity AND "breast cancer" OR "breast carcinoma" AND "premenopausal women", overweight AND obesity AND "breast cancer" OR "breast carcinoma" AND "postmenopausal women". Inclusion criteria included articles in English, full text, using an observational study design, and displaying adjusted odds ratios. Articles were reviewed using PRISMA diagrams and analyzed using Revman 5.3.
Results: A meta-analysis of 10 articles concluded that overweight women were 1.35 times more likely to develop premenopausal breast cancer than women with a normal BMI (aOR= 1.35; 95% CI= 0.98 to 1.86; p= 0.070). A meta-analysis of 10 articles concluded that obese women were 1.27 times more likely to develop premenopausal breast cancer than women with normal BMI (aOR= 1.27; 95% CI= 0.95 to 1.69; p= 0.110). A meta-analysis of 9 articles concluded that overweight women had a 1.28 times risk of developing postmenopausal breast cancer compared with women with a normal BMI (aOR= 1.28; 95% CI= 1.00 to 1.63; p= 0.050). A meta-analysis of 11 articles concluded that obese women were 1.52 times more likely to develop postmenopausal breast cancer than women with normal BMI (aOR= 1.52; 95% CI= 1.17 to 1.98; p= 0.002).
Conclusion: Overweight and obesity increase the risk of pre-menopausal and postmenopausal breast cancer.

Keywords: overweight, obesity, breast cancer, premenopause, postmenopausal.

Correspondence:
Shofia Nur Fadhila. Masters Program in Public Health, Universitas Sebelas Maret. Jl. Ir. Sutami 36A, Surakarta 57126, Central Java. Email: shofianf@student.uns.ac.id.

Cite this as:
Fadhila SN, Murti B, Widyaningsih V (2021). Overweight and Obesity as Risk Factors of Breast Cancer in Premenopausal and Postmenopausal Women: Meta-Analysis. J Matern Child Health. J Matern Child Health. 06(06): 678-689. https://doi.org/10.26911/thejmch.2021.06.06.06.

BACKGROUND

Breast cancer is still a public health problem worldwide and is currently the leading cause of death in women. Breast cancer is a disease in which cells in the breast grow out of control (CDC, 2020). Breast cancer accounts for one in 4 cancer cases and one in 6 cancer deaths, and ranks first in terms of incidence and mortality in most countries worldwide (World Health Organization, 2018). Based on

data from the International Agency for Research on Cancer (World Health Organization, 2018), breast cancer in women is the most common cancer worldwide (11.7% of total new cases). The World Health Organization (WHO) in 2020, stated that breast cancer is the most common cancer in the world, with 2.3 million women diagnosed with breast cancer and 685,000 deaths globally. By the end of 2020, there were 7.8 million women diagnosed with breast cancer in the last 5 years.

The majority of breast cancer occurs in women and the number of cases is 100 times higher in women than men (Siegel et al., 2020). The majority of breast cancer patients are found in women approaching the age of menopause and are rarely found in women under the age of 45 years. Based on epidemiological data, 50% of breast cancers occur in elderly women, 50-69 years old (Kamińska et al., 2015).

Factors that often influence the occurrence of breast cancer include environmental factors, reproductive factors and lifestyle factors, some of which can be modified (Rojas and Stuckey, 2016). The incidence of breast cancer increases with the majority of risk factors caused by young age at menarche, advanced age at first pregnancy, parity, length of breastfeeding and age of menopause. Other risk factors that can increase the burden of breast cancer are obesity, alcohol consumption and use of hormone therapy (Howell et al., 2014).

The problem of being overweight is associated with the incidence of certain diseases, one of which is breast cancer, and increases the incidence of morbidity and mortality caused by overweight and obesity. Based on epidemiological studies that have been carried out, found a consistent relationship between an increase in body mass index and the development of chronic diseases including hypertension, diabetes, stroke, cardiovascular, musculoskeletal disorders and various types of tumors (Iyengar et al., 2013).

Body Mass Index (BMI) has various associations with breast cancer risk which varies with menopausal status. Body Mass Index showed a significant inverse relationship in premenopausal women and a positive relationship in postmenopausal women to breast cancer (Friedenreich, 2001). Overweight and obesity affect breast cancer by various mechanisms including increased estrogen synthesis, causing insulin resistance and inhibition of sex hormone binding globulin synthesis (Arcidiacono et al., 2012).

The risk of breast cancer in postmenopausal women in several studies that have been conducted showed a significant positive relationship. The results of other studies indicate that there is a positive relationship between body mass index and the incidence of breast cancer, both in premenopausal and postmenopausal women (Wada et al, 2014). Based on this background, comprehensive research is needed from various primary studies on overweight and obesity as risk factors for breast cancer in premenopausal and postmenopausal women. The aim of this study was to investigate overweight and obesity as risk factors for premenopausal and postmenopausal breast cancer.

SUBJECTS AND METHOD

1. Study Design

The study design used in this research is a systematic review and meta-analysis, using PRISMA flow diagram guidelines. Search articles through PubMed database, Google Scholar, SpringerLink and Science Direct. The articles used in the research are articles that have been published from 2010-2021. The keywords in the search for articles were overweight AND obesity AND "breast cancer" OR "breast carcinoma" AND "premenopausal women", overweight AND obesity AND

"breast cancer" OR "breast carcinoma" AND "postmenopausal women".

2. Inclusion Criteria

Inclusion criteria in this study include full text articles with case control study designs, English articles, using multivariate analysis by including adjusted Odds Ratio, adult female research subjects, intervention in the form of overweight and/or obesity and outcome in the form of breast cancer incidence in women. premenopause and postmenopause.

3. Exclusion Criteria

Exclusion criteria in this study included articles published in languages other than English and primary studies that had previously been meta-analyzed.

4. Operational Definition of Variables

Formulation of the problem in this study using PICO. The population is adult women. Intervention is overweight and obesity with comparison that is normal weight. Outcome in the form of premenopausal and postmenopausal breast cancer.

Overweight is someone who has a body mass index between 25.0 – 29.9 kg/m^2

Obesity is someone who has a body mass index 30.0 kg/m2

Normal BMI is someone who has a body mass index between 18.5 – 24.9 kg/m2

Premenopausal breast cancer is an abnormal growth of cells in breast tissue that occurs at the age of <41 years and is diagnosed by radiological examination of breast cancer.

Postmenopausal breast cancer is an abnormal growth of cells in breast tissue occurring at the age of > 55 years and diagnosed by radiological examination of breast cancer.

5. Study Instrument

Assessment of the quality of research articles using the Critical Appraisal Checklist for Case Control Study (CEBMa, 2014).

6. Data Analysis

The articles were collected using PRISMA flow diagram guidelines and analyzed using the Review Manager 5.3 application by calculating effect size and heterogeneity to determine the combined research model and form the final meta-analysis in the form of forest plots and funnel plots.

RESULTS

The process of selecting and reviewing articles using the PRISMA flow diagram can be seen in Figure 1. A total of 12 articles were declared eligible and included in the meta-analysis consisting of 5 research articles from the Asian continent, including Bangladesh, Iran, Arabia and two articles from Thailand country. Four research articles from the Americas including from America, San Francisco, Mariana Island and Brazil and 3 research articles from the African continent including from African countries, Morocco and Tunisia.

1. Overweight as a risk factor for premenopausal breast cancer

Interpretation of the results of the meta-analysis process can be seen through the forest plot. A total of 10 articles were included in the meta-analysis. The forest plot (Figure 2) shows that overweight women are 1.35 times more likely to develop premenopausal breast cancer compared to women who have a normal body mass index but this is not statistically significant (aOR= 1.35; 95% CI= 0.98 to 1.86; p=0.070). The heterogeneity of the research data shows I2 = 75% so that the distribution of the data is declared heterogeneous (random effect model). The funnel plots show that there is no publication bias in this study which is known from the symmetrical distribution of the plots (see Figure 3).

2. Obesity as a risk factor for premenopausal breast cancer

A total of 10 articles were included in the meta-analysis. Forest plots showed that obese women were 1.27 times more likely to develop premenopausal breast cancer compared to women with normal body mass index but not statistically significant (aOR= 1.27; 95% CI= 0.95 to 1.69; p= 0.110) (see Figure 4) . The heterogeneity of the research data shows I^2 = 73% so that the distribution of the data is declared heterogeneous (random effect model). The funnel plot (Figure 5) shows that there is a publication bias in this study which is known from the asymmetric distribution of the plots. The estimated effect size in obese women on the risk of premenopausal breast cancer is lower the actual effect size (underestimate).

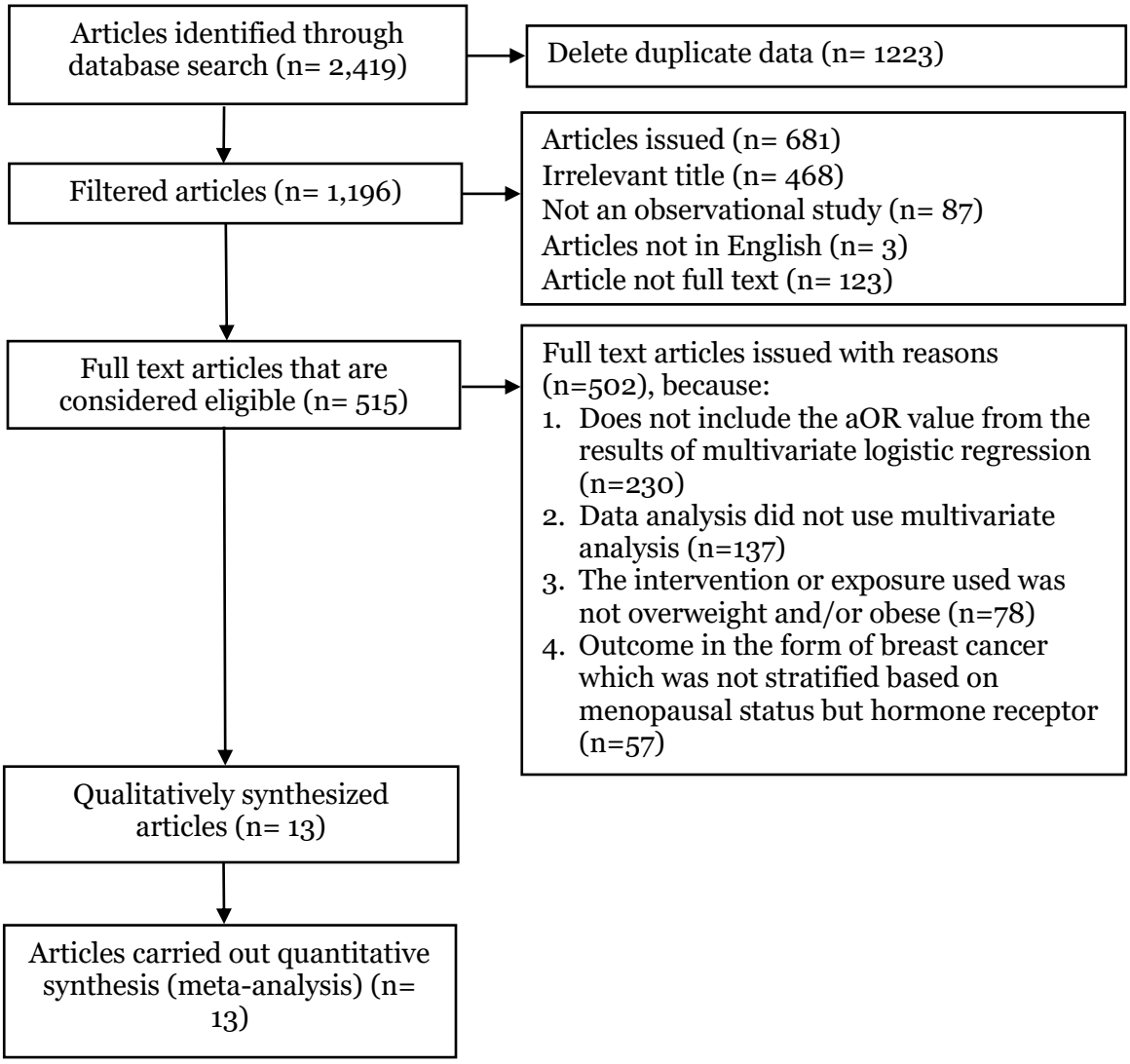

Figure 1. PRISMA Flow Diagram

3. Overweight as a Risk Factor for Postmenopausal Breast Cancer

A total of 9 articles were included in the meta-analysis. The forest plot (Figure 6) showed that overweight women were 1.28 times more likely to develop postmenopausal breast cancer compared to women with a normal body mass index and was statistically

significant (aOR= 1.28; 95% CI=1.00 to 1.63; p=0.050). The heterogeneity of the research data shows I2 = 63% so that the distribution of the data is declared heterogeneous (random effect model). Figure 7 shows a funnel plot which indicates that there is a publication bias in this study which is known from the asymmetric distribution of the plots. The estimated effect size in obese women on the risk of premenopausal breast cancer exceeds the actual effect size (overestimate).

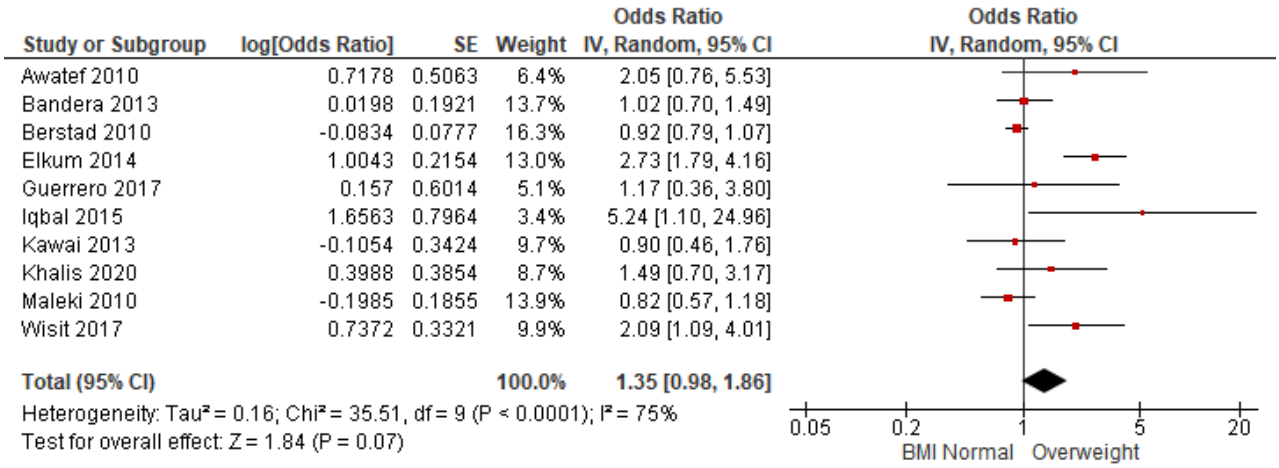

Figure 2. Forest Plot of Overweight as Risk for Premenopausal Breast Cancer

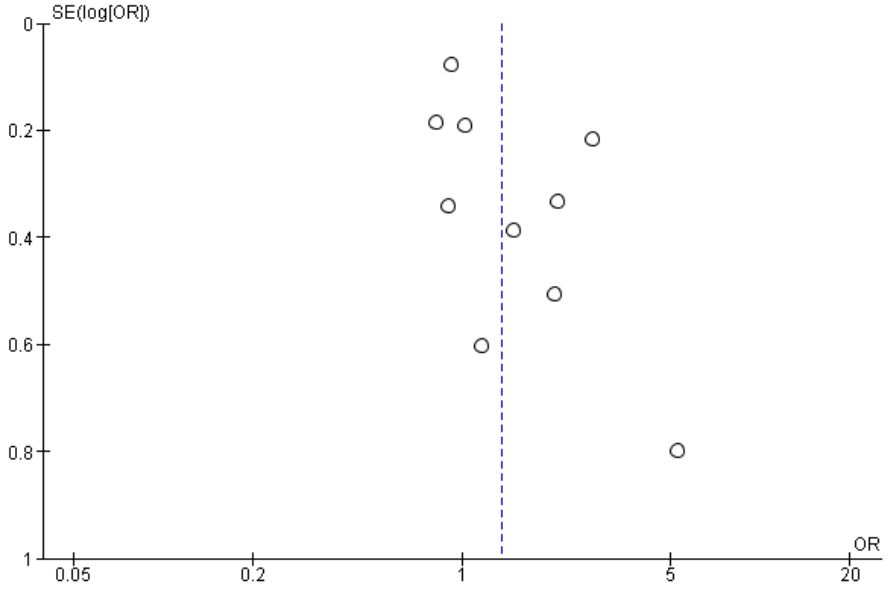

Figure 3. Funnel Plot Overweight as a Risk Factor for Premenopausal Breast Cancer

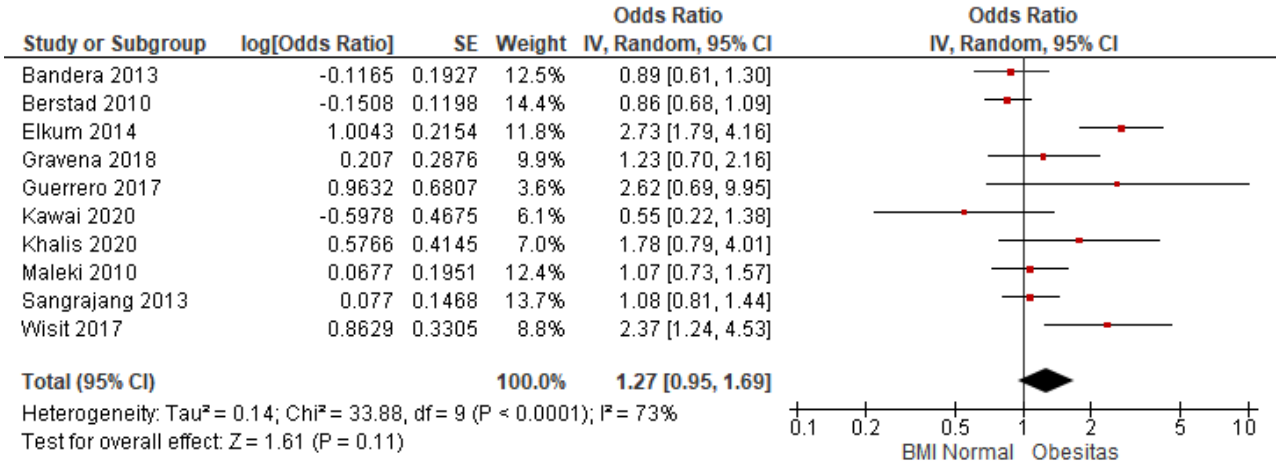

Figure 4. Forest Plot of Obesity as a Risk Factor for Premenopausal Breast Cancer

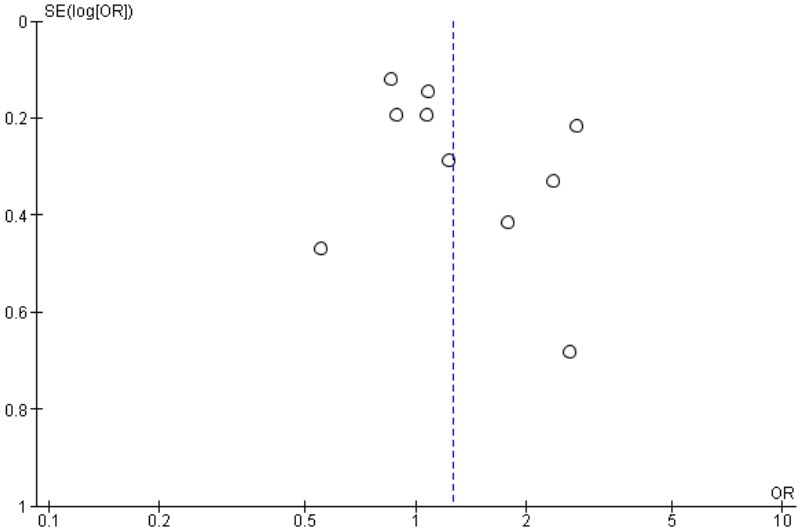

Figure 5. Funnel Plot of Obesity as a Risk Factor for Premenopausal Breast Cancer

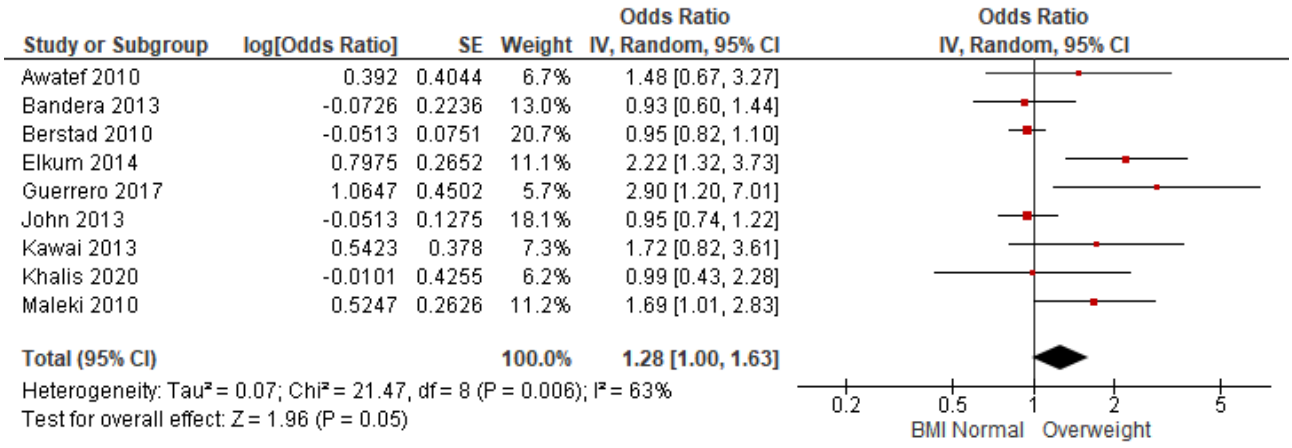

Figure 6. Forest Plot of Overweight as a Risk Factor for Postmenopausal Breast Cancer

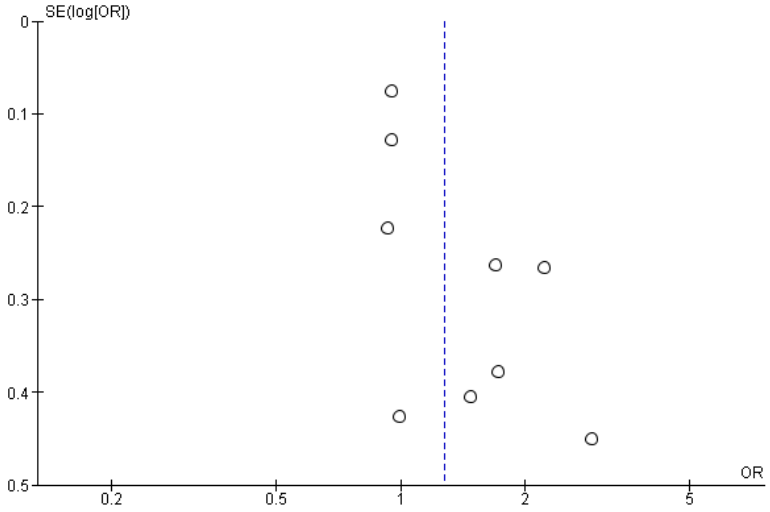

Figure 7. Funnel Plot Overweight as a Risk Factor for Postmenopausal Breast Cancer

4. Obesity as a Risk Factor for Postmenopausal Breast Cancer

A total of 11 articles were included in the meta-analysis. The funnel plot (Figure 8) showed that obese women were 1.52 times more likely to develop postmenopausal breast cancer compared to women with normal BMI and were statistically significant (aOR = 1.52; 95% CI= 1.17 to 1.98; p= 0.002). The heterogeneity of the research data shows I^2 = 76% so that the distribution of the data is declared heterogeneous (random effect model). Figure 9 shows a funnel plot which indicates that there is a publication bias in this study which is known from the asymmetric distribution of the plots. The estimated effect size in obese women on the risk of premenopausal breast cancer exceeds the actual effect size (overestimate).

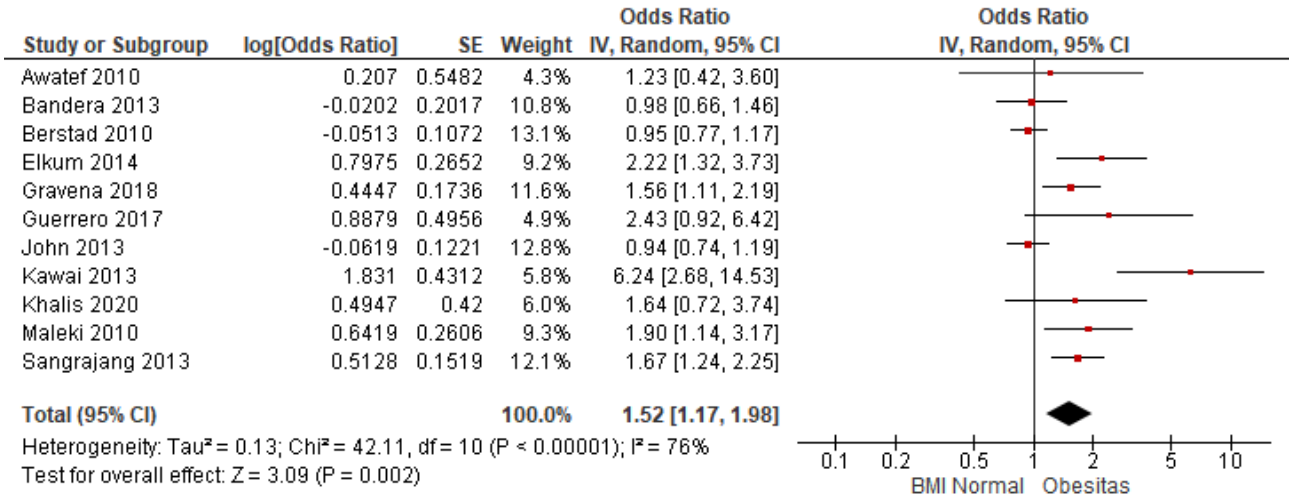

Figure 8. Forest Plot of Obesity as a Risk Facto for Postmenopausal Breast Cancer

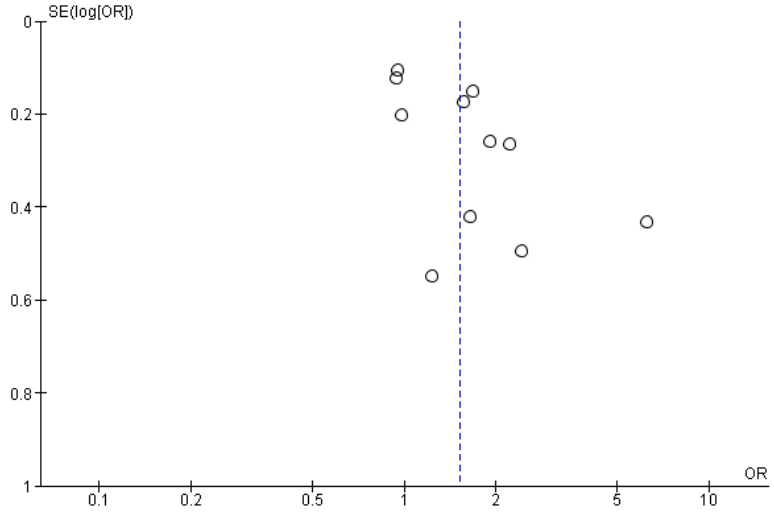

Figure 9. Funnel Plot of Obesity as a Risk Factor for Postmenopausal Breast Cancer

DISCUSSION

This study shows the results that there is a positive relationship between overweight and obesity with the risk of premenopausal and postmenopausal breast cancer, both of which are at risk of increasing the incidence of both premenopausal and postmenopausal breasts.

Based on the results, overweight women have a 1.28 times risk of developing postmenopausal breast cancer compared to women with a normal body mass index. These results are supported by Wada et al. (2014), Sarkissyan et al. (2011) and Chen et al. (2016) which states that being overweight increases the risk of postmenopausal breast cancer and is statistically significant. This study also states that obese women are 1.52 times more likely to develop postmenopausal breast cancer compared to women with a normal body mass index. These results are in line with Chen et al. (2016), Wang et al. (2016) and Sarkissyan et al. (2011) which states that there is an increased risk of breast cancer in women with a large body mass index (obesity).

This study also showed that there was a positive relationship between overweight and obesity and the risk of premenopausal breast cancer, but it was not statistically significant. Overweight women have a 1.35 times risk of developing premenopausal breast cancer compared to women with a normal body mass index. These results are in line with several studies related to the relationship between overweight and the risk of premenopausal breast cancer, where the risk of breast cancer incidence increases with the increase in body mass index (Chen et al., 2016; Wada et al., 2014). Meanwhile, obese women have a 1.27 times risk of developing premenopausal breast cancer compared to women with a normal body mass index.

1. Overweight as a Risk Factor for Premenopausal Breast Cancer

The results of this study are supported by a systematic review and meta-analysis conducted by Nindrea et al. (2019) in 15 research articles with the aim of determining the association of overweight and obesity with breast cancer during the premenopausal period in Asian women. The results showed that overweight women were 1.17 times more likely to develop premenopausal breast cancer compared to normal weight women (aOR= 1.17; 95% CI= 1.10 to 1.25; p<0.001).

The cross-sectional study conducted by Taleban et al. (2019) which aims to evaluate the relationship between anthropometric indices and breast cancer in Iranian women. The study found that overweight women were 1.01 times more likely to develop premenopausal breast cancer compared to normal weight women (OR= 1.01; 95% CI: 0.71 to 1.41).

In contrast to other meta-analytical studies conducted by Suzuki et al. (2009) to assess the effect of body mass index on breast cancer risk by taking mention that being overweight during the premenopausal period will reduce breast cancer risk (OR = 0.80; 95% CI = 0.70 to 0.92).

Some premenopausal women who are overweight may experience irregular ovulation leading to irregular menstrual cycles. This has the potential to reduce levels of estrogen and progesterone, where both hormones play an important role in increasing the proliferation of breast cancer cells (Rashid et al., 2020).

2. Obesity as a risk factor for premenopausal breast cancer

The results of this study are supported by a systematic review and meta-analysis conducted by (Nindrea et al., 2019) on 15 research articles with the aim of determining the association of overweight and obesity with breast cancer during the premenopausal period in Asian women. The results showed that obese women had a 1.36 times risk of developing premenopausal breast cancer compared to women with normal weight (aOR= 1.36; 95% CI= 1.26 to 1.47; p<0.001).

In line with Wang et al. (2016), which aims to determine the characteristics and risk factors of Chinese women's breast cancer stratified by menopausal status, showed that obese women have a 1.82 times risk of developing premenopausal breast cancer compared to women who have a normal body mass index and statistically significant (OR= 1.82; 95% CI=1.33 to 2.50; p= 0.002).

Obese premenopausal women have lower estrogen levels because of estrogen storage in adipose tissue, decreased ovarian activity, and frequent anovulatory cycles. General obesity is considered a protection for breast cancer in premenopausal women (Pacholczak et al., 2016).

The more frequent anovulatory cycles among obese premenopausal women and the faster clearance of free estrogen in the liver among obese women than among lean women, may lead to lower levels of estrogen and progesterone (Suzuki et al., 2009).

Body mass index in young women is a protective factor for breast cancer because of the higher prevalence of menstrual irregularities or ovulatory cycles in women with high BMI and therefore lower exposure to ovarian sex steroids. Obese premenopausal women have a higher number of anovulatory cycles, which results in decreased levels of estradiol and progesterone, thereby reducing the risk of breast cancer (Rowland et al., 2002).

3. Overweight as a risk factor for postmenopausal breast cancer

The results of this study are supported by Park et al. (2021) showed that in postmenopausal women, the risk of breast cancer increases with the increase in body mass index. Breast cancer risk increased linearly in overweight (aHR= 1.11; 95% CI= 1.08 to 1.14).

A similar meta-analysis on the effect of body mass index on breast cancer risk was conducted by Suzuki et al. (2009), stated that there was an increased risk of breast cancer during the postmenopausal period (OR=1.89; 95% CI=1.52 to 2.36).

Sarkissyan et al. (2011), examined the relationship between obesity and breast cancer using a cross-sectional study design on 471 African-American women. The results showed that overweight women were 2.3

times more likely to develop prostate cancer than normal weight women and were statistically significant (OR=2.3; 95% CI=1.1 to 5.1; p= 0.030).

In contrast to Wang et al. (2016) in their study which aims to determine the characteristics and risk factors of Chinese women's breast cancer stratified by menopausal status, reported that overweight women had a 0.89 times lower incidence of postmenopausal breast cancer compared to women who had a normal body mass index, but not significantly. statistics (OR=0.89; 95% CI=0.67 to 1.17; p= 0.400).

In overweight women, androstendione and testosterone are aromatized to estrogen in adipose tissue, which then causes an increase in estrogen levels. In addition, high levels of leptin in overweight women compared to normal weight women are also known to increase estrogen levels. These factors cumulatively affect the risk of overweight postmenopausal women to develop breast cancer (Morris et al., 2011).

4. Obesity as a risk factor for postmenopausal breast cancer

The results of this study are in line with the research of Park et al. (2021) which aims to examine the relationship between obesity and body mass index (BMI) according to menopausal status. The results of this study indicate that in postmenopausal women, the risk of breast cancer increases with the increase in body mass index. Breast cancer risk increased linearly in obese women (aHR=1.28; 95% CI=1.25 to 1.2).

In line with these studies, Wang et al. (2016) in his research which aims to determine the characteristics and risk factors of Chinese women's breast cancer stratified by menopausal status, suggested that obese women have a 1.09 times risk of experiencing postmenopausal breast cancer compared to women with a normal body mass index (OR= 1.09; 95% CI=0.76 to 1.57).

Obesity has an effect on estrogen among postmenopausal women which is explained by the shift in the main source of endogenous estrogen after menopause, where excess adipose tissue after menopause can increase endogenous estrogen production from aromatization of androgens in peripheral adipose tissue (Suzuki et al., 2009). Obesity increases the risk of developing breast cancer after menopause and it has even been estimated that 50% of postmenopausal breast cancer is caused by obesity (Brown and Simpson, 2014).

The association of breast cancer and obesity in postmenopausal women may also be influenced by the decrease in physical activity observed in older women (>50 years). Recent studies suggest exercise may be beneficial for reducing cancer risk. Postmenopausal women who exercised moderately had lower levels of insulin, glucose, and insulin-like growth factor-1 (IGF-I). Insulin and IGF-I are able to function in a mitogenic capacity by promoting cell growth, therefore, decreasing insulin and IGF-I levels is a beneficial protective measure against cancer (Irwin et al., 2010).

AUTHORS CONTRIBUTION

Shofia Nur Fadhila is the main researcher who selects the topic, searches for and collects research data. Bhisma Murti and Vitri Widyaningsih analyzed data and reviewed research documents.

FUNDING DAN SPONSORSHIP

This study is self-funded.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

ACKNOWLEDGMENT

Thanks go to database providers PubMed, Google Scholar, SpringerLink and Science Direct.

REFERENCES

Arcidiacono B, Iiritano S, Nocera A, Possidente K, Nevolo MT, Ventura V, Foti D, Chiefari E and Brunetti A (2012). Insulin resistance and cancer risk: An overview of the pathogenetic mechanisms. Exp. Diabetes Res., 2012. doi: 10.1155/2012/789174.

CEBMa (2014). Critical Appraisal for Case Control Study. Amsterdam.

Brown KA and Simpson ER (2014). Obesity and breast cancer: The role of dysregulated estrogen metabolism. Obes. Breast Cancer Role Dysregulated Estrogen Metab. 1–56. doi: 10.1007-/978-1-4899-8002-1.

Friedenreich CM (2001). Review of anthropometric factors and breast cancer risk. Eur. J. Cancer Prev., 10(1): 15–32. doi: 10.1097/00008469-200102000-000-03.

Howell A, Anderson AS, Clarke RB, Duffy SW, Evans DG, Garcia-Closas M, Gescher AJ, Key TJ, Saxton JM and Harvie MN (2014). Risk determination and prevention of breast cancer. Breast Cancer Res., 16(5): 1–19. doi: 10.1186/-s13058-014-0446-2.

Irwin ML, Varma K, Alvarez-reeves M, Cadmus L, Wiley A, Chung GG, Dipietro L, Mayne ST, Yu H and Haven N (2010). NIH Public Access, (203): 1–16. doi: 10.1158/1055-9965.EPI-08-0531.Randomized.

Iyengar NM, Hudis CA and Dannenberg AJ (2013). Obesity and Inflammation: New Insights into Breast Cancer Development and Progression. Am. Soc. Clin. Oncol. Educ. B. 33: 46–51. doi: 10.120-0/edbook_am.2013.33.46.

Kamińska M, Ciszewski T, Łopacka-Szatan K, Miotła P and Starosławska E (2015). Breast cancer risk factors. Prz. Menopauzalny, 14(3): 196–202. doi: 10.5114/-pm.2015.54346.

Morris PG, Hudis CA, Giri D, Morrow M, Falcone DJ, Zhou XK, Du B, Brogi E, Crawford CB, Kopelovich L, Dannenberg AJ and Subbaramaiah K (2011). Breast Tissue of Obese Women With Breast Cancer. Cancer Prev. Res. (Phila). 4(7): 1021–9. doi: 10.1158/1940-6207.CAPR-11-0110.Inflammation.

Nindrea R, Aryandono T, Lazuardi L and Dwiprahasto I (2019). Association of overweight and obesity with breast cancer during premenopausal period in Asia: A meta-analysis. Int. J. Prev. Med. 10(1): 192. doi: 10.4103/IJPVM.-IJPVM_372_18.

Pacholczak R, Klimek-Piotrowska W and Kuszmiersz P (2016). Associations of anthropometric measures on breast cancer risk in pre- and postmenopausal women-a case-control study. J. Physiol. Anthropol. 35(1). doi: 10.1186/S40101-016-0090-X.

Park JW, Han K, Shin DW, Yeo Y, Chang JW, Yoo JE, Jeong SM, Lee SK, Ryu JM and Park YM (2021). Obesity and breast cancer risk for pre- and postmenopausal women among over 6 million Korean women. Breast Cancer Res. Treat. 185(2): 495–506. doi: 10.1007/-s10549-020-05952-4.

Picon-Ruiz M, Morata-Tarifa C, Valle-Goffin JJ, Friedman ER and Slingerland JM (2017). Obesity and adverse breast cancer risk and outcome: Mechanistic insights and strategies for intervention. CA. Cancer J. Clin., 67(5): 378–397. doi: 10.3322/CAAC.21405.

Rashid FA, Alhashemi WKH, Al-Saffar AT, Salman EA and Najeeb DA (2020). Obesity and breast cancer risk in different menopausal status: A review. Biochem. Cell. Arch., 20(1): 1875–1878. doi: 10.35124/bca.2020.20.1.1875.

Rojas K and Stuckey A (2016). Breast Cancer Epidemiology and Risk Factors. Clin.

Obstet. Gynecol., 59(4): 651–672. doi: 10.1097/GRF.0000000000000239.

Rowland AS, Baird DD, Long S, Wegienka G, Harlow SD, Alavanja M and Sandler DP (2002). Influence of medical conditions and lifestyle factors on the menstrual cycle. Epidemiology, 13(6): 668–674. doi: 10.1097/00001648-200211000-00011.

Sarkissyan M, Wu Y and Vadgama J V. (2011). Obesity is associated with breast cancer in African-American women but not Hispanic women in South Los Angeles. Cancer, 117(16): 3814–3823. doi: 10.1002/cncr.25956.

Siegel RL, Miller KD and Jemal A (2020). Cancer statistics, 2020. CA. Cancer J. Clin. 70(1): 7–30. doi: 10.3322/caac.-21590.

Suzuki R, Orsini N, Saji S, Key TJ and Wolk A (2009). Body weight and incidence of breast cancer defined by estrogen and progesterone receptor status-A meta-analysis. Int. J. Cancer. 124(3): 698–712. doi: 10.1002/ijc.23943.

Taleban R, Sirous R, Sirous M, Razavi S, Taghvaei R, Sirous S, Khalighinejad F, Dehghani Firouzabadi A, Qobadi M, Dehghani Firouzabadi F, Moafi M, Zand K and Farajzadegan Z (2019). The Relationship between Anthropometric Indices and Breast Cancer in Central Iran. Nutr. Cancer, 71(8): 1276–1282. doi: 10.1080/01635581.2019.1604005.

Wada K, Nagata C, Tamakoshi A, Matsuo K, Oze I, Wakai K, Tsuji I, Sugawara Y, Mizoue T, Tanaka K, Iwasaki M, Inoue M, Tsugane S and Sasazuki S (2014). Body mass index and breast cancer risk in Japan: A pooled analysis of eight population-based cohort studies. Ann. Oncol. 25(2): 519–524. doi: 10.1093-/ANNONC/MDT542.

Wang Xin, Li L, Gao J, Liu J, Guo M, Liu L, Wang W, Wang J, Xing Z, Yu Z and Wang Xiang (2016). The Association Between Body Size and Breast Cancer in Han Women in Northern and Eastern China. Oncologist, 21(11): 1362–1368. doi: 10.1634/THEONCOLOGIST-.2016-0147.

World Health Organisation (2018). Latest global cancer data : Cancer burden rises to 18. 1 million new cases and 9. 6 million cancer deaths in 2018 Latest global cancer data : Int. Agency Res. Cancer, (September): 13–15.