

THE EFFECT OF HOUSEHOLD AIR POLLUTION EXPOSURE ON THE INCIDENCE OF ACUTE RESPIRATORY INFECTION IN CHILDREN UNDER FIVE IN ASIA: A META-ANALYSIS

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ABSTRACT

ASIA is a continent with many people who still have and use biomass or solid fuel use (SFU) for cooking and various household air pollution. Previous research has mentioned the negative effects of household air pollution on the incidence of acute respiratory infections in children under 5 years. Acute respiratory diseases have even become the cause of at least 4 million deaths of children under 5 years old every year in the world. The meta-analysis aimed to estimate the correlation between household air pollution and the incidence of acute respiratory infections in children under five in ASIA. This study was a meta-analysis. Primary data is taken through the electronic databases such as: PubMed, Science Direct, Web of Science, Springer Link and Cochrane Database. By using the search keywords "Household air pollution AND acute respiratory tract infections AND adjusted odds ratio", "indoor air pollution AND acute respiratory tract infections AND adjusted odds ratio", and "paparan asap rumah tangga DAN ISPA DAN adjusted odds ratio". Articles taken between 2013-2023. Statistical analysis was performed using the RevMan 5.3. 7 articles qualified for quantitatively analysis. The exposure of household air pollution can increase the risk of acute respiratory infections 3 times in children under five and statistically significant (OR 3.36; 95% CI: 2.96 – 3.81; p value < 0.001). Exposure to household air pollution is a significant risk factor for the incidence of acute respiratory infections in children under 5 years.

Keywords: acute respiratory tract infection; asia; children under five; household air pollution; metaanalysis

INTRODUCTION

ARI or acute respiratory tract infection can occur in the upper and lower respiratory tract, is an infection caused by trace bodies or bacteria, Haemophilus influenzae type B (Hib) virus, without or accompanied by lung parenchyma. A mortality survey in 2016 ranked ISPA as causing 32.10% of infant deaths in Indonesia, making it the highest cause of death. It is reported that ARI has caused death in ± 4 million of the 13 million under-five deaths each year. (Son, 2019) (Yeimo, 2018). This infection can affect one or more of the airway systems from the nose to the alveoli, sinuses, middle ear cavity, and pleura. Symptoms of the disease take time to arise ranging in a matter of hours, as well as an incubation period of 1 to 4 days, transmission not only through droplets, but contact of hands or contaminated surfaces can also transmit this disease. (Widianti, 2020) (Nannyonga, 2020).

Various factors both intrinsic and extrinsic can cause a child to suffer from ARI, one of which is the nutritional status of children under five and factors that are rarely considered by health experts, namely occupancy factors that include exposure to household air pollution and occupancy density. According to research, people who live in high-density housing have a 6,167 times chance of experiencing the incidence of ARI disease compared to the density of eligible occupancy. This result is reinforced by research that reports that high exposure to household air pollution will cause a toddler to be 5 times more likely to suffer from ARI and even progress to pneumonia. (Zairinayati, 2020) (Yeimo, 2018).

METHOD

This research was conducted by *systematic review* and meta-analysis by searching and selecting data from the results of analysis conducted across ethnicities, races, and also locations in countries located on the continent of ASIA during the last 10 years, namely 2013-2023 . The research was conducted by applying the principle of PRISMA (*Preferred reporting items for systematic review and meta-analysis protocols*). Research data is sought from several indexing including: PubMed, Science Direct, Web of Science, Springer Link and Cochrane Database. By using the search keywords "*House hold air pollution AND acute respiratory tract infections AND adjusted odds ratio*", "*indoor air pollution AND acute respiratory tract infections AND adjusted odds ratio*", and "*Exposure to household air pollution AND ISPA AND adjusted odds ratio*". Full paper article with observational study design. Articles published in English and/or Indonesian. Include the results of research in the form of *adjusted odds ratio* as an indication of the most ideal analysis for multivariate research. *Outcome* is an ISPA event. Exposure is pollution that occurs in the household / air pollution in the house such as: cigarette smoke, burning from household kitchens that are not separated from other rooms or lack of ventilation, and routine mosquito coil burning.

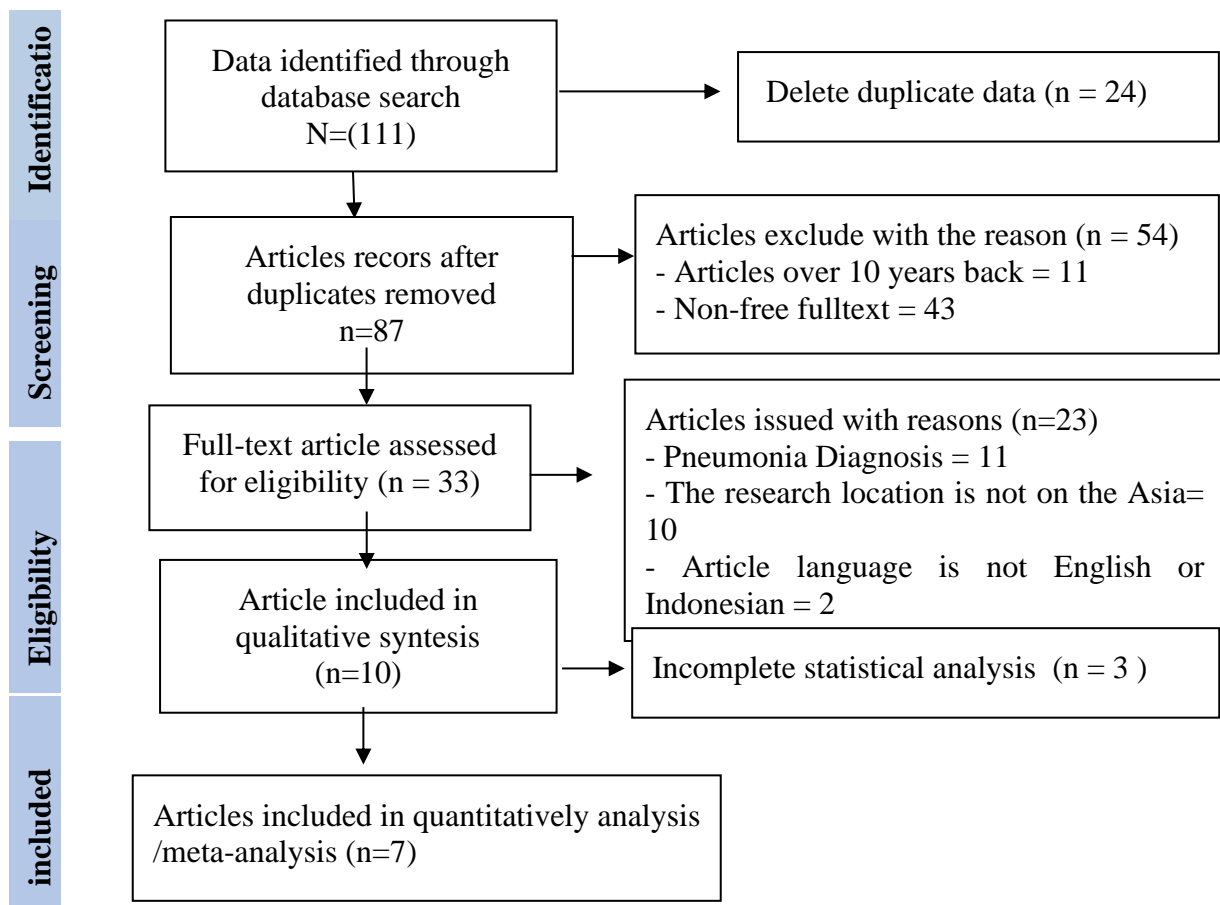


Figure 1. PRISMA flow chart diagram

The article is a primary study with observational design or meta-analysis of observational studies. The study subjects were a maximum of 59 months old. Research with protocol design, experimental quasy, RCT. Univariate or bivariate analysis. The diagnosis outcome is pneumonia or tuberculosis. The subject had HIV/AIDS. This meta-analysis will be carried out using Odds

ratio estimation analysis. Researchers will use fixed effect analysis when heterogeneity is $\leq 50\%$ and will use random effect if heterogeneity is $> 50\%$.

Table 1.
Summary source table

Author	Subjects	Country	Result
(Mondal, 2020)	247,743 toddlers	India	- Bivariate: Use of biomass fuels (OR [odds ratio]: 1.10, 95% CI: 1.01–1.20), households without separate kitchens (OR: 1.22, 95% CI: 1.14–1.30) smoking behavior of household members (OR: 1.06, 95% CI: 1.00–1.12). Multivariate: The effect of biomass fuels and households without separate kitchens increases the likelihood of pediatric ARI by 36% (adjusted OR: 1.35, 95% CI: 1.21–1.51)
(Anjaswanti, 2022)	14 articles summarized from 2016 to 2020	Indonesian	The behavior of household members who smoked was 2,585 times more likely to develop pneumonia than the behavior of non-smoking household members (OR = e0.95 = 2,585 (95% CI 0.69- 1.21).
(Looking Forward, 2022)	8 articles	Indonesian	Children living in a home environment that has air pollution from burning mosquito repellent, kitchen, and cigarette smoke are 1.9 or 2 times more likely to suffer from acute respiratory infections (PR: 1.904; 95%CI: -0.29 - 0.47)
(Rana, 2019)	27,565 toddlers living indoors	Afghanistan	The prevalence of ARI was higher in children living in homes with solid fuel use compared to children living in households without SFU (adjusted prevalence ratio (aPR) = 1.10; 95% CI: (0.98, 1.23). These results have controlled for kitchen location variables.
(Supraptini, 2010)	88,579 toddlers	Indonesian	Toddlers with exposure to house smoke in the form of poor fuel use have a risk of suffering from ARI by 1,195 times (95% CI: 1,115-1,280) these results have controlled for variables such as toddler age, nutritional status, maternal

Author	Subjects	Country	Result
(Islam, 2022)	8,347 Toddlers	Bangladesh	education, maternal occupation, domestic smokers, outdoor pollution and floor type. From the analysis of this study it was found that the odds ratio (OR) was 1.69 [95% confidence interval (CI): 1.06–2.71]. This showed that children in homes exposed to combustion smoke were 1.7 times more likely to experience an episode of ARI. After adjusting for cooking fuel, type of roofing material, age of child (months), and sex of child – the effect of solid fuel was similar to the adjusted odds ratio (AOR) for ISPA (OR: 1.69, 95% CI: 1.05 –2.72)
(Susilowati, 2022)	26 research articles conducted in various regions from 2011-2021	Indonesian	Based on the results of this study showed that there was a significant relationship between ventilation (OR=0.814, RR=1.138, 95% CI: 0.280-2.369), and the incidence of ARI in toddlers.

Forest plot analysis

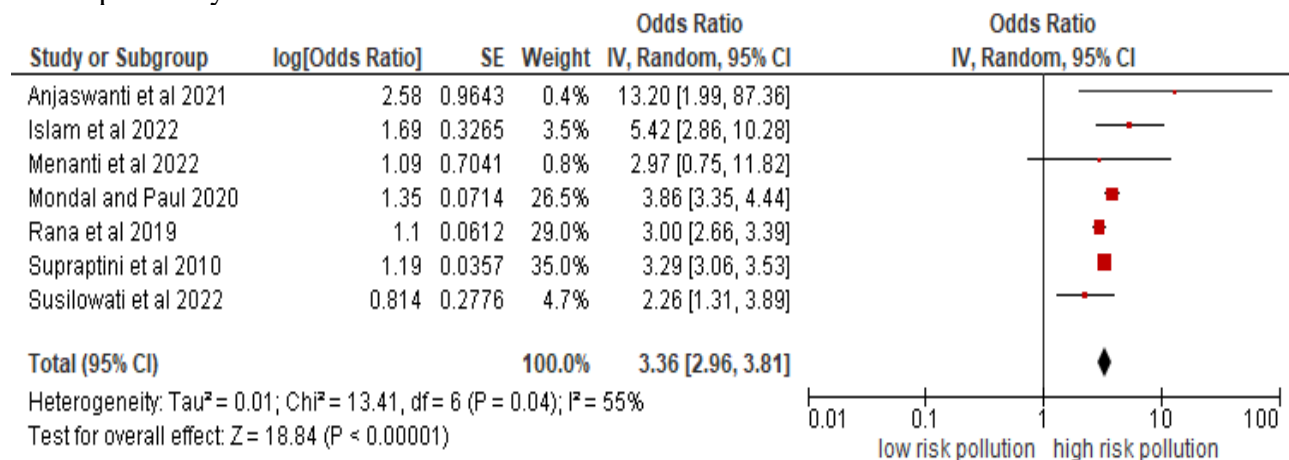


Figure 2. Forest plot meta-analysis of the relationship between household air pollution and the incidence of ARI in toddlers

Based on the results of the forest plot analysis above, it can be seen that in children under 5 years of age, exposure to household air pollution or indoor air pollution will increase the risk of acute respiratory infections 3 times compared to children living in a household environment that has clean airflow and statistically significant Odds Ratio (OR 3.36; 95% CI: 2.96 – 3.81; p value <

0.001). The results of this meta-analysis show a statistically significant value for the negative influence of smoke exposure in households on the incidence of respiratory infections in children under 5 years old in Asian countries. The results report that 37 low- and middle-income countries spread across Africa, the Americas, Southeast Asia, Europe, the Eastern Mediterranean and the Western Pacific region still use household cooking energy sources that still use solid biomass (wood, charcoal/manure, agricultural crops) have the opportunity as risk factors for respiratory tract infections in children under five with a probability ratio of incidence after controlling for various confounding variables (AOR: 1,17; 95% CI: 1.09–1.25) compared to cleaner energy sources such as Liquid Petroleum Gas (LPG), electricity, biogas, and natural gas. (Al-Janabi, 2021) In this analysis, exposure to household pollution comes from various harmful fumes, including: kitchen burning, cigarette smoke, burning mosquito repellent or insect repellent, and exposure to the use of solid fuels as heating with poor ventilation. In Indonesia, household air pollution is usually found in traditional houses that do not have adequate partitions or ventilation.(Yeimo, 2018). The cooking process that causes harmful fumes in the house will increase the concentration of particles in the room of the house. Children under five years old are more likely to spend time indoors, even near indoor fires and heating during cooking because they have to be close to their mothers. In addition, more children have higher breathing frequencies, narrower airways, and larger lung surfaces, so they breathe 50% more polluted air under normal conditions than older children while those children's immune systems are still developing to fight off various infections.(Chafe, et al., 2015)(Gordon, et al., 2014).

CONCLUSION

Researchers also suggest for countries in ASIA especially Indonesia to switch household cooking energy sources from biomass solids to cleaner alternatives will achieve respiratory health benefits in children under five years around the world. High-quality mixed methods research is still needed to increase the acceptance and uptake of clean cooking energy source interventions in a sustainable manner within Asian countries.

REFERENCES

- Son, Y. & W. S. S., 2019. Factors causing the occurrence of ARI. *Journal of Health*, pp. 10(1), 37-40.
- Yeimo, Y. Q. I. & M. B., 2018. Environmental factors associated with pneumonia in children under-five in Nduga District, Papua. *Journal of Epidemiology and Public Health*, 3(3), pp. 307-311..
- Widianti, S., 2020. Ispa Treatment in Children Under Five (Literature Study). *Journal of Health and Development*, 10(20), pp. 79-88.
- Nannyonga, B. K. K. W. R. K. K. P. S. J. M. L. T. M. F. E. .. & a. m. o. t. U. S.-C.-2. S. A. C., 2020. Estimating the Effect and Cost-Effectiveness of Facemasks in Reducing the Spread severe Acute Respiratory Syndrome-Coronavirus 2 (SARS-CoV-2) in Uganda. *medRxiv*, p. 06.
- Zairinayati, Z. & P. D. H., 2020. THE RELATIONSHIP BETWEEN OCCUPANCY DENSITY AND VENTILATION AREA WITH THE INCIDENCE OF ISPA IN PALEMBANG FLATS. *Indonesian Journal for Health Sciences*, 4(2), pp. 121-128.

- Aromataris, E. & P. A., 2014. The systematic review: an overview. *AJN The American Journal of Nursing*, 114(3), pp. 53-58.
- Mondal, D. & P. P., 2020. Effects of indoor pollution on acute respiratory infections among under-five children in India: Evidence from a nationally representative population-based study. *PLOS One*, 15(8), p. e0237611.
- Anjaswanti, R. N. A. R. & L. A., 2022. META-ANALYSIS STUDY: RISK FACTORS FOR PNEUMONIA INCIDENCE IN TODDLERS IN INDONESIA IN 2016-2021. *Journal of Community Mental Health and Public Policy*, 4(2), pp. 56-70.
- Awaiting, L. A. R. L. M. T. L. A. S. A. J. S. N. & R. M. A., 2022. BEHAVIORAL RISK FACTORS OF FAMILIES WITH THE INCIDENCE OF ACUTE RESPIRATORY TRACT INFECTIONS (ARI) IN TODDLERS IN INDONESIA: META-ANALYSIS 2015-2020.. *VISIKES: Journal of Public Health*, 21(2).
- Rana, J. U. J. P. R. & O. Y., 2019. Associations between indoor air pollution and acute respiratory infections among under-five children in Afghanistan: do SES and sex matter?. *International Journal of Environmental Research and Public Health*, 16(6), p. 2910.
- Islam, M. A. A. H. M. N. A. T. A. A. M. A. A. S. M. N. E. A. .. & A. F., 2022. Association of household fuel with acute respiratory infection (ARI) under-five years children in Bangladesh. *Frontiers in Public Health*, Volume 10.
- Susilowati, E. & M. A., 2022. *ARI AND ITS CAUSATIVE FACTORS*. Pontianak, In Proceedings of the National Seminar on Public Health, University of Muhammadiyah Pontianak, pp. 161-177.
- Supraptini, S. ., 2010. Factors of air pollution in the house associated with the incidence of ispa in toddlers in Indonesia. *Indonesian Journal of Health Ecology*, 9(2), pp. 1238-1247.
- Al-Janabi, Z. W. K. E. T. G. N. & B. S. E., 2021. A cross-sectional analysis of the association between domestic cooking energy source type and respiratory infections among children aged under five years: Evidence from demographic and household surveys in 37 low-middle income countries. *International Journal of Environmental Research and Public Health*, 18(16), p. 8516.
- Chafe, Z. et al., 2015. Household cooking with solid fuels contributes to ambient PM2.5 air pollution and the burden of disease. *Environ. Health Perspect*, p. 122.
- Gordon, S. et al., 2014. Respiratory risks from household air pollution in low and middle income countries. *Lancet Respir. Med*, Volume 2, p. 823–860.