



## SYSTEMATIC REVIEW

# Investigating the relationship between breast cancer and the postmenopausal period: a systematic meta-analysis

Mehmet Kivrak<sup>1,\*</sup> , Demet Nak<sup>2</sup> 

<sup>1</sup>Department of Biostatistics and Medical Informatics, Recep Tayyip Erdogan University Faculty of Medicine, 53100 Rize, Turkey

<sup>2</sup>Department of Nuclear Medicine, Recep Tayyip Erdogan University Training and Research Hospital, 53100 Rize, Turkey

**\*Correspondence**

mehmet.kivrak@erdogan.edu.tr  
(Mehmet Kivrak)

**Abstract**

One possible explanation for the ongoing debate surrounding breast cancer risk factors is that differences in assessment methodologies lead to conflicting results. One way to address methodological differences in assessment between studies is to use a single standardized assessment to calibrate cancer studies. To achieve this goal, we conducted a meta-analysis, integrating findings from various studies that utilized menopause risk factors in the evaluation of breast cancer cases. We conducted a systematic literature review from 2010 to 2023 and included studies that examined the association between the postmenopausal period and breast cancer. Among the results, we found statistically significant evidence that the postmenopausal period has a positive association with breast cancer. We identified and carefully reviewed 49 articles considered relevant in the literature review and 12 met all of our inclusion and exclusion criteria. The intercept value was 0.768 (positive), indicating a significant degree of heterogeneity between the studies. The standard error (0.209) suggests that the effect size estimation is more precise and reliable across studies. The observed log odds ratios ranged from -0.1716 to 2.0202, with the majority of estimates being positive (92%). The estimated average log odds ratio based on the random-effects model was 0.7679 (95% Confidence Interval (CI): 0.3590 to 1.1768). Therefore, the average outcome significantly differed from zero ( $z = 3.6809$ ,  $p < 0.001$ ). Kendall's Tau value was 0.455, and the  $p$ -value was 0.045, indicating a positive, statistically significant and moderate relationship between breast cancer and the postmenopausal period. The results obtained in this study carry significant implications for shaping public health policies and breast cancer screening programs. Understanding breast cancer cases in the postmenopausal period holds substantial importance in devising tailored treatment strategies. These findings can provide valuable insights for the enhancement of clinical practice, allowing for more effective and individualized treatment approaches.

**Keywords**

Postmenopausal period; Breast cancer; Systematic meta-analysis

## 1. Introduction

Breast cancer stands as one of the most prevalent types of cancer among women worldwide, representing a substantial public health concern [1]. Breast cancer is a disease that arises as a result of the complex interplay of various factors, including age, genetic predisposition, hormonal changes and lifestyle factors. Many of these factors vary in postmenopausal women [2]. The risk and progression of breast cancer are influenced by a multitude of factors, making it a complex process. Notably, the postmenopausal period plays a crucial role in this intricate equation. Extensive research on the risk of breast cancer during the postmenopausal years has garnered significant attention in the scientific community over many years. This period, characterized by postmenopause, marks a

vital transitional phase in women's lives. The postmenopausal phase has been associated with a potential increase in breast cancer risk, primarily attributed to shifts in hormone levels and age-related factors [3]. While numerous epidemiological studies suggest that the postmenopausal period may increase the risk of breast cancer, the findings in this area are often inconclusive. For instance, Smith *et al.* [4] proposed that postmenopausal hormonal changes are linked to an increased risk of breast cancer. However, Huang and his team emphasized the complexity of the postmenopausal period's effect on breast cancer risk, with lifestyle factors also playing a significant role [5]. The postmenopausal phase is characterized by hormonal changes, which can influence breast cancer risk. Specifically, a decrease in estrogen hormone levels tends to reduce the risk of breast cancer, suggesting that the post-menopausal period may

be a factor that lowers the risk of breast cancer [6]. To gain a comprehensive understanding of the relationship between breast cancer and the postmenopausal period and to determine the impact of menopause on breast cancer, it is imperative to conduct a thorough review of existing literature and further explore the intricacies of this relationship. These studies can contribute to a more nuanced comprehension of breast cancer risk and help guide women during this transitional phase of life.

This study aimed to consolidate and clarify the relationship between postmenopausal periods and breast cancer through new meta-analysis findings.

## 2. Methods

### 2.1 Literature review

First, keywords such as “breast cancer”, “postmenopausal period”, “relationship”, “correlation” and “risk factors” were selected. Subsequently, PubMed (MEDLINE) and Web of Science database search engines were chosen. The combined keywords using Boolean operators were as follows: (“Breast cancer” OR “Mammarian carcinoma” OR “Breast neoplasms”) AND (“Postmenopausal period” OR “Postmenopausal phase”) AND (“Correlation” OR “Relation”) AND (“Risk” OR “Risk factors”). Original research articles in English published between 2010 and 2023 were included. Additionally, references in the identified papers were reviewed, and those meeting the search criteria were added. The reference lists of retrieved papers were screened, and papers that potentially met the inclusion criteria were retrieved and analyzed. This study relates to data from America, China, India, Brazil, Pakistan, Taiwan and South Korea regions.

### 2.2 Selection criteria

We included original studies that specifically related breast cancer in the postmenopausal period. We applied the following inclusion criteria: (a) original research; (b) use operational definition of subthreshold breast cancer symptoms; (c) subjects are limited to post-menopausal specimens (>45 years); (d) functional results were evaluated and results reported; (e) articles are written in English. Articles were excluded if (a) there was a review or opinion, or (b) the study was not available in English or was not available through PubMed and Web of Science (WOS). A clinician and an associate professor scanned all articles for relevance by reviewing the abstracts and assessing their relevance by identifying relevant articles as full text.

### 2.3 Analytic approach

In the etiology of breast cancer, the relationship between the postmenopausal period and the disease was examined. The analysis was carried out using the log risk ratio as the outcome measure. A random-effects model was fitted to the data. The amount of heterogeneity (*i.e.*,  $\tau^2$ ), was estimated using the maximum-likelihood estimator [7]. In addition to the estimate of  $\tau^2$ , the Q-test for heterogeneity [8] and the  $I^2$  statistic are reported. In case any amount of heterogeneity

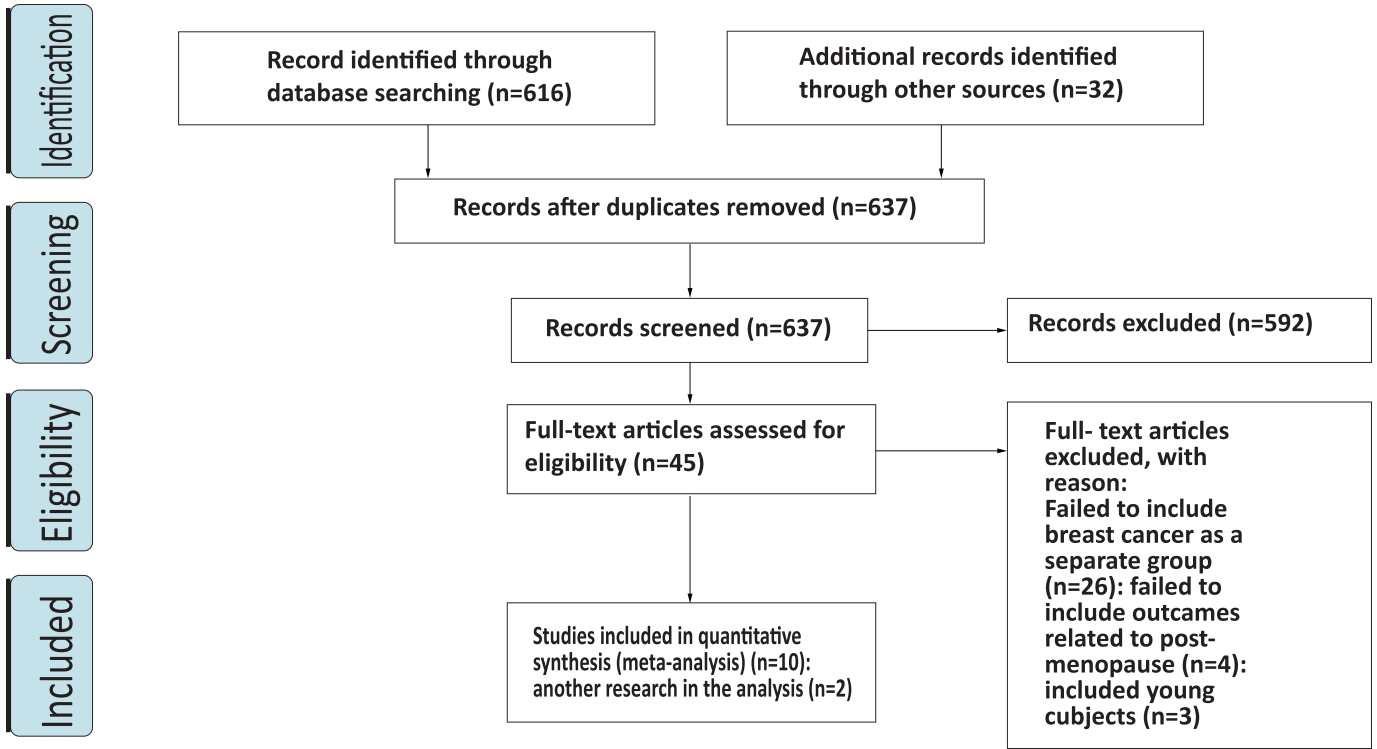
is detected (*i.e.*,  $\tau^2 > 0$ , regardless of the results of the Q-test), a prediction interval for the true outcomes is also provided. Studentized residuals and Cook’s distances are used to examine whether studies may be outliers and/or influential in the context of the model. Studies with a studentized residual larger than the  $100 \times (1 - 0.05/(2 \times k))$ th percentile of a standard normal distribution are considered potential outliers (*i.e.*, using a Bonferroni correction with two-sided  $\alpha = 0.05$  for  $k$  studies included in the meta analysis). Studies with a Cook’s distance larger than the median plus six times the interquartile range of the Cook’s distances are considered to be influential. The rank correlation test and the regression test, using the standard error of the observed outcomes as predictor, are used to check for funnel plot asymmetry. The random effect model is a type of statistical model used in meta-analysis and takes into account heterogeneity between studies. Heterogeneity refers to the situation where the results of different studies show random variations. The random effect model takes into account this random variation between studies and helps to interpret the results in a more general way. Using a random effect model attempts to achieve a broader result, taking into account heterogeneity between studies. All analyses were implemented in Jamovi 2.4.6 [9–11].

### 2.4 PICOT

PICOT is a methodological framework frequently used in identifying clinical questions and research topics and in the design of clinical trials [12]. In the study, P (Population): Breast cancer patients in the postmenopausal period, I (Intervention/Exposure): The effect of the postmenopausal period on the risk of breast cancer, C (Comparison/Control): Breast cancer patients in the pre-menopausal period or the non-intervention group, O (Outcome): The relationship between breast cancer and post-menopausal period, T (Time): Refers to studies between 2010 and 2023.

## 3. Result

As demonstrated in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram (Fig. 1), 45 articles that were considered relevant in the literature review were identified and thoroughly examined. Out of these 45 articles, only 10 met all of our inclusion and exclusion criteria. In meta-analyses, the intercept of the random effects model provides important statistical information regarding the results of the meta-analysis and the heterogeneity between studies. This heterogeneity suggests the need for further subgroup analyses to understand the complexity of this relationship. When initially conducting a systematic meta-analysis study, although the average result was estimated to be positive, in some studies, the actual result could actually be negative. Therefore, 2 articles obtained from different sources in accordance with predetermined criteria were included in the study ( $n = 2$ ). Studies were excluded for the following reasons: (a) they were unable to include sub-threshold breast cancer as a separate group with operationalized diagnostic criteria ( $n = 26$ ), (b) they couldn’t incorporate sub-threshold post-menopausal related outcomes ( $n = 4$ ), and (c) they included young subjects ( $n = 3$ ).



**FIGURE 1. PRISMA Diagram.** Two articles obtained from different sources in accordance with predetermined criteria were included in the study.

A detailed breakdown is presented in the PRISMA Diagram in Fig. 1.

Each of the 12 studies identified in Table 1 includes information about the author's name, study year, subject's name, sample source (such as clinic or society), study type, number of incidents in the experimental and control groups, and the country.

### 3.1 Meta-analysis results

The intercept for the random effect model in meta-analyses provides important statistical information regarding the results of the meta-analysis and heterogeneity between studies. While intercept expresses the estimated effect size of studies, it also reflects heterogeneity. Intercept value = 0.768 (positive), indicating important degree of heterogeneity between studies. That is, the results of the studies differ from each other, and some of these differences are due to random variation. The standard error (0.209) indicates that the effect size estimation is more precise and reliable across studies. The observed log odds ratios ranged from  $-0.1716$  to  $2.0202$ , with the majority of estimates being positive (92%). The estimated average log odds ratio based on the random-effects model was  $0.7679$  (95% CI:  $0.3590$  to  $1.1768$ ). Therefore, the average outcome differed significantly from zero ( $z = 3.6809$ ,  $p \leq 0.001$ ) in Table 2.

According to the Q-test in Table 2, the true outcomes appear to be heterogeneous ( $Q(11) = 150.1792$ ,  $p < 0.0001$ ,  $\tau^2 = 0.4567$ ,  $I^2 = 95.5111\%$ ). A 95% prediction interval for the true outcomes is given by  $-0.6184$  to  $2.1542$ . Hence, although the average outcome is estimated to be positive, in some studies the true outcome may in fact be negative. An examination of the studentized residuals revealed that none of the studies had a

value larger than  $\pm 2.8653$  and hence there was no indication of outliers in the context of this model. According to the Cook's distances, none of the studies could be considered to be overly influential. Both the rank correlation and the regression test indicated potential funnel plot asymmetry ( $p = 0.0447$  and  $p = 0.0184$ , respectively).

In this case, the results of the studies are closer to each other and the level of heterogeneity is low. A total of  $k = 12$  studies were included in the analysis.

The forest graph for 12 studies, which were considered within the framework of the research criteria, is shown in Fig. 2. In this figure, the effect size for the relationship between breast cancer and the post-menopausal period, which each investigator considers separately, can be reached at the lower and upper limits of the effect size at the 95% confidence interval. For example, in the study of Yang *et al.* [19] (2022), the estimated effect size was found to be 2.02. This may indicate a high positive association between breast cancer and the postmenopausal period. In addition, the confidence interval for this relationship was specified as (1.61, 2.43). Similarly in the study of Liu *et al.* [14] (2022), the estimated effect size was found to be 0.25. This may indicate a slight positive association between breast cancer and the postmenopausal period. This indicates that the estimate is uncertain and that this dietary habit has the potential to reduce or increase breast cancer risk, but more research is needed to draw a firm conclusion. If we look at another example, the effect size was found to be 0.46 in the study of Xue *et al.* [13] (2021). Similarly, this may indicate a slight positive association between breast cancer and this particular dietary habit. However,  $(-0.26, 1.17)$  may show that the result of the analysis is not statistically significant and the reliability of the

**TABLE 1. Summary of studies included in meta-analysis and qualitative review.**

Author	Names of Subject	Sample	Type of study	NIEG	NICG	Country
Included in meta-analysis		Clinical	Case-control	25	42	China
Xue, H <i>et al.</i> [13] (2021)						
	Total Experimental sample size: 45					
	Total control sample size: 95					
Liu, L <i>et al.</i> [14] (2022)						
	Total Experimental sample size: 925	Clinical	Methodological	309	260	China
	Total control sample size: 923	Database	Case-control			
Paleari, RG <i>et al.</i> [15] (2011)						
	Total Experimental sample size: 134	Community	Cross-sectional	89	45	Brazil
	Total control sample size: 129	Clinical				
Campbell Jenkins, BW <i>et al.</i> [16] (2011)						
	Total Experimental sample size: 37	Community	Prospective	35	2323	America
	Total control sample size: 3165		Cohort			
Sankar, V <i>et al.</i> [17] (2022)						
	Total Experimental sample size: 130	Clinical	Case-control	88	57	India
	Total control sample size: 130					
Fatima, N <i>et al.</i> [18] (2010)						
	Total Experimental sample size: 181	Clinical	Prospective	88	212	Pakistan
	Total control sample size: 858		Comparative			
Yang, PC <i>et al.</i> [19] (2022)						
	Total Experimental sample size: 644	Clinical	Retrospective	536	52	Taiwan
	Total control sample size: 131		Cohort			
Javed, S <i>et al.</i> [20] (2011)						
	Total Experimental sample size: 100	Clinical	Cross-sectional	49	16	Pakistan
	Total control sample size: 100					
Oh, H <i>et al.</i> [21] (2016)						
	Total Experimental sample size: 310	Clinical	Cross-sectional	113	157	India
	Total control sample size: 552	Database				
Wang, X <i>et al.</i> [22] (2016)						
	Total Experimental sample size: 1400	Clinical	Case-control	465	402	China
	Total control sample size: 1400	Database				
Cho, YA <i>et al.</i> [23] (2010)						
	Total Experimental sample size: 358	Clinical	Cross-sectional	148	164	Korea
	Total control sample size: 360	Community				
Dibaba, DT <i>et al.</i> [24] (2018)						
	Total Experimental sample size: 5380	Clinical	Case-control	5174	85,488	America
	Total control sample size: 89,175	Database				

*NIEG: Number of incidents in experimental group; NICG: Number of incidents in control group.*

TABLE 2. Heterogeneity statistics of the study.

	Estimate	se	$z$	$p$	CI Lower	CI Upper	
Intercept	0.768	0.209	3.680	<0.001	0.359	1.177	
	Tau	Tau <sup>2</sup>	$I^2$	H <sup>2</sup>	$df$	Q	$p$
	0.676	0.457	95.510 (%)	22.277	11	150.179	<0.001

CI: Confidence Interval.

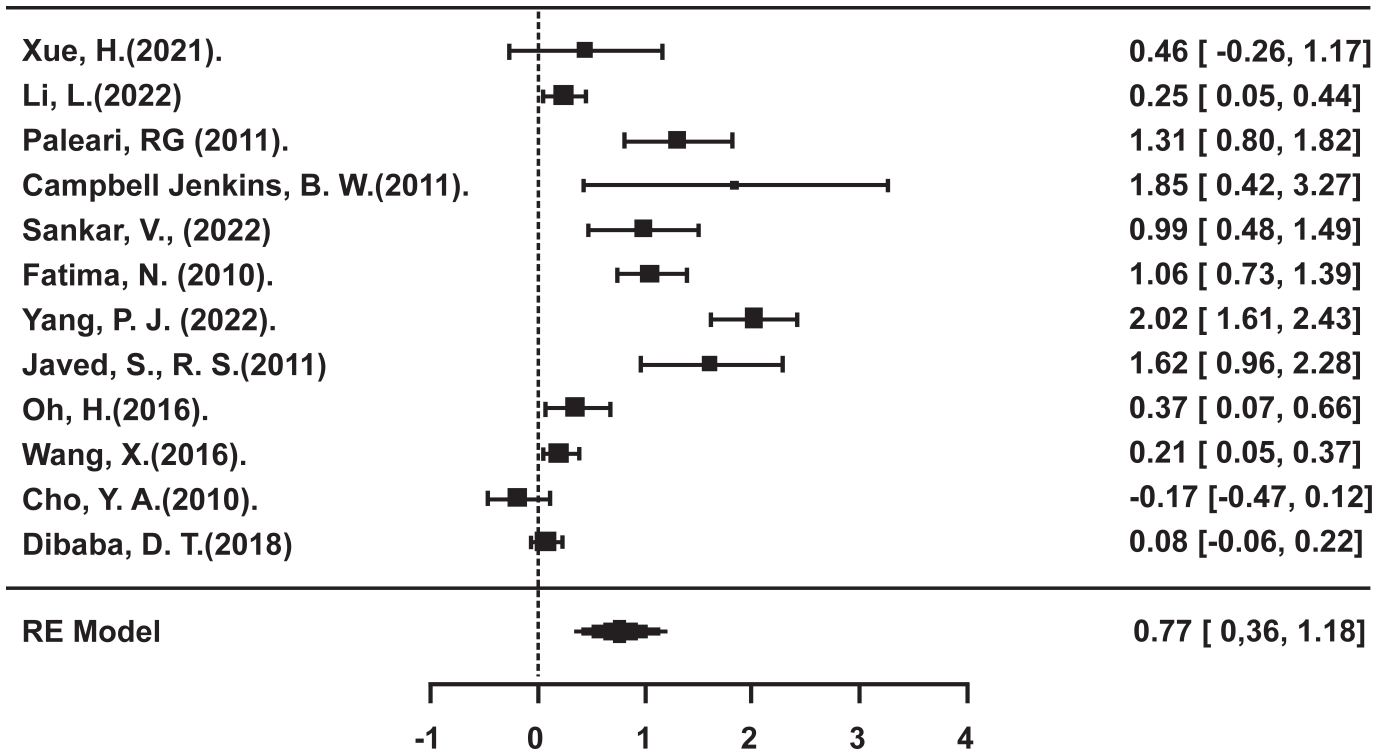


FIGURE 2. Forest plot for breast cancer and the postmenopausal period. RE: Random Effects.

result is low, since the confidence interval values contain zero.

Kendall's Tau value was 0.455 and  $p$ -value was 0.045, so it can be said that the relationship between breast cancer and postmenopausal period is positive, statistically significant and moderate (Table 3).

TABLE 3. Rank correlation test for funnel plot asymmetry.

Kendall's Tau	$p$
0.455	0.045

### 3.2 Publication bias findings

In a meta-analysis study, the researcher states only the studies with statistically significant results; however, intentionally or deliberately hiding or not stating the results that are not statistically significant will cause the effect size to be obtained as a result of the meta-analysis to be larger or smaller than it should be.

In Fig. 3, Examining the statistically significant ones, and eliminating the insignificant ones and not taking them into account, reveals the danger that all the studies done in that field cannot be represented [25]. Such a situation may cause

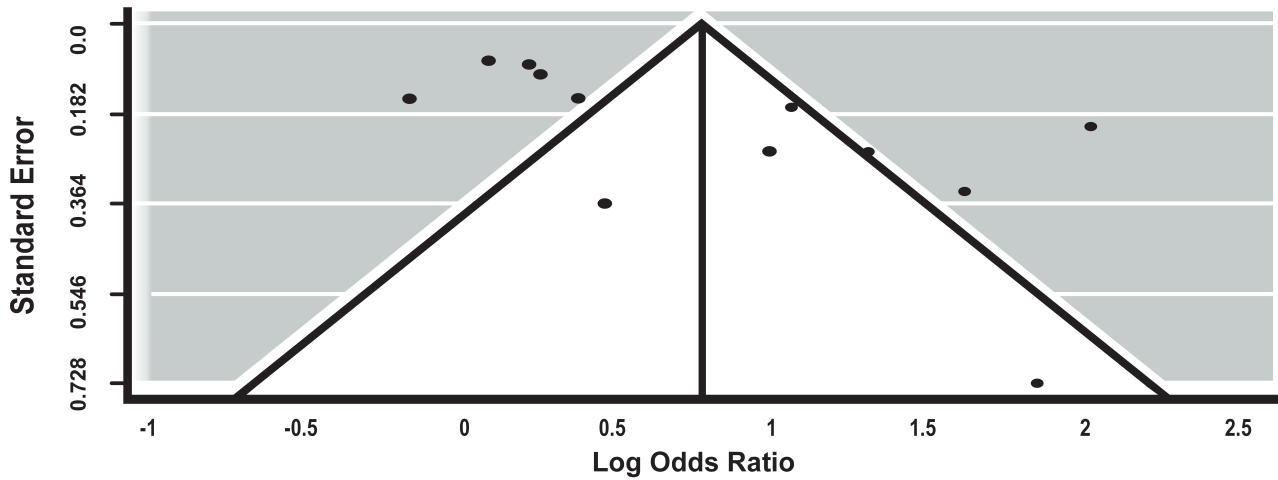
publication bias. Publication bias can be tested using the funnel scatterplot and the Classic fail-safe N statistic. As seen in the graph, almost all of the 12 studies included in the study are at the top of the graph. According to graph, a slow-level image of publication bias can be said. In the classic fail-safe N statistic, the power of the study and the number of studies that must be included in the analysis for the  $p$  value to be greater than the alpha value can be learned. The number of additional studies required for the  $p$  value to be greater than 0.05 is 605.

### 4. Discussion

The postmenopausal period is characterized by significant changes in hormone levels as a natural part of women's aging process. In particular, a decrease in estrogen levels has been associated with breast cancer risk [26]. It has been postulated that this decrease may lead to structural and hormonal changes in breast tissue during the postmenopausal period [27]. However, the results of research on this topic in the literature are quite contradictory.

More research on this topic is needed because breast cancer is a significant threat to women's health. It is important for postmenopausal women to understand this risk and take precautions when necessary. For example, some epidemiological studies have found a strong link that postmenopause





#### Fail-Safe N Analysis (File Drawer Analysis)

Fail-Safe N	$p$
605	<0.001

**FIGURE 3. Funnel scatterplot for publication bias.**

may increase the risk of breast cancer [28]. However, other studies suggest that this relationship is complex and not fully understood [29]. These conflicting results reflect the complexity of understanding the relationship between postmenopause and breast cancer.

In a study investigating the relationship between breast cancer and the postmenopausal period, based on the results of a meta-analysis conducted with 12 original articles, the intercept estimate is 0.768, RE (Random Effects) is 0.77, and Kendall's Tau is 0.45. The obtained results from the meta-analysis provide significant insights for evaluating the association between postmenopause and breast cancer. These results indicate that there is heterogeneity among the study samples when utilizing the random effects model, suggesting that the relationship between postmenopause and breast cancer may vary in different subgroups. This heterogeneity suggests the necessity of further subgroup analyses to comprehend the complexity of this relationship. Similarly, the articles in the study seem to be in agreement with each other, possibly implying that postmenopausal women may be at an increased risk of breast cancer. This underscores the need for additional research and the importance of breast cancer screening programs for this age group.

The results obtained are crucial for shaping public health policies and breast cancer screening programs. Postmenopausal women may require additional information and resources to comprehend and mitigate their risk of breast cancer. Furthermore, breast cancer cases during the postmenopausal period are significant in determining treatment strategies. These findings can inform clinical practice by enabling more effective personalization and direction of treatment approaches.

In conclusion, this meta-analysis study has made a significant contribution both in the realm of scientific research and clinical practice by scientifically establishing the connection between postmenopause and breast cancer. These findings hold importance in guiding breast cancer research and shaping healthcare policies. Future research endeavors may delve more deeply into this relationship to further elucidate risk factors and protective measures.

#### AVAILABILITY OF DATA AND MATERIALS

The datasets generated and analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

#### AUTHOR CONTRIBUTIONS

MK, DN—conceptualization, resources, supervision; formal analysis; investigation; methodology, software, visualization; writing-original draft; writing-review & editing; MK—data curation; project administration; validation.

#### ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

#### ACKNOWLEDGMENT

Not applicable.

## FUNDING

This research received no external funding.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## REFERENCES

- [1] Rozenberg S, Di Pietrantonio V, Vandromme J, Gilles C. Menopausal hormone therapy and breast cancer risk. *Best Practice & Research Clinical Endocrinology & Metabolism*. 2021; 35: 101577.
- [2] Cabasag CJ, Vignat J, Ferlay J, Arndt V, Lemmens V, Praagman J, *et al*. The preventability of cancer in Europe: a quantitative assessment of avoidable cancer cases across 17 cancer sites and 38 countries in 2020. *European Journal of Cancer*. 2022; 177: 15–24.
- [3] Chlebowski RT, Anderson GL, Aragaki AK, Manson JE, Stefanick ML, Pan K, *et al*. Association of menopausal hormone therapy with breast cancer incidence and mortality during long-term follow-up of the women's health initiative randomized clinical trials. *JAMA*. 2020; 324: 369–380.
- [4] Smith T, Sahni S, Thacker HL. Postmenopausal hormone therapy—local and systemic: a pharmacologic perspective. *The Journal of Clinical Pharmacology*. 2020; 60: S74–S85.
- [5] Huang MC, Huang TT, Feng HC, Chen IC, Chang CI, Wang TN, *et al*. Lifestyle factors and energy intakes with risks of breast cancer among pre-and post-menopausal women in Taiwan. *Nutrients*. 2023; 15: 3900.
- [6] Chlebowski RT, Aragaki AK. The women's health initiative randomized trials of menopausal hormone therapy and breast cancer: findings in context. *Menopause*. 2023; 30: 454–461.
- [7] Hardy C. Understanding power: bringing about strategic change. *British Journal of Management*. 1996; 7: S3–S16.
- [8] Cochran WG. Some methods for strengthening the common  $\chi^2$  tests. *Biometrics*. 1954; 10: 417–451.
- [9] The jamovi project. jamovi. (Version 2.4) (Computer Software). 2023. Available at: <https://www.jamovi.org> (Accessed: 15 August 2023).
- [10] R Core Team. R: A Language and environment for statistical computing. (Version 4.1) (Computer software). 2022. Available at: <https://cran.r-project.org> (Accessed: 18 August 2022).
- [11] Viechtbauer W. Conducting meta-analyses in R with the metafor package. *Journal of Statistical Software*. Link. 2010; 36: 1–48.
- [12] Villegas JLV, Choque RAM. Defining a good research question using the PICOT and FINGER format. *Gaceta Médica Boliviana*. 2020; 43: DEFINING-A.
- [13] Xue H, Qiao R, Yan L, Yang S, Liang Y, Liu Y, *et al*. The correlation between potential “Anti-Cancer” trace elements and the risk of breast cancer: a case-control study in a Chinese population. *Frontiers in Oncology*. 2021; 11: 646534.
- [14] Liu L, Zhai W, Wang F, Yu L, Zhou F, Xiang Y, *et al*. Using machine learning to identify gene interaction networks associated with breast cancer. *BMC Cancer*. 2022; 22: 1070.
- [15] Paleari RG, Peres RM, Florentino JO, Heinrich JK, Bragança WO, del Valle JCT, *et al*. Reduced prevalence of the C825T polymorphism of the G-protein beta subunit gene in women with breast cancer. *The International Journal of Biological Markers*. 2011; 26: 234–240.
- [16] Campbell Jenkins BW, Addison C, Wilson G, Liu J, Fortune M, Robinson K, *et al*. Association of the joint effect of menopause and hormone replacement therapy and cancer in African American women: the Jackson heart study. *International Journal of Environmental Research and Public Health*. 2011; 8: 2491–2504.
- [17] Sankar V, Rama P, Mohammed S, John S, Sivakumar V, Rodrigues PA. Association of reproductive risk factors and comorbidities among molecular subtypes of breast cancer in a Tertiary care hospital. *Brazilian Journal of Pharmaceutical Sciences*. 2022; 58: e18816.
- [18] Fatima N, Zaman MU, Fatima T. Increased risk of breast cancer in multiparous and lactating women attending a breast care clinic in Pakistan: a paradigm shift. *Asian Pacific Journal of Cancer Prevention*. 2010; 11: 1219–1223.
- [19] Yang P, Hou M, Ou-Yang F, Tsai E, Wang T. Association of early-onset breast cancer with body mass index, menarche, and menopause in Taiwan. *BMC Cancer*. 2022; 22: 1–11.
- [20] Javed S, Ali M, Sadia S, Aslam MA, Masood AI, Shaikh RS, *et al*. Combined effect of menopause age and genotype on occurrence of breast cancer risk in Pakistani population. *Maturitas*. 2011; 69: 377–382.
- [21] Oh H, Bodelon C, Palakal M, Chatterjee N, Sherman ME, Linville L, *et al*. Ages at menarche- and menopause-related genetic variants in relation to terminal duct lobular unit involution in normal breast tissue. *Breast Cancer Research and Treatment*. 2016; 158: 341–350.
- [22] Wang X, Li L, Gao J, Liu J, Guo M, Liu L, *et al*. The association between body size and breast cancer in Han women in northern and Eastern China. *The Oncologist*. 2016; 21: 1362–1368.
- [23] Cho YA, Kim J, Park K, Lim S, Shin A, Sung M, *et al*. Effect of dietary soy intake on breast cancer risk according to menopause and hormone receptor status. *European Journal of Clinical Nutrition*. 2010; 64: 924–932.
- [24] Dibaba DT, Braithwaite D, Akinyemiju T. Metabolic syndrome and the risk of breast cancer and subtypes by race, menopause and BMI. *Cancers*. 2018; 10: 299.
- [25] Borenstein M, Cooper H, Hedges L, Valentine J. Effect sizes for continuous data. *The Handbook of Research Synthesis and Meta-Analysis*. 2009; 2: 221–235.
- [26] Key TJ, Balkwill A, Bradbury KE, Reeves GK, Kuan AS, Simpson RF, *et al*. Foods, macronutrients and breast cancer risk in postmenopausal women: a large UK cohort. *International Journal of Epidemiology*. 2019; 48: 489–500.
- [27] Yaghjian L, Colditz GA, Rosner B, Tamimi RM. Mammographic breast density and breast cancer risk: interactions of percent density, absolute dense, and non-dense areas with breast cancer risk factors. *Breast Cancer Research and Treatment*. 2015; 150: 181–189.
- [28] Zhu D, Chung H, Dobson AJ, Pandeya N, Giles GG, Bruinsma F, *et al*. Age at natural menopause and risk of incident cardiovascular disease: a pooled analysis of individual patient data. *The Lancet Public Health*. 2019; 4: e553–e564.
- [29] Rees M, Abernethy K, Bachmann G, Bretz S, Ceausu I, Durmusoglu F, *et al*. The essential menopause curriculum for healthcare professionals: a European Menopause and Andropause Society (EMAS) position statement. *Maturitas*. 2022; 158: 70–77.

**How to cite this article:** Mehmet Kivrak, Demet Nak. Investigating the relationship between breast cancer and the postmenopausal period: a systematic meta-analysis. *European Journal of Gynaecological Oncology*. 2024; 45(2): 1-7. doi: 10.22514/ejgo.2024.021.