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SMOKING BEHAVIOR AND THE INCIDENT OF OSTEOPOROSIS IN THE ELDERLY: META-ANALYSIS

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ABSTRACT

Osteoporosis is a metabolic bone illness which involves bone density loss and micro destruction, enabling bone to develop into fragile, porous, and readily shattered. There are both controllable and non-modifiable risk variables for osteoporosis. Smoking, drinking behavior, and numerous other modifiable variables are examples. The goal of this research is to identify the possibility of osteoporosis among senior smokers. Research purposes to determine the influence of smoking behavior and the incidence of osteoporosis The following PICO criteria are used in this systematic review and meta-analysis investigation: Population: The elderly are the majority of the population. Intervention: smoking. Comparison: not smoking. Outcome: Osteoporosis. The articles used in this research were obtained from three databases: Google Scholar, Pubmed, and Science Direct. Keywords to search for articles are "Obesity" AND "Preeclampsia" AND Multivariate AND Pregnancy. Over 2013 and 2023, articles were utilized. To choose articles, the PRISMA flow diagram has been used. The papers were evaluated using the Review Manager 5.3 instrument. Seven cohort studies in the country of the United States (America), Europeans (Bosnia and Herzegovina), China, Iran, and Korea are among the countries in Asia that have been included in the systematic review and meta-analysis.. In accordance to the cohort study's forest plot results, elderly smokers have a 1.30 times greater risk of osteoporosis than elderly nonsmokers (aOR= 1.30; 95% CI= 0.81 to 2.08), and the results of this study are statistically significant (p <0.001).

Keywords: elderly; osteoporosis; smoking

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INTRODUCTION

Osteoporosis is a degenerative illness that weakens bones by causing bone tissue to degrade faster than new cells are produced (Haas & LeBoff, 2018). Yusni and Rahman (2019) state that osteoporosis is a condition that cannot be recognized early. Osteoporosis is a serious health issue among the elderly which is characterized by low bone density and damage to the bone microstructure causing bones to become brittle, porous, and easily fractured (Widiyanto et al., 2023). This syndrome is caused by a lack of peak bone mass development throughout growth and a faster loss in bone mass following menopause in women as they enter old age (Nugraheni et al., 2021). The World Health Organization (WHO) ranks osteoporosis as the second most serious worldwide health issue, following cardiovascular disease. (Sani et al., 2020).

Risk factors for osteoporosis are grouped into modifiable and non-modifiable risk factors. Risk factors that cannot be modified are age, gender, family history, and history of bone

fractures, while risk factors that can be modified are body mass index, alcohol consumption, smoking drugs, endogenous hormones such as estrogen, early menopause, physical activity, and disease. systemic and long-term. long-term use of steroids. use. (Afni & Hanafi, 2019). Data provided by WHO shows that residents aged over 50 years are most susceptible to fractures due to osteoporosis. In Europe, 34.8% of the total population, Southeast Asia 17.4 (Pradipta, 2014). Data obtained from the Indonesian Osteoporosis Association reports that the prevalence of osteoporosis in Indonesia in women is 32.3% and in men is 28.8%, the average age affected by osteoporosis is over 50 years old. (Luthfie & Herwana, 2019). Osteoporosis in the elderly can occur due to several factors, such as race or genetics, gender, hormonal decline, short stature, lack of physical activity, smoking habits, lack of sun exposure, low calcium intake, coffee, alcohol, long-term drug abuse, and diabetes. In 2007, the Indonesian Osteoporosis Association and the researchers published a white paper that revealed the prevalence of osteoporosis in adults over 50 to be 32.3% in women and 28.8% in men. Meanwhile, data from the Hospital Information System indicates that around 200 occurrences of leg fractures related to osteoporosis occur for every 100,000 people over the age of forty.

Osteoporosis in the elderly can occur due to several factors, such as race or genetics, gender, hypothyroidism, short stature, lack of physical activity, smoking, lack of exposure to sunlight, low calcium, caffeine, and alcohol intake, carbonated drinks, long-term drug use, and diabetes. Smoking is a risk factor for osteoporosis because smokers lose bone mass more quickly than non-smokers. Smoking causes osteoporosis in the elderly by up to 40%. Dimyati's research (2017), with the chi-square test obtained $p = 0.047$ ($p < 0.05$), meaning that there is a statistically significant relationship between smoking habits and the incidence of osteoporosis and how to calculate the OR results obtained 3.121 ($1.133<OR<8.603$) means having a smoking habit in the elderly. The risk of osteoporosis is 3,121 times higher than light smoking habits.Based on the background above, it is important to research "the relationship between smoking habits and the incidence of osteoporosis in the elderly".

METHOD

A systematic review and meta-analysis were conducted for this study. The publications utilized in this study were found between 2013 and 2022 in a number of databases, including Google Scholar, Pubmed, and Science Direct. ·The PRISMA flow diagram was used to choose the articles. The following keywords can be used to look for articles: Seniors and "Smoking" and "Osteoporosis" and Multivariate The research outcome is the incidence of osteoporosis, and the inclusion criteria for this study are full-text papers with a cohort study design, research subjects are aged adults who smoke, and multivariate analysis utilizing an adjusted Odds Ratio (aOR) to evaluate the estimated effect. Publications published in languages other than English and statistical findings presented as bivariate analysis are the exclusion criteria for this research paper. Using the eligibility criteria that were established using the PICO model, the article search was conducted. Population: elderly. Intervention ¬: Smoking Comparison: no smoking. Outcome: osteoporosis

The act of burning tobacco products—such as cigars, white cigarettes, clove cigarettes, and other tobacco-based products—for the purpose of burning, smoking, and/or snorting is known as smoking. tar smoke—either pure or enhanced. The tools employed include medical and health records, as well as data gathering records from police related to diagnosis. There are categories on the measuring scale. Osteoporosis is a disorder that can lead to brittle bones since it is characterized by a loss of bone mass and bone tissue quality. There are categories on the measuring scale. Review Manager (RevMan 5.3) was used to assess the study data.

The extent of the link and the data's heterogeneity are assessed using forest plots and funnel plots. Random effect models were used for data that varied between studies, and fixed effect models were utilized for homogenous data.

RESULTS

Several journal databases, including Google Scholar, Pubmed, and Science Direct, were used in the article search. Figure 1 illustrates the PRISMA flow diagram for the associated manuscript review procedure. There are seven publications regarding the frequency of osteoporosis among elderly smokers.. After removing published publications, 1,011 papers were discovered, 30 of which fulfilled the criteria for further full-text analysis. The first search produced 1,670 documents. For the quantitative assessment using meta-analysis, a total of seven papers that passed the quality evaluation were selected. Research publications originate from three continents: America (America), Europe (Bosnia and Herzegovina), and Asia (Iran, Korea, and China), as seen in Figure 2. The investigators' methodology for evaluating the study's quality is presented in Table 1. Table 2 includes eight publications from cohort studies that demonstrate the impact of smoking on the incidence of osteoporosis. Older adults who smoke had a 1.30 times greater risk of osteoporosis than older adults who do not smoke, according to the cohort analysis's forest plot results (aOR= 1.30; 95% CI= 0.81 to 2.08). These results are statistically significant (p0.001). I2 = 96%, which suggests that the study's data pattern is diverse (random effect model), reveals the study's data heterogeneity.

The form of the distribution of effect values from the primary research of this meta-analysis lies more to the right than to the left of the vertical line of mean estimates, indicating publication bias, according to the funnel plot results from the cohort studies. The publication bias tends to overstate the impact of actual smoking behaviors on the incidence of osteoporosis because it is located to the right of the average vertical line, which follows the same direction as the diamond shape in the forest plot.ustrated in a *Funnel Plot*

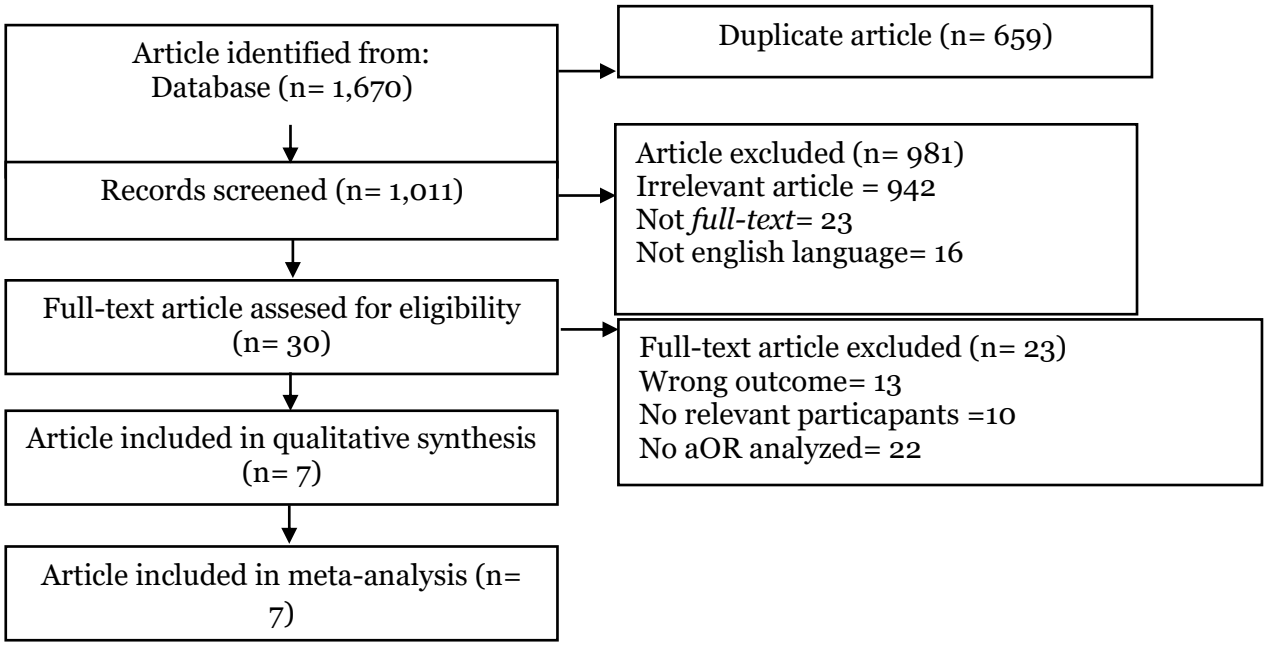

Figure 1. PRISMA flow diagram

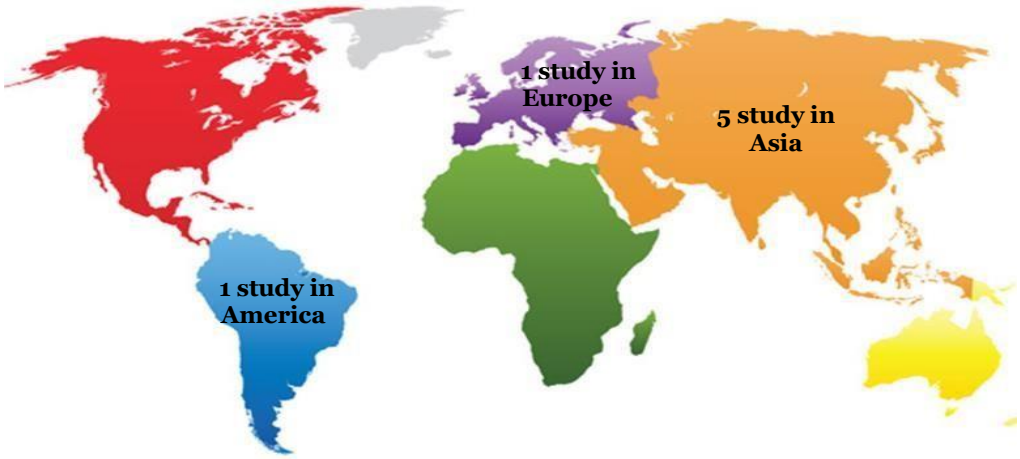

Figure 2. Map of the research area on the relationship between smoking habits with osteoporosis

Table 1.
Findings from a quality evaluation of research on the connection between smoking and osteoporosis incidence.

Author (Year)	Question Criteria							Total
	1	2	3	4	5	6	7	
Bijelic *et al*, 2017	7	4	4	4	4	4	2	29
Heidari *et al*, 2017	8	4	4	4	4	4	2	30
Huang *et al*, 2023	8	4	4	4	4	4	2	30
Kim *et al*, 2013	7	4	4	4	4	4	2	29
Kwon *et al*, 2020	8	4	4	4	4	4	2	30
Lee *et al*, 2017	8	4	4	4	4	4	2	30
Wang *et al*, 2023	8	4	4	4	4	4	2	30

Description of answer score:
1. If there is a conflict of interest, the value is "0".
2. If there is no conflict of interest, the value is "2".
3. If in doubt, the value is “1”

Description of question criteria:
1. Formulation of research questions in the acronym PICO
   a. Is the population in the PICO meta-analysis and the main research the same?
   b. Is the definition intended for the meta-analysis the same as the operational definition of exposure/intervention in the original study?
   c. Does the comparison that was employed in the main research match the one that was intended for the meta-analysis? In the RCT, did the comparator receive a placebo or standard therapy?
   d. Do the outcome variables that were planned for the meta-analysis match those that were studied in the original study?
2. Methods for selecting research subjects
   a. Is the sample selected from the population so that the sample represents the population?
   b. Was the allocation of subjects into experimental and control groups carried out by randomization?
3. Methods for measuring comparison (intervention) and outcome variables (outcome)
   a. Are the exposure/intervention and outcome variables measured with the same instruments (measuring tools) in all primary studies?

b. If the variable is measured on a categorical scale, are the cutoffs or categories used the same across primary studies?

4. Design-related bias
   a. Was double-blinding carried out, that is, the research subjects and research assistants who helped measure the outcome variables did not know the intervention status of the research subjects?
   b. Is there a possibility of "Loss-to Follow-up Bias"? What have primary studies done to prevent or overcome such bias?
5. Methods for controlling confusion
   a. Is there any ambiguity in the results/conclusions of primary studies?
   b. Have primary study researchers used appropriate methods to control the influence of confounding?
6. Statistical analysis methods
   a. Are outcome data compared between the experimental group and the control group after the intervention?
   b. Was all data analyzed according to randomization results or only data from subjects who met the research protocol?
7. Conflict of interest
   a. Is there a conflict of interest with the research sponsor?
   (UNS Public Health, 2023)

Table 2.
Primary studies included in the meta-analysis are described in detail.

Author (Year)	Country	Sample	P	I	C	O
Bijelic et al, 2017	Bosnia	100	Menopausal Women	Smoking, Coffee, Alcohol	Non Smoking, Coffee, Alcohol	Osteoporosis
Heidari et al, 2017	Iran	533	Elderly Males	Diabetes, obesity, anemia, smoking, obesity	Non-Diabetes, obesity, anemia, smoking	Osteoporosis
Huang et al, 2023	America	1777	Middle-aged – elderly	Diabetes, obesity, anemia, smoking, obesity, alcohol, coffee	Non Diabetes, obesity, anemia, smoking, Obesity, Alcohol, Coffee	Osteoporosis
Kim et al, 2013	Korea	664	Menopausal Women	Smoking	Non Smoking	Osteoporosis
Kwon et al, 2020	Korea	5117	Elderly	Cigarette smoking	Non Cigarette smoking	Osteoporosis
Lee et al, 2017	Korea	1846	Women Elderly	Smoking	Nonsmoking	Osteoporosis
Wang et al, 2023	China	22081	Elderly	smoking	Nonsmoking	Osteoporosis

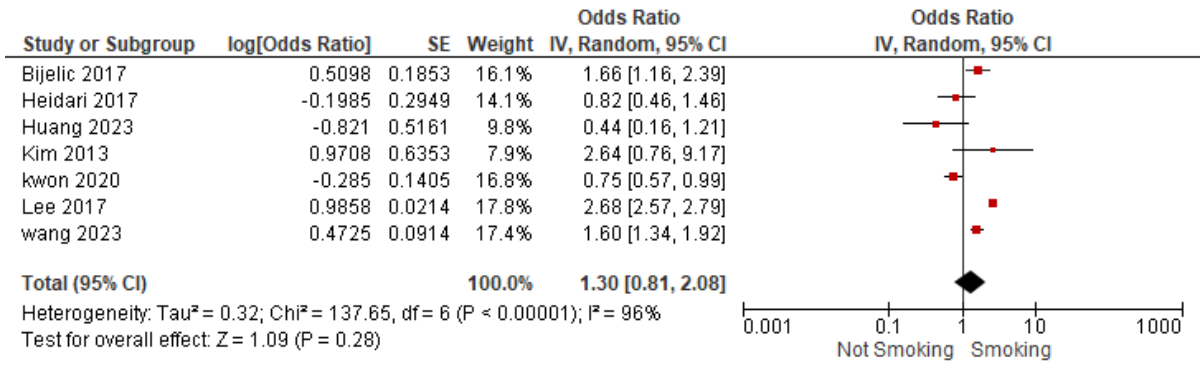

Figure 3. The correlation between cigarette smoking and osteoporosis is illustrated

in a Funnel Plot

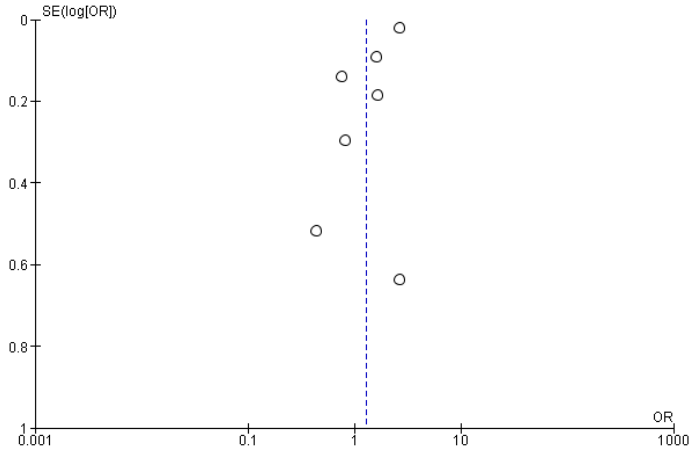

Figure 4. The correlation between cigarette smoking and osteoporosis is illustrated in a Funnel Plot

DISCUSSION

Parents who smoke have a 1.30 times higher risk of developing osteoporosis than parents who do not smoke (aOR= 1.30; 95% CI= 0.81 to 2.08), according to the cohort analysis's forest plot results, which are statistically significant (p0.001). I2= 96%, which shows that the data distribution is heterogeneous (random effect model), demonstrates the heterogeneity of the research data. The distribution of effect estimates from the main study for this meta-analysis falls more to the right than to the left of the vertical line of mean estimates, indicating publication bias, according to the cohort studies' funnel plot results. Overestimation of the impact of real smoking behaviors on the incidence of osteoporosis is a tendency of the publishing bias, which is to the right of the average vertical line and in the same direction as the location of the diamond shape in the forest plot.

The elderly who smoke have a higher risk of osteoporosis as a result of this comprehensive investigation and meta-analysis. Smoking as a risk factor was first identified as a cause of osteoporosis. Recent studies show that there is a direct link between the use of tobacco such as snuff and decreased bone density. Exposure to tobacco can reduce the possibility of bone growth, women who smoke produce less estrogen and therefore tend to experience menopause earlier, which affects the function of estrogen in bone density. The healing process for fractures in smokers takes longer than in non-smokers. Smoking is one of the causes of osteoporosis because the substances in it, such as nicotine, can inhibit the production of bone-forming cells. Research results using the chi-square test obtained $p = 0.047$ ($p < 0.05$), meaning that smoking habits have a statistically significant association with the incidence of osteoporosis and how to calculate the OR results obtained 3.121 ($1.133<OR<8.603$) meaning that you have a smoking habit. in the elderly. The risk of osteoporosis is 3,121 times higher than light smoking habits. Tobacco contains at least 150 toxins and produces many free radicals. Nicotine and free radicals found in tobacco affect osteoblast activity, damage the bone formation process, and increase the bone resorption process.

A study suggests smoking harms bone mineral density in postmenopausal women, placing them at risk of vertebral fractures. Smoking can negatively impact bone health through several mechanisms. First, by exerting a direct toxic effect on osteoclasts and blood flow, it affects bone health and causes the risk of fractures, especially in the femur. Second, it involves indirect effects on bones which can influence sex hormones so that they can inhibit

the vitamin D-PTH axis in postmenopausal women, where vitamin D-PTH plays a role in regulating calcium and phosphate homeostasis. Smokers show lower PTH values than former smokers and never-smokers. Based on the research results of Suarni (2017), the results of this study show that the factors causing osteoporosis are genetic factors for 18 people (72%), physical activity factors for 20 people (80%), smoking and drinking factors for 10 people (40%), the age factor > 50 years was 19 people (76%) and the disease factor was 15 people (60%). This research is in line with the results of research showing that 41 respondents who smoked (59.4%) were found to have osteoporosis and 24 people (85.7%) were non-smokers, more than osteoporosis sufferers and smokers, namely 23 people (56.7%).).. Smokers often have characteristics associated with low bone mass. These include low body weight, high caffeine and alcohol intake, and early menopause in women. Once these factors are controlled, a smoker still has the same bone mass density as a non-smoker.

CONCLUSION

Based on the findings of study publications published on three continents: America (America), Europe (Bosnia and Herzegovina), and Asia (Iran, Korea, and China). The forest plot findings of the cohort analysis demonstrate that older individuals who smoke have a 1.30 times higher risk of osteoporosis than older individuals who avoid tobacco use (aOR= 1.30; 95% CI= 0.81 to 2.08), and these outcomes are considered significant ($p<0.001$). The data distribution is considered heterogeneous (random effect model) and the outcomes are statistically significant ($p<0.001$).

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