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Meta-analysis

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Meta-Analysis of the Effect of Exposure to Indoor Cigarette Smoke in Pregnant Women on the Risk of Infants Low Birth Weight

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ABSTRACT

Background: Problems related to low birth weight are often found in developing countries. Exposure to cigarette smoke is one of the factors causing low birth weight, in this case caused by the chemicals in cigarettes which affect the health of pregnant women and babies. This study aims to determine the effect of exposure to secondhand smoke in the home on pregnant women on the risk of giving birth to babies with low birth weight.
Subjects and Method: This study is a systematic review and meta-analysis using the PRISMA flow chart and the PICO model. Population: pregnant women. Intervention: exposure to household cigarette smoke is high. Comparison: household exposure to secondhand smoke is low. Outcome: low birth weight. The databases used are PubMed, Google Scholar, and Science Direct with keywords ("Pregnancy Women" OR "Passive Smoking" OR "Low Birth Weight") AND "Case Control Study". A total of 9 articles met the inclusion criteria, namely primary full text paper, case-control design, adjusted Odds Ratio (aOR), research subjects of pregnant women, interventions in the form of high cigarette smoke exposure, and outcomes in the form of low birth weight for analysis carried out with RevMan 5.3.
Results: A meta-analysis has been carried out on 9 articles with a case-control study design from the Asian Continent and the African Continent in pregnant women with a sample size of 4,244. The results of the meta-analysis showed that pregnant women who were exposed to secondhand smoke from the environment had a risk of giving birth to babies with low birth weight 1.82 times compared to those not exposed to secondhand smoke and the effect of exposure was statistically significant (aOR= 1.82; 95% CI= 1.54 to 2.16; p <0.001).
Conclusion: The effects of exposure to cigarette smoke in pregnant women can increase the risk of low birth weight babies.

Keywords: passive smokers, low birth weight, pregnant women, babies,

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BACKGROUND

Low birth weight (LBW) is defined as a newborn weighing <2,500 grams. Babies born weighing <2,500 grams have a high risk of death compared to babies who have normal weight ≥ 2,500 grams (Xi et al., 2020). Low birth weight has a death rate of more than 20 times that of normal weight babies. The number of smokers worldwide reaches 1.2 billion people and 800 million of them are in developing countries (Pei et al., 2016).

The ASEAN Tobacco Control Atlas places Indonesia as a country that ranks first as a country with the highest prevalence of smokers in ASEAN, namely 50.68%. In Indonesia, Gorontalo is ranked fourth with the highest proportion of smokers every day, which is equal to 26.8%. Exposure to secondhand smoke during pregnancy is associated with an estimated 22% risk of having a low birth weight baby of less than 2500 grams (WHO, 2013).

Problems related to low birth weight are often found in developing countries, especially in developing countries which still have a relatively low level of human resources and socioeconomic level. The number of births in the world is approximately 27.1%, while each country has several disparities related to the LBW problem (Anil et al., 2015). In Indonesia itself, there are problems related to LBW, it was recorded in 2019 that as many as 111,827 babies or 3.4% of child births had low birth weight (LBW) while in 2020, the percentage showed a figure of 11.37% which was not much different from 2019 of 11.32% (BPS, 2020).

Exposure to cigarette smoke is one of the factors causing low birth weight, in this case caused by the chemicals in cigarettes (Kataoka et al., 2018). Cigarette smoke contains lead, which affects the health of mothers and babies if exposed to pregnant women (Hamadneh et al., 2021). Meanwhile, other substances such as carbon monoxide (CO) from cigarettes that are inhaled by pregnant women will be carried into the mother's bloodstream, causing reduced oxygen reception for the baby and the placenta (Dorey et al., 2020).The impact of cigarette smoke on pregnant women who are exposed to secondhand smoke are at higher risk of experiencing complications such as miscarriage, premature birth, or babies born with low birth weight. This is because the harmful substances contained in cigarette smoke are absorbed and enter the bloodstream (Khot et al., 2018).

This study aims to analyze the effect of exposure to secondhand smoke in the home on pregnant women on the risk of giving birth to babies with low birth weight, based on the results of similar previous studies.

SUBJECTS AND METHOD

1. Study Design

This research was conducted using a systematic review and meta-analysis was carried out using primary data, namely data from similar previous research results. Article searches were carried out using several databases, namely: Google Scholar, PubMed, and Science Direct. The keywords used are ("Passive Smoking" OR "Pregnancy Women" OR "Low Birth Weight") AND "aOR" AND "Case-Control".

2. Steps of Meta-Analysis

The meta-analysis was carried out through 5 steps as follows:

1) Formulate research questions through the PICO format (Population, Intervention, Comparison, Outcome).
2) Search for primary study research articles from several databases.
3) Conducting article selection by determining inclusion and exclusion criteria and conducting critical assessments.
4) Extracting selected primary study data and synthesizing effect estimates using the RevMan 5.3 application.

5) Interpret results and draw conclusions.

3. Inclusion Criteria

Full-text article using a case-control study design, research subjects were pregnant women, the outcome of the study was low birth weight, and the results of the analysis used were multivariate analysis with adjusted odds ratio (aOR) to measure effect estimates income and the research outcome is stunting.

4. Exclusion Criteria

Articles published in languages other than English, articles before 2012, and outcome measures in research are incomplete or do not clearly describe results.

5. Operational Definition of Variables

Exposure to Cigarette Smoke: is direct or indirect contact during pregnancy that comes from the environment.

Low Birth Weight Babies: are babies whose weight is weighed after 1 hour of birth and weighs <2,500 grams.

6. Study Instruments

The quality assessment of the main article in this study used the Primary Study Quality Assessment for Case-Control Study Design in Meta-Analytic Research sourced from the Public Health Sciences Masters Study Program, Postgraduate School, Universitas Sebelas Maret.

7. Data Analysis

The articles in this study were collected using the PRISMA diagram and analyzed using the Review Manager 5.3 application (RevMan 5.3) by calculating the effect size and heterogeneity (I^2) to determine the combined research model and form the final results of the meta-analysis. The results of data analysis are presented in the form of forest plots and funnel plots.

RESULTS

The process of searching for primary articles related to the effect of exposure to cigarette smoke in the home on pregnant women on the risk of giving birth to babies with low birth weight, in this meta-analysis study was carried out on several databases and the results obtained were 9 articles which can be seen in Figure 1 PRISMA Flow Diagram. The total number of articles in the initial search process is 1,000 articles. After the process of deleting published articles, 744 articles were found, with 45 of them meeting the requirements for a full text review.

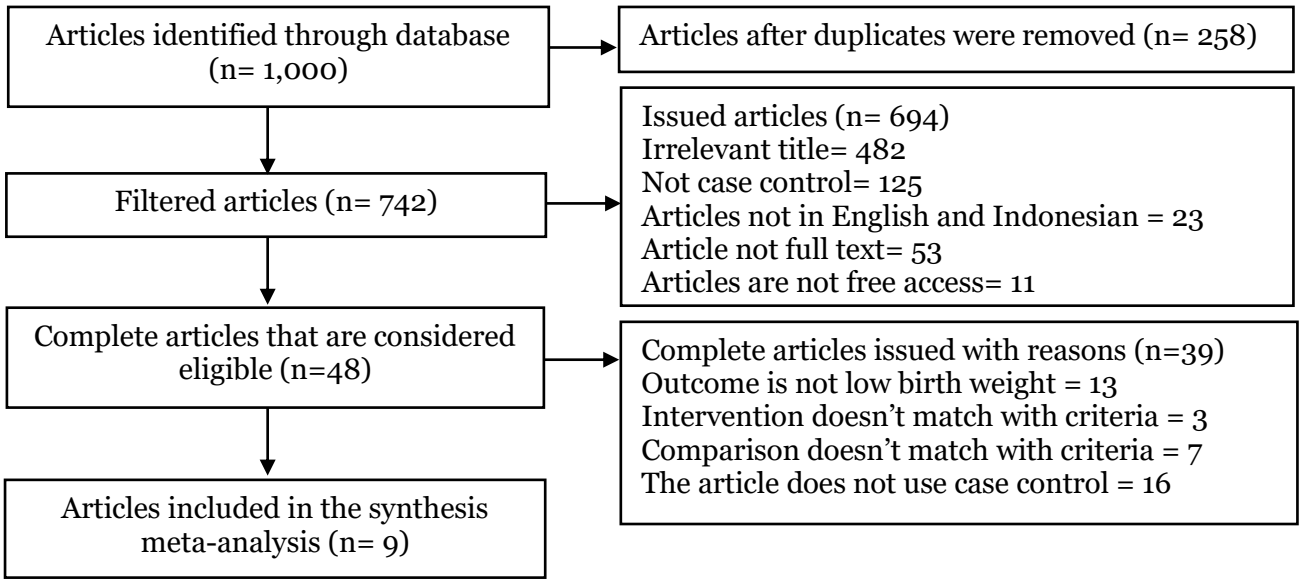

Figure 1. PRISMA Flow Diagram

Figure 2 shows the distribution area of the 9 primary articles used in this study, namely from the Asian continent and the African continent. The research was conducted in Nepal, Morocco, Sierra Leone, Indonesia and China.

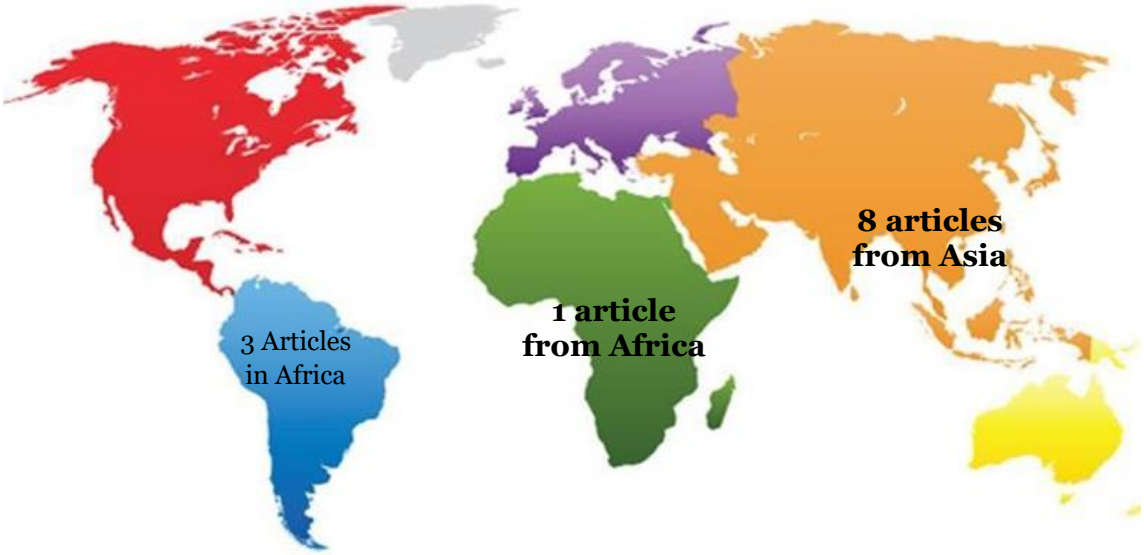

Figure 2. Map of the study area on the effects of exposure to cigarette smoke inside the home in pregnant women on the risk of giving birth to babies with low birth weight

Table 1. Results of quality assessment of case-control studies on the effect of exposure to secondhand smoke in the home on pregnant women on the risk of having a baby with low birth weight

Articles	Questions Checklist												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
Anil et al. (2020)	2	2	2	2	2	1	2	2	2	2	2	2	23
Benkaddour et al. (2016)	2	2	2	2	2	2	2	2	1	2	1	2	22
Kargbo et al. (2022)	2	2	2	2	2	2	2	2	2	2	1	2	23
Khattar et al. (2013)	2	2	2	2	2	2	2	2	2	2	1	2	23
Mingude et al. (2020)	2	2	2	2	2	2	2	2	2	2	2	2	24
Owa et al. (2019)	2	2	2	2	2	2	2	2	2	2	2	2	24
Paudel et al. (2022)	2	2	2	2	2	2	2	2	2	2	2	2	24
Rang et al. (2020)	2	2	2	2	2	2	2	2	2	2	1	2	23
Xi et al. (2020)	2	2	2	2	2	2	2	2	2	2	1	2	23

Description of the question criteria:

1 = Does this study address clearly focused questions/problems?
2 = Are the research methods (research design) appropriate to answer the research questions?
3 = Is the case taken acceptable?
4 = Is control selection acceptable?
5 = Were the results measured accurately to minimize bias?
6 = Apart from the experimental intervention, were the groups treated the same?
7 = Have the authors taken into account potential confounding factors in the design or in the analysis?

8 = How big is the treatment effect?
9 = How precise is the estimate of the treatment of affect?
10 = Are the results reliable?
11 = Are the results applicable to the local population?
12 = Are the results of this study consistent with the available evidence?

Description of the answer score:
0 = No
1 = Don't Know
2 = Yes

Table 2 presents a description of 9 case-control articles as a source of meta-analysis of the effects of exposure to secondhand smoke in the home in pregnant women on the risk of having a baby with low birth weight. The description of primary research on the effect of exposure to cigarette smoke in the home on pregnant women on the risk of giving birth to babies with low birth weight was conducted through a meta-analysis of 9 articles. The research locations varied, namely Nepal, Morocco, Sierra Leone, Indonesia and China.

There were differences in the number of samples used, the smallest was 156 and the largest sample was 1,670. The total number of samples included in the meta-analysis of the effect of exposure to cigarette smoke in the home on pregnant women on the risk of having a baby with low birth weight is 4,244 pregnant women.

Table 2. The effect of exposure to cigarette smoke in the home on pregnant women on the risk of giving birth to babies with low birth weight

Author (year)	Country	Sample size	P	I	C	O
Anil et al. (2020)	Nepal	369	Pregnant women aged 20-30 years	High exposure to cigarette smoke in the house	Low exposure to smoke	LBW
Benkaddour et al. (2016)	Morocco	288	Pregnant women	High exposure to cigarette smoke	Low exposure to smoke	LBW
Kargbo et al. (2022)	Sierra	438	Pregnant women aged 24 years	Exposed to cigarette smoke	Not exposed to cigarette smoke	LBW
Khattar et al. (2013)	India	300	Pregnant women	Exposed to cigarette smoke	Not exposed to cigarette smoke	LBW
Mingude et al. (2020)	Ethiopia	300	Pregnant women aged 20-34 years	High exposure to cigarette smoke	Low exposure to smoke	LBW
Owa et al. (2019)	Indonesia	156	Pregnant women aged 20-35 years	Exposed to cigarette smoke	Not exposed to cigarette smoke	LBW
Paudel et al. (2022)	Nepal	423	Pregnant women aged 20-35 years	High exposure to cigarette smoke	Low exposure to secondhand smoke	LBW
Rang et al. (2020)	Ethiopia	300	Pregnant women aged 21-34 years	Exposure to secondhand smoke status	Not exposed to cigarette smoke	LBW
Xi et al. (2020)	Cina	1,670	Pregnant women aged 18-35 years	High exposure to cigarette smoke	Low exposure to smoke	LBW

Table 3. Adjusted Odd Ratio (aOR) effect of exposure to indoor cigarette smoke in pregnant women on the risk of infants low birth weight (N=4,244)

Author (Year)	aOR	95%CI	
		Lower Limit	Upper Limit
Anil et al. (2020)	1.40	0.80	2.45
Benkaddour et al. (2016)	1.77	1.22	2.57
Kargbo et al. (2022)	4.36	1.94	9.80
Khattar et al. (2013)	4.72	1.19	18.7
Mingude et al. (2020)	2.85	1.42	5.70
Owa et al. (2019)	2.60	0.88	7.68
Paudel et al. (2022)	8.98	2.13	37.90
Rang et al. (2020)	1.92	1.31	2.81
Xi et al. (2020)	1.40	1.05	1.87

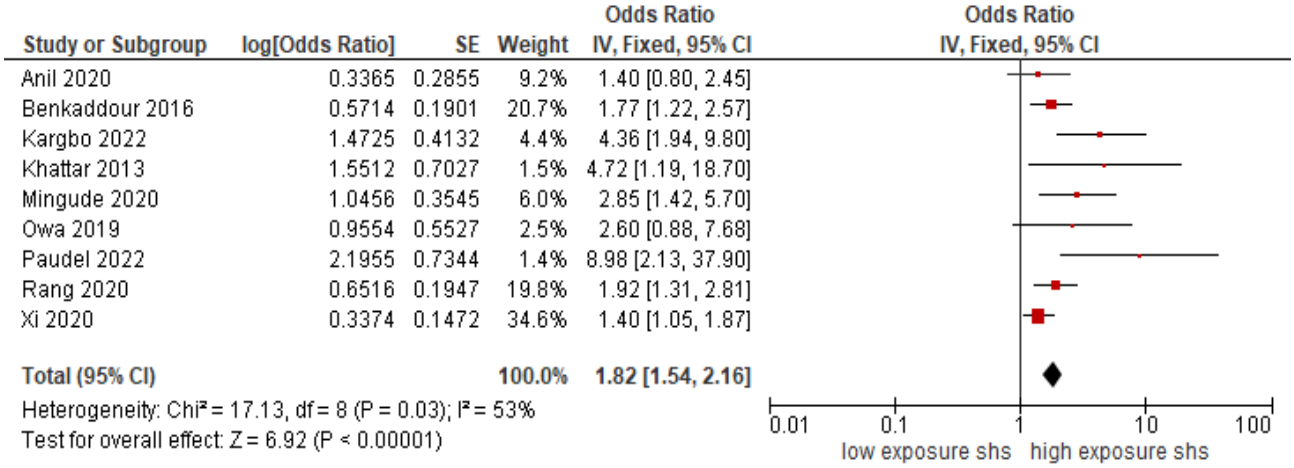

Figure 3. Forest plot of the effect of exposure to secondhand smoker of pregnant women on the risk of infants low birth weight

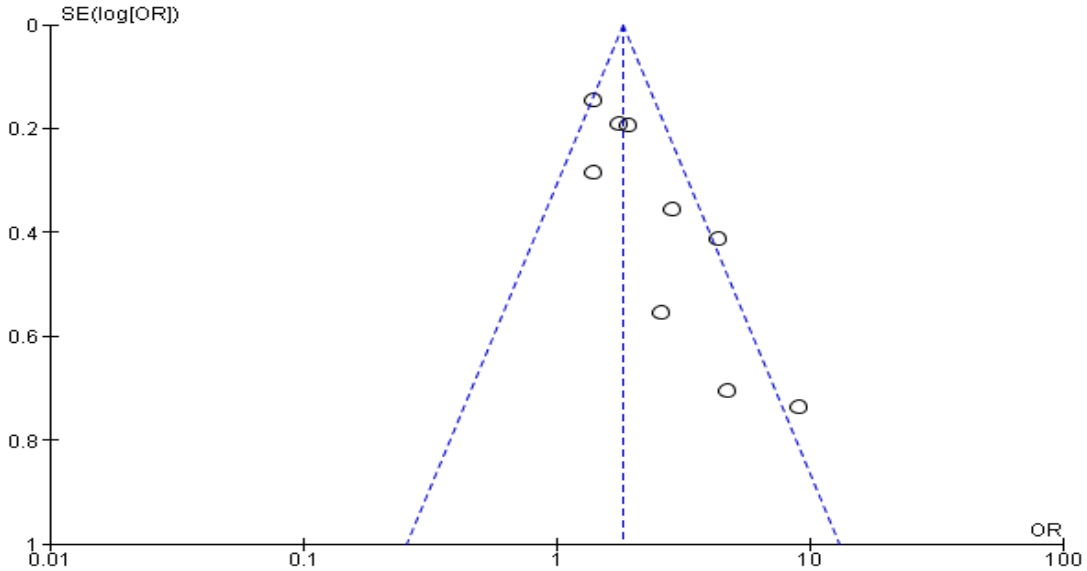

Figure 4. Funnel plot of the effect of exposure to secondhand smoker of pregnant women on the risk of infants low birth weight

The forest plot in Figure 3 shows that there is an effect of exposure to cigarette smoke inside the house on pregnant women on the risk of having a baby with low birth weight. from the environment have a risk of giving birth to a child with low birth weight 1.82 times compared to not exposed to cigarette smoke and the relationship is statistically significant (aOR= 1.82; 95% CI= 1.54 to 2.16; p <0.001). The effect estimation between studies showed quite high heterogeneity (I^2= 53%; p <0.001), with the calculation of the average effect estimation using the Random Effect Model (REM) approach.

The funnel plot in Figure 4 shows that the distribution of effect estimates is more to the right than to the left of the average vertical line for small sample primary studies, thus indicating publiccation bias because the distribution is more to the right of average vertical line.

DISCUSSION

The effects of exposure to cigarette smoke in the home on pregnant women on the risk of giving birth to babies with low birth weight were processed using RevMan 5.3. The results of systematic reviews and meta-analyses are presented in the form of forest plots and funnel plots. The results of the forest plot of this research article with a case-control design show that there is an effect of exposure to cigarette smoke in the house in pregnant women on the risk of having a baby with low birth weight.

A total of 9 case-control research articles as a source of meta-analysis of the effects of exposure to cigarette smoke in the home in pregnant women on the risk of giving birth to babies with low birth weight. Pregnant women who were exposed to secondhand smoke from the environment had a risk of giving birth to babies with low birth weight 1.82 times compared to those not exposed to secondhand smoke and the relationship was statistically significant (aOR= 1.82; 95%CI= 1.54 to 2.16; p<0.001). The results of this meta-analysis indicated that the effect estimation heterogeneity was quite high between primary studies in this meta-analysis with I^2= 53%. So the synthesis of the overall effects of primary studies in this meta-analysis was carried out using the random effect model approach.

Exposure to secondhand smoke during pregnancy is associated with an estimated 22% risk of having a low birth weight baby of less than 2,500 grams (WHO, 2013). Exposure to indirect smoking can increase the risk of giving birth to a baby with low birth weight. Some of the compounds found in cigarette smoke can cross the placenta. The carbon monoxide contained in cigarettes can cause low birth weight. One of the causes is decreased oxygen supply to the fetus, which causes fetal hypoxia.

Low birth weight babies are conditions in which a newborn is weighed within one hour after birth and shows a figure that weighs less than 2,500 grams regardless of how long the woman is carrying the baby (Supriyanto et al., 2018). Judging from this risk, it arises because the fetus lacks nutrition, these nutrients are only distributed to several organs such as the brain and heart but are not distributed to other organs, so of course other organs become victims (Gebregzabiherher et al., 2017).

The results of this study are in line with other studies which state that cigarette smoke causes severe risk factors, pregnant women who are exposed to cigarette smoke have a 3 times greater risk of experiencing mild placenta than pregnant women who are not exposed to cigarette smoke. As well as the increased risk of miscarriage, low baby weight and baby's airway disorders.

Exposure to cigarette smoke is one of the factors causing low birth weight, in this case caused by the chemicals in cigarettes.

Based on Government Regulation Number 109 of 2012 concerning safeguarding materials containing addictive substances in the form of tobacco products for health, tobacco is a product that is used by burning, smoking, and inhaling or chewing, cigarettes are one of the products produced by tobacco. Cigarette smoke contains lead, which affects the health of mothers and babies when exposed to pregnant women (Regulation of the Government of the Republic of Indonesia Number 109, 2012).

AUTHOR CONTRIBUTION

Dinda Nur Asri Mutiara Ramadhani, as a researcher who selects topics, searches for and collects research data. Bhisma Murti and Uki Retno Budhiastuti analyzed the data and reviewed research documents.

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CONFLICT OF INTEREST

There is no conflict of interest in this study.

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