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Maternal Secondhand Smoke Exposure and Risk of Preterm Birth: A Systematic Review and Meta-Analysis With National Epidemiological Context From Indonesia

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Abstract

Background

Secondhand smoke (SHS) exposure during pregnancy is an important yet preventable risk factor for adverse birth outcomes. Despite declining global tobacco use, Indonesia continues to experience a high smoking prevalence, particularly among men, resulting in substantial household SHS exposure among pregnant women. This study aimed to evaluate the association between maternal SHS exposure and preterm birth and to contextualize these findings using nationally representative Indonesian survey data.

Methods

A systematic review and meta-analysis were conducted following PRISMA guidelines. Electronic databases (PubMed, Cochrane Library, and ScienceDirect) were searched for observational studies published between 2013 and 2025 investigating the association between prenatal SHS exposure and preterm birth. Three independent reviewers performed study selection, data extraction, and quality assessment. Pooled odds ratios (ORs) with 95% confidence intervals (CIs) were calculated using a random-effects model in Review Manager 5.4. To provide epidemiological context, data from the 2018 National Basic Health Research (Riskesdas) and the 2023 Indonesian Health Survey (SKI) were descriptively reviewed.

Results

Nine studies were included in the qualitative synthesis, of which seven were eligible for meta-analysis. Maternal SHS exposure during pregnancy was significantly associated with an increased risk of preterm birth (pooled OR = 1.63, 95% CI 1.30–2.05; I^2 = 52%). National survey data demonstrated persistently high indoor smoking prevalence in Indonesia, with more than 80% of smokers reporting smoking inside homes or enclosed spaces in both 2018 and 2023. Indoor smoking was disproportionately concentrated among socioeconomically disadvantaged and rural populations.

Conclusions

Maternal SHS exposure significantly increases the risk of preterm birth. These findings provide evidence-based support for Government Regulation No. 28 of 2024 and highlight the potential maternal and neonatal health benefits of comprehensive tobacco control measures aimed at reducing household SHS exposure.

INTRODUCTION

Tobacco use remains one of the leading preventable causes of morbidity and premature mortality worldwide, accounting for more than eight million deaths annually, including approximately 1.3 million deaths attributable to secondhand smoke (SHS) exposure [1] [2]. Although the World Health Organization (WHO) projects a decline in global tobacco use prevalence from 26.4% in 2010 to 18.1% by 2030, this trend has not been observed uniformly across countries. In contrast to the global decline, Indonesia continues to experience persistently high tobacco consumption, with smoking prevalence projected to increase from 33.2% in 2010 to 38.7% in 2030 [3]. This divergent trend places Indonesia among the countries with the highest tobacco burden worldwide and has important implications for household SHS exposure and population health.

The predominance of male smokers in Indonesia has important implications for household SHS exposure. In many Indonesian households, smoking is commonly practiced inside homes, thereby increasing the risk of SHS exposure among family members. National survey data revealed that 80.6% of smokers aged ≥ 10 years reported smoking inside homes or enclosed spaces in Riskesdas 2018 [4], and this proportion further increased to 81.5% in the 2023 Indonesian Health Survey (SKI) [5]. These findings indicate persistently high levels of household SHS exposure in Indonesia and suggest that vulnerable populations, particularly pregnant women, remain at considerable risk of involuntary tobacco smoke exposure.

Pregnant women are especially susceptible to the adverse effects of SHS exposure because tobacco smoke contains numerous toxic substances, including nicotine, carbon monoxide, polycyclic aromatic hydrocarbons, and other oxidizing agents [6]. Maternal exposure to SHS during pregnancy has been associated with placental dysfunction, oxidative stress, chronic inflammation, impaired uteroplacental perfusion, and fetal hypoxia [7]. These pathophysiological mechanisms may disrupt normal fetal growth and development, ultimately increasing the risk of adverse pregnancy outcomes, including preterm birth [8].

Preterm birth, defined as delivery before 37 completed weeks of gestation, remains a major contributor to neonatal morbidity and mortality worldwide [9]. In Indonesia, preterm birth continues to represent an important public health concern. Nationally representative surveys reported a preterm birth prevalence of 29.5% in Riskesdas 2018 and 11.1% in SKI 2023, underscoring the substantial burden of prematurity in the country. Although differences in survey methodology should be considered when interpreting temporal changes, these findings emphasize the continuing need for effective preventive strategies targeting modifiable risk factors.

Several epidemiological studies have investigated the association between maternal SHS exposure during pregnancy and preterm birth. Nevertheless, the reported findings remain inconsistent, and the magnitude of the association has not been fully established [10] [11] [12]. Furthermore, evidence synthesis addressing the implications of SHS exposure for maternal and neonatal health policies in Indonesia remains limited. Given that SHS exposure is a potentially modifiable environmental risk factor,

understanding its impact on preterm birth is essential for informing effective public health interventions and tobacco control policies.

In response to the increasing burden of tobacco use, the Indonesian government enacted Government Regulation No. 28 of 2024 as an implementing regulation of Law No. 17 of 2023 on Health, introducing comprehensive tobacco control measures, including restrictions on tobacco sales and accessibility [13]. Although the primary objective of this regulation is to reduce tobacco consumption, its potential maternal and neonatal health co-benefits through reductions in household SHS exposure have received limited attention.

Therefore, this systematic review and meta-analysis aimed to synthesize available evidence regarding the association between maternal exposure to secondhand smoke during pregnancy and the risk of preterm birth. Additionally, this study discusses the implications of these findings for strengthening tobacco control policies in Indonesia, particularly in supporting the implementation of Government Regulation No. 28 of 2024.

METHODS

Study design

This study was conducted as a systematic review and meta-analysis to evaluate the association between maternal exposure to secondhand smoke (SHS) during pregnancy and the risk of preterm birth. The study was designed and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement.

a. Descriptive Analysis of the Current National Situation in Indonesia

To provide epidemiological context for interpreting the meta-analysis findings and their policy implications, nationally representative survey data from the 2018 National Basic Health Research (Riskesdas) and the 2023 Indonesian Health Survey (Survei Kesehatan Indonesia [SKI]) were descriptively reviewed. Data were extracted from official reports published by the Indonesian Ministry of Health, and only survey cycles with comparable measurements of smoking behavior and preterm birth were included to ensure consistency across reporting periods.

Literature search

A comprehensive literature search was conducted in PubMed, Cochrane Library, and ScienceDirect from database inception to 2025. The search strategy combined Medical Subject Headings (MeSH) and free-text terms related to secondhand smoke, pregnancy, and preterm birth. Additional studies were identified through manual screening of reference lists of eligible articles and relevant reviews.

Eligibility Criteria

Studies were selected according to the Population, Exposure, Comparator, Outcome (PECO) framework. The population comprised pregnant women, with maternal exposure to secondhand smoke (SHS) during pregnancy as the exposure and non-exposed women as the comparator. The primary outcome was preterm birth (< 37 weeks of gestation). Observational studies (cohort, case-control, or cross-sectional) reporting the association between prenatal SHS exposure and preterm birth and providing effect estimates or sufficient data for effect size calculation were included. Only peer-reviewed articles published in English between 2013 and 2025 were considered. Studies focusing exclusively on active maternal smoking, lacking relevant outcomes or quantitative data, as well as reviews, editorials, conference abstracts, case reports, letters, and animal studies were excluded.

Data Extraction and Quality Assessment

After duplicate removal, three independent reviewers screened titles, abstracts, and full texts according to predefined eligibility criteria. Data extraction was independently performed using a standardized form that included study characteristics, exposure and outcome assessment methods, effect estimates, and adjusted variables. Study quality was independently assessed by three reviewers using the Newcastle–Ottawa Scale (NOS) for cohort and case-control studies and the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for cross-sectional studies. Disagreements were resolved through discussion and consensus.

RESULTS

The study selection process is presented in Fig. 1. A total of 1,489 records were identified through the initial literature search, including 244 records from PubMed, 8 records from the Cochrane Library, and 1,237 records from ScienceDirect. After title and abstract screening, 1,469 records were excluded because they did not meet the predefined eligibility criteria. The remaining 20 articles underwent duplicate screening, resulting in the removal of two duplicate records. Subsequently, 18 full-text articles were assessed for eligibility. Of these, nine articles were excluded due to inappropriate participant characteristics or ineligible study designs. Consequently, nine studies were included in the qualitative synthesis, of which seven studies provided sufficient data and were included in the quantitative meta-analysis. Manual screening of the reference lists of eligible studies did not identify any additional relevant articles.

The characteristics of the included studies are summarized in **Supplementary 1.** A total of nine observational studies published between 2013 and 2025 were included in the qualitative synthesis. The studies were conducted across eight countries and comprised various study designs, including cohort, case-control, and cross-sectional studies. Sample sizes ranged from 234 to 88,550 participants. Most studies assessed maternal secondhand smoke exposure during pregnancy in household and/or

workplace settings. Preterm birth, commonly defined as delivery before 37 completed weeks of gestation, was the primary outcome in seven studies and was included in the quantitative meta-analysis.

Figure 2. illustrates the current national burden of indoor smoking and preterm birth in Indonesia. The prevalence of indoor smoking among smokers aged ≥ 10 years remained consistently high, increasing marginally from 80.6% in 2018 to 81.5% in 2023. During the same period, the reported prevalence of preterm birth decreased from 29.5% to 11.1%. Nevertheless, direct temporal comparisons of preterm birth prevalence should be interpreted with caution due to potential methodological differences between the two national surveys.

Figure 3. demonstrates a socioeconomic gradient for both indoor smoking and preterm birth. Indoor smoking prevalence decreased progressively from 90.5% among the poorest households to 69.9% among the richest households. Similarly, preterm birth prevalence generally declined from 13.2% among the poorest households to 9.9% among the richest households, although a slight increase was observed in the upper-middle wealth quintile. These findings indicate that lower socioeconomic groups bear a disproportionately higher burden of both household smoking exposure and adverse birth outcomes.

Figure 4. presents the distribution of indoor smoking and preterm birth according to place of residence. Indoor smoking prevalence was consistently higher in rural than in urban areas in both survey cycles (87.2% vs. 74.7% in Riskesdas 2018 and 88.8% vs. 75.9% in SKI 2023). Likewise, the prevalence of preterm birth was higher among rural populations than urban populations (32.7% vs. 26.8% in 2018 and 11.8% vs. 10.6% in 2023).

DISCUSSION

Principal Findings

This study synthesized evidence regarding the association between maternal secondhand smoke (SHS) exposure during pregnancy and preterm birth through a systematic review and meta-analysis, complemented by a descriptive analysis of nationally representative Indonesian survey data. Overall, the findings demonstrated that prenatal SHS exposure was significantly associated with an increased risk of preterm birth, while household indoor smoking remained highly prevalent in Indonesia. Together, these findings underscore the importance of reducing SHS exposure as part of broader maternal and neonatal health strategies.

Biological Plausibility

Several biological mechanisms may explain the observed association between maternal secondhand smoke (SHS) exposure and preterm birth. SHS contains thousands of chemicals, including nicotine, carbon monoxide, polycyclic aromatic hydrocarbons, and numerous oxidizing agents, many of which are known to adversely affect placental and fetal development. Importantly, no safe level of tobacco smoke exposure during pregnancy has been established.

One of the principal mechanisms involves uteroplacental vascular dysfunction. Nicotine-induced vasoconstriction may reduce uteroplacental blood flow, thereby compromising oxygen and nutrient delivery to the fetus. Concurrently, carbon monoxide exposure decreases fetal oxygen availability through the formation of carboxyhemoglobin, resulting in chronic fetal hypoxia. Together, these processes may induce fetal stress and increase susceptibility to premature initiation of labor [14] [15] [16] [17]

Placental dysfunction is also likely to play a central role. Evidence from both the included studies and the broader literature suggests that maternal SHS exposure is associated not only with preterm birth but also with low birth weight and intrauterine growth restriction, adverse outcomes that frequently share common placental and vascular pathophysiological pathways. Tobacco smoke toxicants may impair placental angiogenesis, alter trophoblastic function, and compromise placental perfusion, thereby increasing the risk of adverse pregnancy outcomes [18] [19] [15] [20]

In addition, SHS exposure may disrupt endocrine and inflammatory pathways involved in the maintenance of pregnancy. Tobacco toxicants have been reported to alter steroid hormone production, interfere with prostaglandin synthesis, and modify oxytocin responsiveness, all of which are biologically relevant to cervical ripening, membrane integrity, myometrial activation, and the timing of labor onset. Furthermore, oxidative stress, systemic inflammation, and endothelial dysfunction induced by SHS may contribute to placental injury and premature activation of parturition pathways [21] [15] [22]

Collectively, these interrelated mechanisms provide strong biological plausibility for the epidemiological findings of the present study and support SHS as an important and potentially modifiable risk factor for preterm birth.

Current Meta-Analysis Findings

Across the nine included studies, secondhand smoke exposure during pregnancy is generally associated with higher odds of preterm birth, but the magnitude and consistency of that association vary by exposure source, exposure intensity, population, and the degree to which studies accounted for active smoking and obstetric confounding [19] [23] [24]. The attached evidence is more consistent in Asian and lower- and middle-income settings, where household exposure prevalence is high, than in settings with lower background smoke exposure or less precise exposure ascertainment [18] [24] [25].

The present forest plot Fig. 5. demonstrated that maternal exposure to secondhand smoke (SHS) during pregnancy was associated with a 63% increase in the odds of preterm birth (pooled OR = 1.63, 95% CI 1.30–2.05). Although moderate heterogeneity was observed (I^2 = 52%), likely reflecting differences in study settings, exposure definitions, and methodological approaches, the direction of effect was remarkably consistent across studies. This finding was further supported by the qualitative synthesis, which revealed generally concordant associations across diverse geographical and socioeconomic contexts. Studies conducted in China, Rwanda, Vietnam, the United States, and Saudi Arabia consistently reported elevated risks of preterm birth among SHS-exposed women, with adjusted effect estimates

ranging from 1.38 to 2.09 [19] [23] [24] [21]. The consistency of these associations across multiple populations and study designs suggests that the adverse effect of prenatal SHS exposure is not restricted to a particular setting but represents a broadly generalizable phenomenon. Nevertheless, variations in the magnitude of effect indicate that SHS is more likely to function as an independent yet context-dependent risk factor rather than a uniform causal determinant exerting identical effects across populations. Collectively, these findings strengthen the evidence supporting SHS as an important and potentially modifiable risk factor for preterm birth.

Current National Situation of Indoor Smoking and Preterm Birth in Indonesia

A notable finding of the present study was the persistently high prevalence of indoor smoking in Indonesia, with more than 80% of smokers reporting smoking inside homes or enclosed spaces in both 2018 and 2023. Indoor smoking remained consistently high across nearly all demographic groups, suggesting that smoking inside the home may represent a deeply embedded social norm rather than merely an individual behavior. Similar patterns have been reported across Low- and Middle-Income Countries (LMICs), where household SHS exposure during pregnancy frequently exceeds active maternal smoking and is particularly common among poorer, less educated, and rural women [10] [26]. These findings indicate that the Indonesian situation reflects broader structural and social determinants operating across many LMIC settings.

The persistence of household SHS exposure despite increasing awareness of tobacco-related harms highlights the importance of social and household contexts. Qualitative studies from Bangladesh and India demonstrated that husbands commonly smoke inside the home, while pregnant women's attempts to establish smoke-free homes are often unsuccessful because of prevailing gender norms and unequal household power dynamics [27]. Likewise, studies from Egypt and the Dominican Republic reported that SHS exposure was more common among women living in rural areas, having smoking husbands, and residing in households where smoking indoors was socially accepted [28] [29]. Collectively, these findings suggest that knowledge alone is insufficient to reduce SHS exposure when smoking is socially tolerated and embedded within household culture.

An apparent discrepancy was observed between the declining prevalence of reported preterm birth and the persistently high prevalence of indoor smoking in Indonesia. However, this should not be interpreted as evidence against the harmful effects of SHS exposure. Preterm birth is a multifactorial outcome influenced by maternal nutrition, antenatal care utilization, management of pregnancy complications, and broader socioeconomic conditions. Therefore, improvements in maternal and neonatal healthcare services may have contributed to declining preterm birth rates, while household SHS exposure has remained largely unchanged. Furthermore, the socioeconomic gradient observed in both indoor smoking and preterm birth suggests that disadvantaged populations may bear a disproportionate burden of tobacco-related harms. Similar inequalities have been documented in Sri Lanka, China, and other LMICs, where lower socioeconomic status and rural residence were consistently associated with greater SHS

exposure during pregnancy [30] [31]. Collectively, these findings underscore the importance of implementing equitable tobacco control strategies targeting vulnerable and underserved populations.

Policy implication

The findings of the present study have important policy implications for Indonesia. In response to the country's substantial tobacco burden, the Indonesian government enacted Government Regulation No. 28 of 2024 as an implementing regulation of Law No. 17 of 2023 on Health. Although the regulation primarily aims to reduce tobacco consumption, the present findings suggest that its effective implementation may also generate important maternal and neonatal health co-benefits through reductions in household secondhand smoke (SHS) exposure. The persistently high prevalence of indoor smoking across nearly all demographic groups indicates that voluntary behavioral change alone may be insufficient to protect pregnant women from SHS exposure, highlighting the need for comprehensive tobacco control strategies.

CONCLUSION

This systematic review and meta-analysis demonstrated that maternal secondhand smoke (SHS) exposure during pregnancy is associated with a significantly increased risk of preterm birth. Despite substantial improvements in maternal and neonatal health indicators, household SHS exposure remains persistently high in Indonesia, particularly among socioeconomically disadvantaged and rural populations. The coexistence of a high indoor smoking burden and elevated preterm birth prevalence among vulnerable groups underscores SHS as an important and modifiable risk factor for adverse pregnancy outcomes. Collectively, these findings provide evidence-based support for the implementation of Government Regulation No. 28 of 2024 and highlight the potential maternal and neonatal health co-benefits of comprehensive tobacco control measures, particularly those aimed at reducing household SHS exposure and promoting smoke-free homes

Declarations

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Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

Author Contributions

B. B. Buana : Project development, data collection, data analysis, manuscript writing and editing.

A. Danianto : Project development, data analysis, manuscript editing.

R. Cahyowati : Project development, manuscript writing and editing, policy analysis.

G. D. H. Wibowo : Project development, policy analysis.

D. L. Kawuryan : Project development, data analysis, manuscript editing.

Ethics Approval

This study is a systematic review and meta-analysis based exclusively on previously published studies. Therefore, ethical approval was not required.

Consent to Participate

Not applicable.

Consent to Publish

Not applicable.

References

1. I. f. H. M. a. E. (IHME), "Global Burden of Disease 2023," 2025.
2. World Health Organization, "WHO report on the global tobacco epidemic, 2025," 2025. [Online]. Available: https://www.who.int/teams/health-promotion/tobacco-control/global-tobacco-report-2025. [Accessed 9 June 2026].
3. World Health Organization, "WHO global report on trends in prevalence of tobacco use 2000–2030," World Health Organization, Geneva, 2024.
4. Ministry of Health of the Republic of Indonesia, "Laporan Nasional Riset Kesehatan Dasar (Riskesdas) 2018," Ministry of Health of the Republic of Indonesia, Jakarta, 2019.
5. Ministry of Health of the Republic of Indonesia, "Survei Kesehatan Indonesia (SKI) Tahun 2023," Ministry of Health of the Republic of Indonesia, Jakarta, 2024.
6. Z. Niu, C. Xie and X. Wen, "Potential pathways by which maternal second-hand smoke exposure during pregnancy causes full-term low birth weight," *Sci Rep*, vol. 29, no. 6, p. 24987, 2016.
7. D. M. Morales-Prieto, P. Fuentes-Zacarias and J. M. Murrieta-Coxca, "Smoking for two- effects of tobacco consumption on placenta," *Molecular Aspects of Medicine*, vol. 87, p. 101023, 2022.

8. H. Cui, T.-T. Gong and C.-X. Liu, "Associations between Passive Maternal Smoking during Pregnancy and Preterm Birth: Evidence from a Meta-Analysis of Observational Studies," *PLOS ONE*, 2016.
9. American College of Obstetricians and Gynecologists, "Prediction and Prevention of Spontaneous Preterm Birth," *Obstetrics & Gynecology*, vol. 138, no. 2, p. e65–e90, 2021.
10. S. Reece, C. Morgan and M. Parascandola, "Secondhand smoke exposure during pregnancy: a cross-sectional analysis of data from Demographic and Health Survey from 30 low-income and middle-income countries," *BMJ Tob Control*, 2018.
11. V. Tong, P. Dietz and I. Rolle, "Clinical interventions to reduce secondhand smoke exposure among pregnant women: a systematic review," *BMJ Tob Control*, 2015.
12. Z. Quinones and D. Li, "Predictors of Secondhand Smoke Exposure During Pregnancy in Costa Rica, the Dominican Republic, and Honduras," *Nicotine and Tobacco Research*, vol. 24, pp. 909–913, 2022.
13. Government of the Republic of Indonesia, "Law of the Republic of Indonesia Number 17 of 2023 on Health," 08 Aug 2023. [Online]. Available: https://share.google/nJglQt2oCLb3UITmK. [Accessed 9 June 2026].
14. B. F. Moore, A. P. Starling and S. Magzamen, "Fetal exposure to maternal active and secondhand smoking with offspring early-life growth in the Healthy Start study," *Int J Obes (Lond)*, vol. 43, no. 4, pp. 652–662, 2019.
15. W. Liu, C. Huang and J. Cai, "Household environmental exposures during gestation and birth outcomes: A cross-sectional study in Shanghai, China," *Science of the Total Environment*, vol. 615, pp. 1110–1118, 2018.
16. I. Hudic, B. Stray-Pedersen and V. Tomic, "Preterm Birth: Pathophysiology, Prevention, Diagnosis, and Treatment," *Biomed Res Int*, 2015.
17. M.-a. Wagijo, A. Sheikh and L. Duijts, "Reducing tobacco smoking and smoke exposure to prevent preterm birth and its complications," *Paediatric Respiratory Reviews*, pp. 3–10, 2017.
18. D. Suzuki, W. M. Wariki and I. H. Octawijaya, "HEALTH EFFECTS OF SECONDHANDSMOKE DURING PREGNANCY ON MATERNAL AND PERINATAL OUTCOMES IN TOMOHON CITY, NORTH SULAWESI, INDONESIA," *The Indonesian Journal of Public Health*, vol. 18, no. 2, 2023.
19. X. Wang, X. Gao and D. Chen, "The effect of active and passive smoking during pregnancy on birth outcomes: A cohort study in Shanghai," *Tobacco Induced Disease*, vol. 22, p. 122, 2024.
20. H. Karumai-Mori, H. Hamada and N. Iwama, "Impact of maternal smoking and secondhand smoke exposure during singleton pregnancy on placental abruption: analysis of a prospective cohort study (the Japan Environment and Children's Study)," *BMJ Open*, vol. 15, no. 3, 2025.
21. A. A. Al-Mughathwai, M. Alharbi and T. Aljehani, "Associations Between Secondhand Smoke Exposure During Pregnancy and Preterm Birth," *Journal of Clinical Medicine*, vol. 14, p. 4325, 2025.
22. J. Leonardi-Bee, J. Britton and A. Venn, "Secondhand smoke and adverse fetal outcomes in nonsmoking pregnant women: a meta-analysis," *Pediatrics*, vol. 127, no. 4, pp. 734 – 41, 2011.

23. E. Rutayisire, M. Mochama and C. K. Ntihabose, "Maternal, obstetric and gynecological factors associated with preterm birth in Rwanda: findings from a national longitudinal study," *BMC Pregnancy and Childbirth*, vol. 23, p. 365, 2023.
24. N. N. Rang, T. Q. Hien and T. Q. Chanh, "Preterm birth and secondhand smoking during pregnancy: A case–control study from Vietnam," *PLOS ONE*, 2020.
25. A. T. Hoyt, M. A. Canfield and P. A. Romitti, "Does Maternal Exposure to Secondhand Tobacco Smoke During Pregnancy Increase the Risk for Preterm or Small-for-Gestational Age Birth?," *Maternal and Child Health Journal*, 2018.
26. S. Chansaeng, W. Boonchieng and W. Naksen, "Secondhand smoke prevention through the perceptions of pregnant women with smoking family members: a Thailand study," *INTERNATIONAL JOURNAL OF QUALITATIVE STUDIES ON HEALTH AND WELL-BEING*, vol. 19, 2024.
27. C. Jackson, R. Huque and V. Satyanarayana, "He Doesn't Listen to My Words at All, So I Don't Tell Him Anything"—A Qualitative Investigation on Exposure to Second Hand Smoke among Pregnant Women, Their Husbands and Family Members from Rural Bangladesh and Urban India," *International Journal of Environmental Research and Publich Health*.
28. E. Stevens, E. Mead-Morse and K. Labib, "Prevalence and factors associated with second hand smoke exposure among a sample of pregnant women in Cairo, Egypt," *BMC Women's Health*, vol. 24, p. 145, 2024.
29. E. Torres, Z. Q. de Monegro and L. French, "Tobacco Use and Exposure to Secondhand Smoke Among Pregnant Women in the Dominican Republic: An Exploratory Look into Attitudes, Beliefs, Perceptions, and Practices," *Nicotine & Tobacco Research*, vol. 13, no. 12, 2011.
30. W. Zhou, X. Zhu and Z. Hu, "Association between secondhand smoke exposure in pregnant women and their socioeconomic status and its interaction with age: a cross-sectional study," *BMC Pregnancy and Childbirth*, vol. 22, p. 695, 2022.
31. A. S. Perera, R. M. Jayasinghe and A. Rajapakse, "Second hand smoking and tobacco use among pregnant women in Yatinuwara Medical Of cer of Health (MOH) area in Sri Lanka," *Journal of Oral Biology and Craniofacial Research*, vol. 11, pp. 442–446, 2021.
32. T.-J. Ko, L.-Y. Tsai and L.-C. Chi, "Parental Smoking during Pregnancy and Its Association with Low Birth Weight, Small for Gestational Age, and Preterm Birth Offspring: A Birth Cohort Study," *Pediatrics and Neonatology*, 2013.
33. <background-color:#5B96A2;vertical-align:baseline;>Supplementary Table 1</background-color:#5B96A2;vertical-align:baseline;>. Main findings of studies included in the systematic review and meta-analysis.

Figures

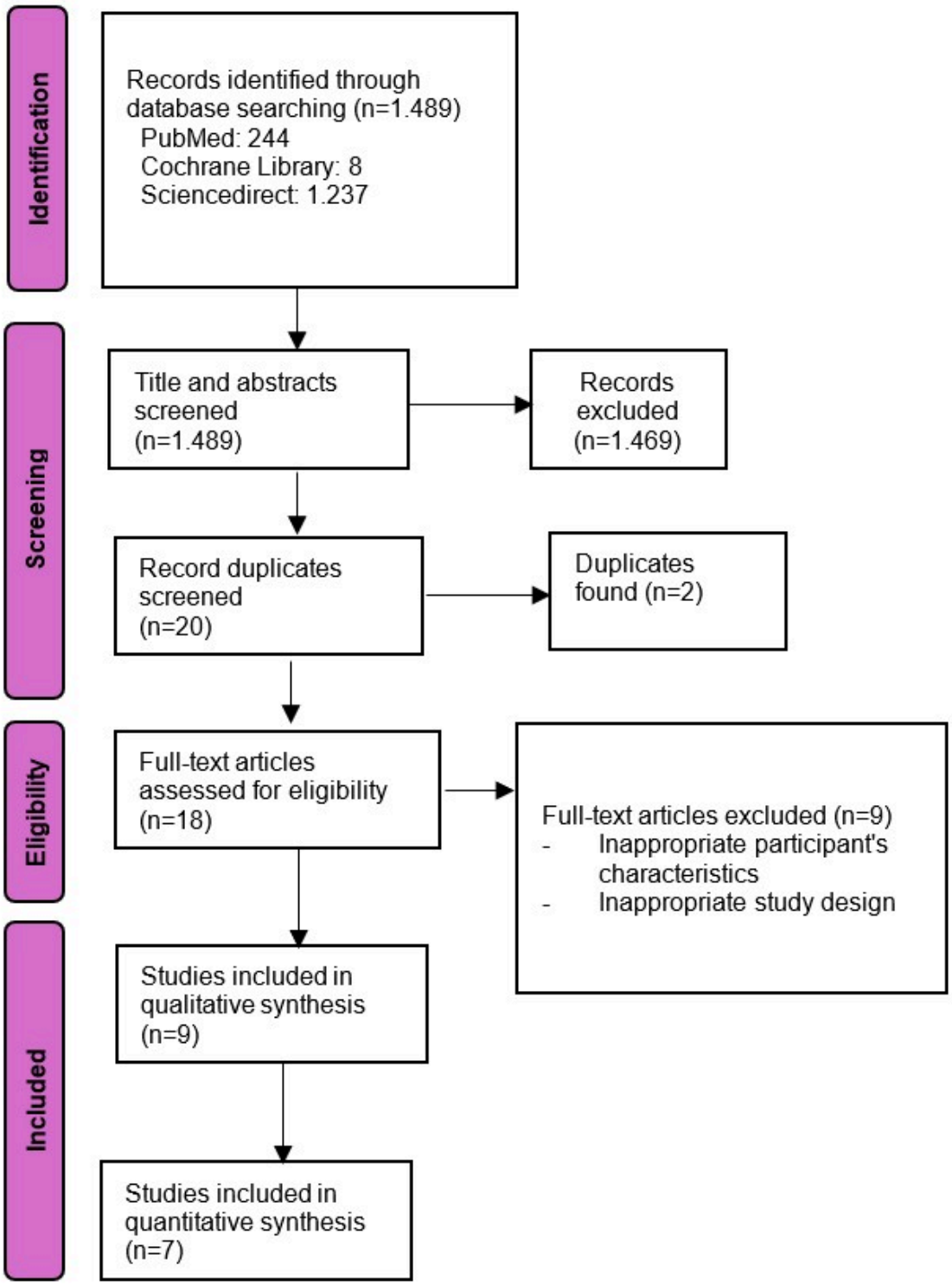


Figure 1

Diagram flow of literature search strategy for this systematic review

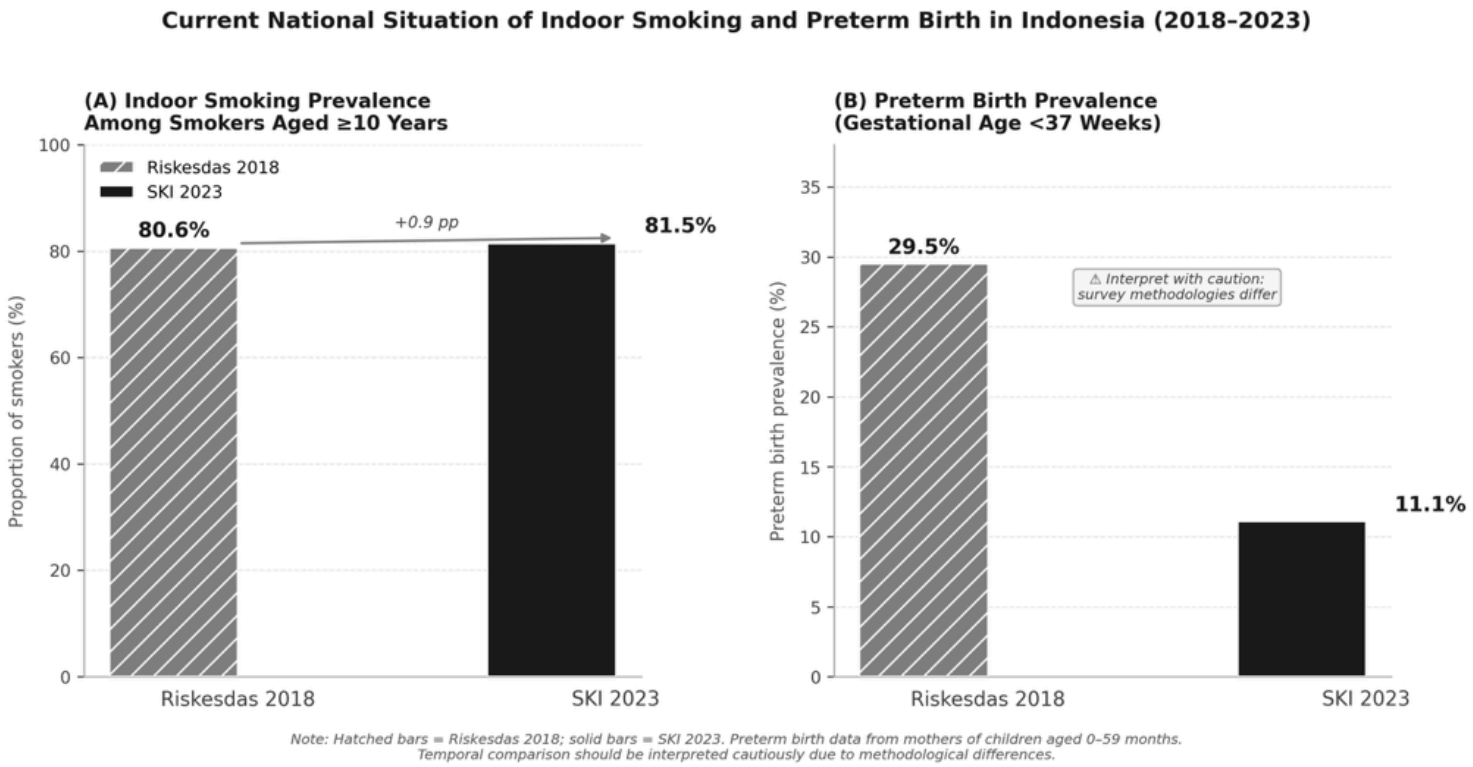


Figure 2

Current National Situation of Indoor Smoking and Preterm Birth in Indonesia

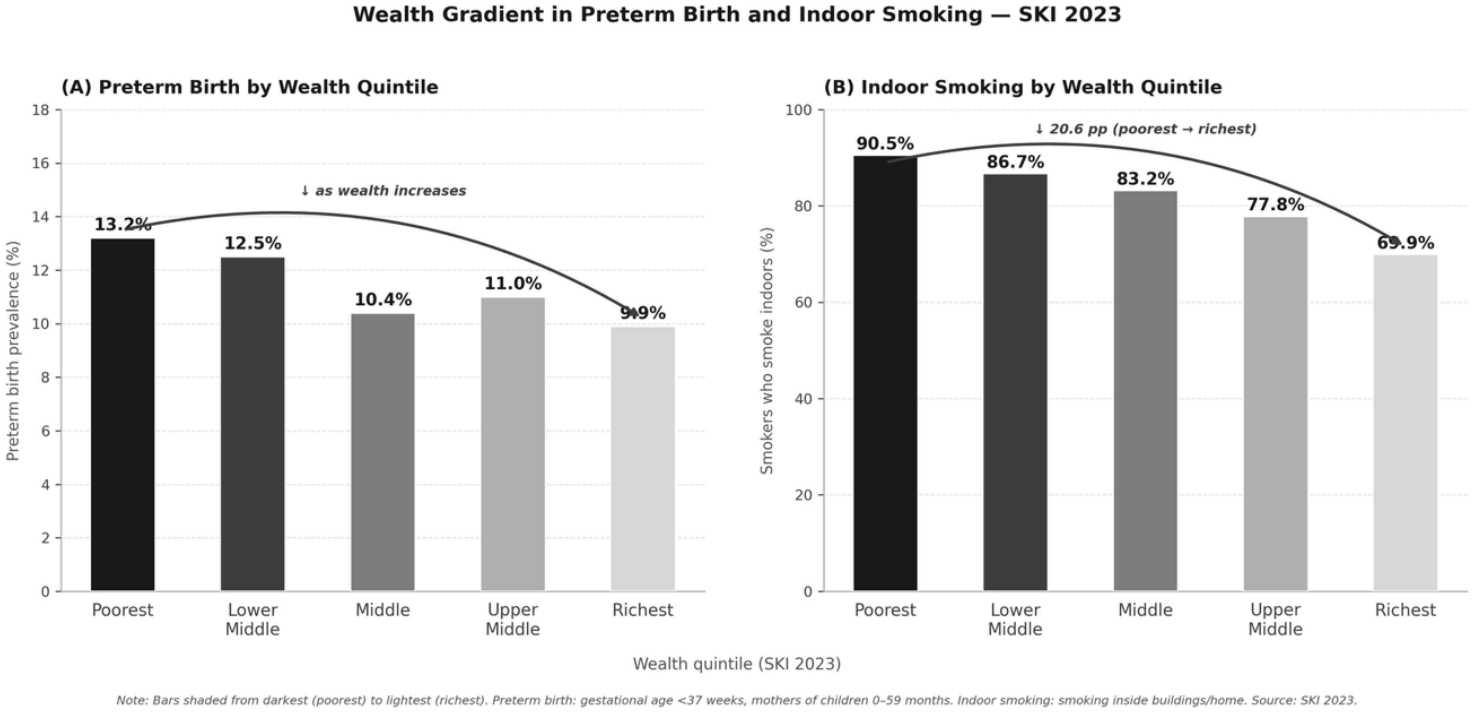


Figure 3

Socioeconomic gradient of preterm birth and indoor smoking according to household wealth quintile in Indonesia, based on the 2023 Indonesian Health Survey (SKI)

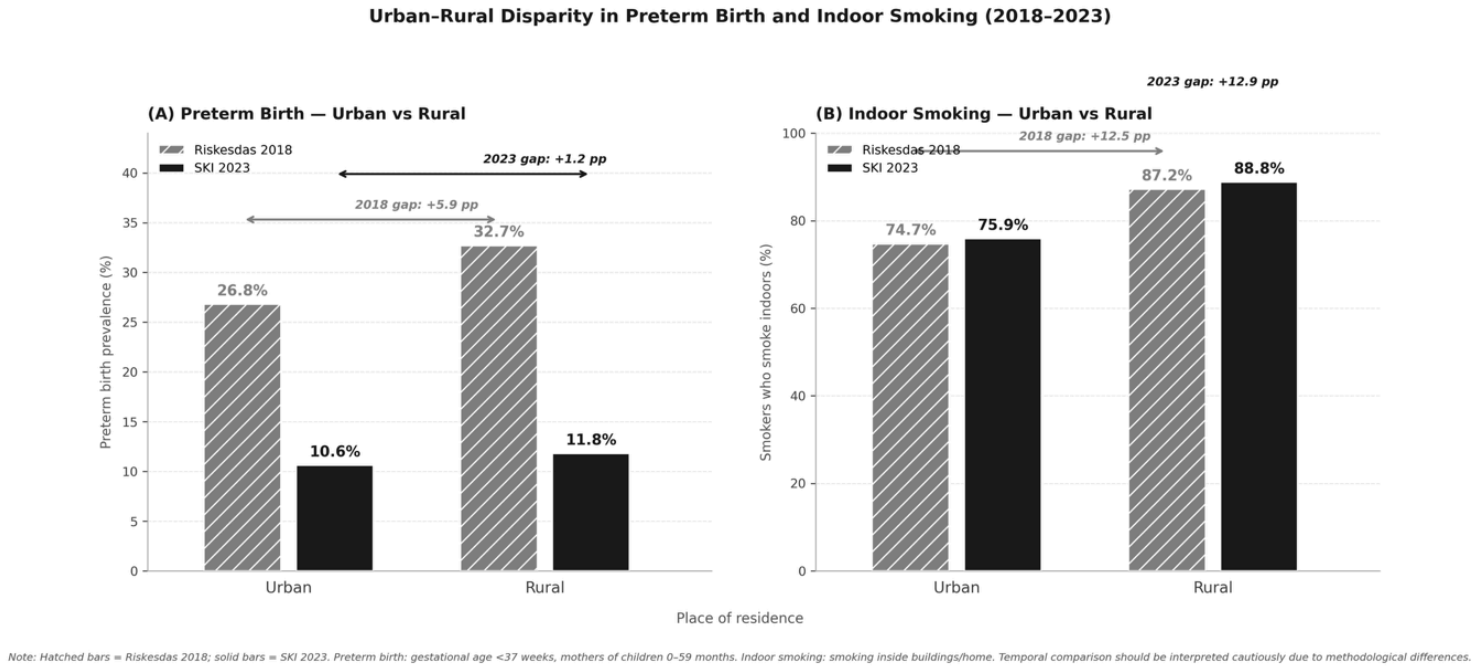


Figure 4

Urban–Rural Distribution of Preterm Birth and Indoor Smoking in Indonesia According to Riskesdas 2018 and SKI 2023.

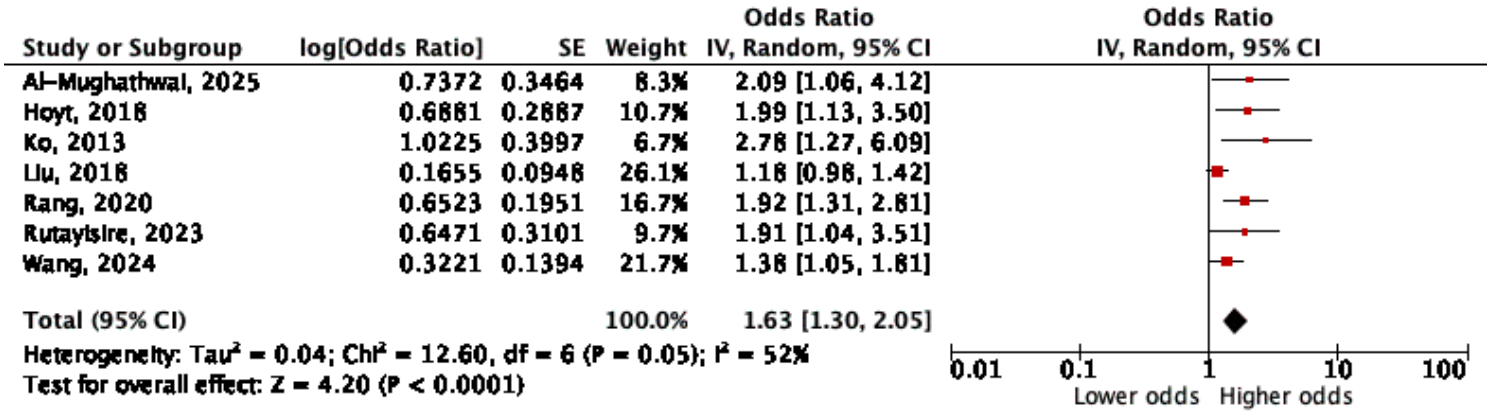


Figure 5

Forest plot of the association between maternal secondhand smoke exposure during pregnancy and preterm birth risk

Supplementary Files

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