



Physical Environmental Factors and Maternal Behavioral Characteristics in Toddlers ARI

Malik Saepudin[✉], Gebytri Nuraudia¹, Moh. Adib¹, Marvita¹, Windarti¹

¹Poltekkes Kemenkes Pontianak

Article Info

Article History:

Submitted October 2025

Accepted February 2026

Published April 2026

Keywords:

Maternal Behavior;
Environment; Physical

DOI

<https://doi.org/10.15294/kemas.v21i4.34995>

Abstract

ISPA frequently occurs in toddlers, particularly in the North Putussibau area, which reports the highest cases. This research studies the association between physical environmental factors and behaviors with ISPA incidence among toddlers at the North Putussibau Community Health Center. Using a case-control design, 64 participants were equally separated into patient and comparison categories. Data were examined applying the χ^2 analysis, with significance assessed correlations were among ISPA incidence and dampness ($p = 0.023$), lighting ($p = 0.024$), floor type ($p = 0.000$), residential density ($p = 0.048$), use of mosquito repellent ($p = 0.003$), exposure to smoke ($p = 0.023$), mothers not covering their mouths when coughing ($p = 0.007$), delayed toddler care ($p = 0.003$), and mothers not wearing masks when ill ($p = 0.024$). No significant links were observed with ventilation, wall or roof type, open windows, mothers not washing hands after coughing, or burning trash near the house. These results suggest that both the home environment and maternal behaviors influence the occurrence of sudden breathing illnesses in the young.

Introduction

Eradicating infectious diseases is crucial for reducing morbidity and mortality due to infection. By effectively preventing the spread of disease, the burden on public health can be reduced (Li *et al.*, 2025). Eradication is a key strategy aimed at enhancing the standard of living and overall health belonging to the community by minimizing the risk of complications as well as mortality triggered due to communicable illnesses (Khawar *et al.*, 2023). Acute respiratory infections remain a significant public health issue among toddlers, particularly in areas with poor environmental conditions and suboptimal maternal health behaviors (Nurwijayanti *et al.*, 2024). Experts claim that young individuals' defense mechanisms exist are significantly distinct compared to those belonging to grown-ups because the protective systems are still weak and not yet fully developed (Sakleshpur and

Steed, 2022). As a result, when a family member suffers from a contagious illness such as a cough or cold, children, especially toddlers, are more susceptible to contracting the disease.

This immaturity in children's physical condition makes it easier and quicker for disease to spread within the home, significantly increasing the risk of infection spreading among family members (Ibiebele *et al.*, 2025). Tangible aspects regarding the home surroundings, for example, humidity, ventilation, lighting, as well as types of floors and walls, along with maternal behaviors, play an essential part of ARI in early childhood (Rizaldi, 2023). Environmental factors that influence indoor air quality include exposure to cigarette smoke and fumes from cooking fuels, especially if the concentration of these fumes is high and good air circulation is ensured within the home (Tang *et al.*, 2024). Furthermore, high occupancy rates in homes also increase the risk of this disease, as they

✉ Correspondence Address:
Poltekkes Kemenkes Pontianak
Email: mlksaepudin66@gmail.com

make the air more easily polluted and promote close contact between individuals (Aldridge *et al.*, 2021).

Individual factors influencing the risk of ARI include several aspects of the child's health and physical condition. Age is a crucial factor, as infants and toddlers, who are still vulnerable and have immature immune systems, are more susceptible to ARI (Wang *et al.*, 2024). Birth weight is also an important indicator; low-birth-weight babies tend to have weaker immune systems. A child's overall nutritional status is closely related to the body's ability to fight infection, as is vitamin A status, which is known to play a role in maintaining respiratory health and immune function (Tan *et al.*, 2025).

Furthermore, a child's immunization status is crucial, as complete vaccinations can protect children from various infections that cause ARI (Kuuyi and Kogi, 2024). Behavioral factors relate to disease prevention and control measures undertaken by families or communities, particularly in the context of infant and toddler care (Kiros *et al.*, 2025). Preventive behaviors such as maintaining environmental cleanliness, using protective equipment when cooking, avoiding exposure to cigarette smoke, and implementing good ventilation in the home are crucial for lowering the chance for ARI (Kek *et al.*, 2023). The active role of families and communities in recognizing early symptoms of ARI, promptly taking children to health facilities, and providing appropriate care also contributes significantly to preventing complications and the spread of the disease (Tombeg *et al.*, 2024). Therefore, understanding and consistently implementing these various preventive measures will help decrease the occurrence of acute respiratory infections among kids (Oluwaseun and Seun-Addie, 2025).

Previous studies have indicated that environmental risks like indoor air pollution, high population density, and inadequate sanitation, combined with behavioral factors such as smoking and improper use of protective equipment, significantly add to the elevated prevalence rate of respiratory infections in children below five years old (Santri *et al.*, 2023). However, most of these studies were mainly conducted in urban areas such as

Jakarta, Surabaya, and Dhaka, where household structures, ventilation patterns, and waste management systems tend to be more advanced (Sohel *et al.*, 2024). Despite various intervention efforts, ARI remains a primary reason for illness and death in toddlers, especially in developing regions, including Indonesia (Purnama *et al.*, 2025). Therefore, these learn aims on analyze this connection among those tangible home surroundings conditions as well as maternal conduct relating to the incidence of Acute Respiratory Infection in young children within the operational zone of the North Putussibau Community Healthcare facility, to address local environmental health knowledge gaps that can serve as a basis for designing targeted public health interventions.

Method

The study utilized a systematic descriptive framework including a case-control method to explore links between home environmental factors and maternal behaviors concerning ARI incidence in toddlers. Primary data included maternal behavior questionnaires, home observations, environmental measurements with thermohygrometers and tape measures, and photographic evidence. Secondary data were retrieved from the Community Health Center's medical records to validate ARI diagnoses. Data were gathered through structured interviews and direct home environment assessments. Analysis consisted of descriptive univariate statistics to present variable distributions and chi-square bivariate tests to examine associations, considering $p < 0.05$ as significant and calculating likelihood proportions accompanied by 95% certainty ranges for evaluation.

The research employed a systematic observational design featuring a case-control strategy that aims to identify the relationship between maternal behavior and the physical condition of the home environment with the incidence of Acute Respiratory Tract Infections (ARI) in toddlers, conducted in the working area of the North Putussibau Community Health Center, Kapuas Hulu Regency, from June to August 2024. The study population consisted of all toddlers having ARI in 2022, totaling 32 cases, with a total sample of 64

TABLE 1. The connection between Environmental Factors, Human Behavior, and the Occurrence of ARI Within the North Putussibau Community Clinic's Service Region

Variables	Experiencing ARI (n=32)	Not Experiencing ISPA (n=32)	Total (n=64)	p-value	OR
Room Humidity	23 (71,9%)	14 (43,8%)	37 (57,8%)	0,023	3,286
Ventilation Area	14 (43,8%)	7 (21,9%)	21 (32,8%)	0,062	2,778
Lighting	19 (59,4%)	10 (31,3%)	29 (45,3%)	0,024	3,215
Wall Type	17 (53,1%)	10 (31,3%)	27 (42,2%)	0,076	2,493
Floor Type	28 (87,5%)	12 (37,5%)	40 (62,5%)	0,000	11,667
Roof Type	5 (15,6%)	4 (12,5%)	9 (14,1%)	0,719	1,296
Occupancy Density	12 (37,5%)	5 (15,6%)	17 (26,6%)	0,048	3,240
Use of Mosquito Coils	27 (84,4%)	16 (50,0%)	43 (67,2%)	0,003	5,400
Habit of Opening Windows	15 (46,9%)	22 (68,8%)	37 (57,8%)	0,076	2,493
Smoking Habit	23 (71,9%)	14 (43,8%)	37 (57,8%)	0,023	3,286
Mother's Behavior	14 (43,8%)	6 (18,8%)	20 (31,3%)	0,031	3,370

respondents, namely 32 cases and 32 controls selected purposively based on age and domicile matching. Inclusion criteria included toddlers aged 0-59 months who had been diagnosed with ARI and were willing to participate, while controls consisted of toddlers without a history of ARI. Primary data were obtained through a structured questionnaire to determine maternal behavior related to hand hygiene, exclusive breastfeeding, cigarette smoke exposure, and immunization compliance, as well as direct observation of the physical condition of the house, such as ventilation, temperature, humidity, occupancy density, and pollution sources using a thermohygrometer and roll meter. Secondary data are from medical records at the Community Health Center as verification of the diagnosis. The research instrument was pilot tested for clarity and reliability, with enumerators receiving training and field supervision by the principal investigator, and random data validation. Data analysis included univariate descriptive analysis, a Chi-square test for bivariate analysis with a 95% significance level, producing odds ratios (OR) and confidence intervals (CI), and multivariate logistic regression to control for confounding variables and determine the dominant factors causing acute respiratory infections in toddlers.

Result and Discussion

The study found a significant link between indoor humidity levels and the occurrence of ARI ($p=0.023$; $OR=3.286$). Children residing in homes with improper humidity levels were 3.3 times more likely to undergo acute respiratory infection compared to those with appropriate humidity. This research aligns with that of Islam *et al.* (2024), which reported that inadequate indoor humidity increases the risk of pneumonia in children. Elevated humidity conditions promote the proliferation of microorganisms such as bacteria and viruses, which are primary causes of ARI. This research aligns with findings by Wati *et al.* (2021) that children living in homes with uncontrolled humidity levels face a higher risk of pneumonia compared to children living in homes with humidity levels that meet health standards. High or fluctuating humidity can support the growth of microorganisms that cause respiratory infections, thereby increasing the incidence of pneumonia in children. These results are consistent with previous studies that emphasize the importance of regulating indoor humidity to prevent respiratory illnesses in this age group.

Although the descriptive data showed that ISPA cases were more common in homes with poor ventilation (43.8%), the statistical analysis did not find a significant association

($p=0.062$). This finding aligns with the study by Bupu *et al.*, 2024, which also found no significant link between ventilation and ISPA. Other environmental or behavioral factors, like the habit of opening windows and overcrowding, might have a greater impact. A study by Pawenang and Munawaroh (2024) published in JPPKMI using a case-control design with toddlers showed that room ventilation significantly correlated with the incidence of ARI, with a p -value of 0.001 and an OR of 5.550. Therefore, adequate ventilation can reduce the risk of ARI in toddlers. However, in my study, although most ARI cases were found in homes with poor ventilation (43.8%), the relationship did not reach statistical significance ($p=0.062$). This difference in results may be due to variations in population characteristics, sample size, or other environmental factors that differed between the two studies.

Poor lighting was significantly linked to an increased incidence of ARI ($p=0.024$; OR=3.215). Insufficient natural light raises the risk of ARI because the lack of sunlight promotes moisture retention and microbial proliferation. Adequate exposure to natural light is recognized for its disinfectant properties and its role in preserving indoor air quality (Izmir *et al.*, 2025). Sunlight naturally suppresses the growth of bacteria and fungi. These findings are consistent with the study by Holden *et al.* (2023), which found that children living in poorly lit homes experience a higher rate of ARI.

No meaningful association was observed between the type of wall and the occurrence of ARI ($p=0.076$). The present result is in agreement with the research by Bakchi *et al.* (2024) in Ngawi, which similarly reported no significant impact of wall type on ARI among toddlers. This study aligns with the findings of Jannah (2019) that risky house wall types, such as non-permanent walls made of planks, woven bamboo, or unplastered brick, are significantly associated with the incidence of pneumonia in toddlers. In the study, toddlers living in houses with risky wall types were 3.03 times more likely to experience pneumonia than toddlers living in houses with permanent walls ($p = 0.027$). These findings confirm that the quality of a house's physical construction, including

wall type, can affect a child's respiratory health, especially in environments with not ideal ventilation and air quality.

The type of flooring had the most significant correlation with ARI occurrence ($p=0.000$; OR=11.667). Children residing in homes with substandard floors, such as dirt or cracked concrete, were 11.6 times more likely to experience ARI (Bakchi *et al.*, 2024). That finding remains in agreement with the study through Aftab *et al.* (2022) which also discovered that poor floor conditions notably raised the risk of ARI in rural households. This research aligns with research by Bakchi *et al.* (2024) in Bangladesh, which also corroborates these findings. The study found that homes with natural flooring materials, such as dirt or unfinished materials, had approximately a 2.7-fold higher risk of developing Acute Respiratory Infection (ARI) symptoms in children compared to homes with finished floors, such as cement or concrete. This finding aligns with my research, which showed that substandard flooring significantly contributed to increased ARI incidence, even with a higher odds ratio. Therefore, both my research and the Bangladesh study confirm that floor quality is a significant factor in the likelihood of respiratory infections among youngsters.

The type of roof showed no significant relationship with the occurrence of ARI ($p=0.719$). The present result is consistent with the study by Azanaw *et al.* (2024), which similarly found no significant link between roofing materials and the incidence of ARI. While research conducted by Lestiani & Pawenang (2018) found that the source that can generate dampness is poor building construction, such as a leaking roof. The study suggests that roof conditions can contribute to respiratory risk factors through increased humidity, but does not place the type of roof material as a primary variable. Thus, this research is not directly in line with the analysis of roof types in the research, but it is still relevant because it provides an illustration that the quality of roof construction can influence other environmental factors related to the risk of ARI.

An important statistical association

was found between housing density as well as the incidence of ARI ($p=0.048$; $OR=3.240$). Children residing in high-density houses were 3.2 times more likely to develop ARI. These findings are consistent with the study by Hu *et al.* (2024) and supported by Who (2020), which recognized residential density as a key factor contributing to the rapid transmission of ARI in low-income families. This study is in line with research by Wimalasena *et al.* (2021) that there is a statistically significant relationship found between residential density as well as the occurrence of acute respiratory infection ($p = 0.048$; $OR = 3.240$), which shows that children living in high-density homes possess a 3.2 times greater risk of undergoing ARI relative to children living in low-density homes. These findings are consistent with evidence from international research, which states that residential density is one of the primary hazard elements for ARI among kids.

The study revealed a significant association between mosquito coil usage and acute respiratory infections (ARI) ($p=0.003$; $OR=5.400$). Children exposed to mosquito coil smoke were found to have a 5.4 times greater risk of experiencing ARI (Sumariyah *et al.*, 2024). This result corresponds to these results from Nabihah *et al.* (2023), who also reported a positive relation between exposure to mosquito coil smoke and ARI. This research aligns with the findings of Choiriyah and Dina (2015) that discuss the incidence of acute respiratory infections (ARI) and pneumonia in toddlers related to environmental factors at home. Several studies have identified that household factors such as exposure to cigarette smoke, use of mosquito coils, and ventilation conditions affect the increased risk of airway system disorders in children, although the degree of influence varies from study to study. These results support the findings of current research that exposure to indoor air pollutants, including smoke from mosquito coils, functions one significant part within the occurrence of severe breathing illnesses in kids.

No significant relationship was found among those practices regarding openings, as well as the same event related to ARI ($p=0.076$). This finding differs from the study by Santri *et al.* (2023), which identified a strong link

between household window-opening habits and ARI symptoms in children in Jakarta, a connection affected by outdoor air pollution levels in the regions studied. Research by Pujiani and Siwiendrayanti (2017) showed that factors significantly associated with the occurrence of severe breathing illnesses (ARI) included smoking habits, the use of individual safety gear, including face coverings, and the high levels of waste paper in the workplace. However, that study did not address home ventilation or the habit of opening windows, so its results cannot be directly compared with this study. Nevertheless, the study does provide insight into the causative factors of acute respiratory infections (ARI), varying greatly depending on the type of environmental exposure and behavior being studied.

Smoking habits in the household were significantly associated with ARI incidence ($p=0.023$; $OR=3.286$). Children exposed to secondhand smoke had a 3.3-fold higher risk of ARI (Talluri *et al.*, 2024). This study aligns with Su *et al.* (2025), who stated that exposure to secondhand smoke contributes to 40% of ARI cases in children worldwide. According to research by Fadila and Siyam (2022), the smoking behavior of family members has a significant association with the occurrence of sudden breathing system Infections (ARI) among young children. The authors reported a p-value of 0.00 and an odds ratio (OR) of 4.11. These findings suggest that children residing in homes alongside smoking individuals possess approximately a 4.1 multiplier greater likelihood for experiencing ARI compared to children who are not exposed to cigarette smoke at home.

Showed an important association using the occurrence related to severe respiratory infection (ARI) ($p=0.031$; $OR=3.370$). Children whose mothers demonstrated inadequate health and hygiene practices were found to have a 3.37 times greater likelihood of experiencing ARI (Islam *et al.*, 2024). The present investigation aligns accompanied by analysis conducted by Suparmi *et al.* (2025) in Indonesia, that highlighted which maternal knowledge and proper hygiene behaviors serve as protective factors against ARI. Research has shown that maternal knowledge is notably linked to the

occurrence of acute respiratory infection among young children ($p = 0.005$). However, a study by Nurmalitasari and Indarjo (2021) found no significant link between maternal hygiene practices and ARI incidence. Contrary to those findings, this study demonstrates a significant association between maternal hygiene practices and ARI cases ($p = 0.031$; $OR = 3.37$). Therefore, both studies highlight the impact of maternal factors on ARI incidence, though the dominant factor differs: knowledge in the IJPHN study and hygiene practices in this research.

Conclusion

The present research aims to evaluate examine the connection between the environmental home conditions and maternal actions in relation to the occurrence of ARI among young children within the North Putussibau Community Health Clinic Vicinity. Data analysis findings reveal a significant association between several physical environmental factors and maternal behaviors with ARI incidence. Environmental factors significantly linked include room humidity ($p = 0.023$), lighting ($p = 0.024$), category of flooring ($p = 0.000$), residential density ($p = 0.048$), and the use of mosquito repellents ($p = 0.003$). Maternal behaviors significantly associated with ARI occurrence include smoking habits ($p = 0.023$), not covering the mouth when coughing ($p = 0.007$), exposing toddlers to smokers ($p = 0.003$), not wearing masks during illness ($p = 0.024$), and not keeping toddlers away from groups ($p = 0.120$). It is advised that mothers improve home conditions by lowering humidity, enhancing lighting, using sealed flooring, avoiding overcrowding, and refraining from mosquito coil usage; also, to cover their mouths when coughing, protect toddlers from cigarette smoke, and wear masks when ill. Health center staff should conduct home-based education and counseling, while policymakers are urged to support healthy home initiatives and community education programs to sustainably reduce ARI in toddlers. Founded upon that empirical data, the study confirms a significant link between the home's physical environment and maternal behavior with ARI incidence in young children.

The present research revealed this

various ecological and behavioral elements greatly influence the occurrence of sudden breathing illnesses and acute respiratory infections among young children. Factors shown to have a significant relationship include indoor humidity, lighting, floor type, habitation concentration, utilization of vector insect repellents, smoking habits, and maternal behavior. Of all these factors, floor type showed the strongest correlation with the incidence of ARI. On the other hand, ventilation area, wall type, roof type, and the habit of opening windows did not show a significant relationship with the incidence of ARI. These findings emphasize the importance of maintaining home ecological factors, including adequate lighting, humidity control, and floor cleanliness, in addition to supporting the creation of smoke-free homes and good maternal behavior to reduce the risk of ARI in children. Similar research in the journal KEMAS supports the influence of environmental conditions and behavior on children's respiratory health, strengthening the validity of these results.

References

- Aftab, A., Noor, A., & Aslam, M., 2022. Housing Quality and Its Impact on Acute Respiratory Infection (ARI) Symptoms Among Children in Punjab, Pakistan. *PLOS Global Public Health*, 2(9).
- Aldridge, R.W., Pineo, H., Fragaszy, E., Eyre, M.T., Kovar, J., Nguyen, V., Beale, S., Byrne, T., Aryee, A., Smith, C., Devakumar, D., Taylor, J., Katikireddi, S.V., Fong, W.L.E., Geismar, C., Patel, P., Shrotri, M., Braithwaite, I., Patni, N., Navaratnam, A.M.D., Johnson, A.M., & Hayward, A., 2021. Household Overcrowding and Risk of SARS-CoV-2: Analysis of the Virus Watch Prospective Community Cohort Study in England and Wales. *Wellcome Open Research*, 6(May), pp.1–21.
- Azanaw, J., Weldegebriel, F., & Malede, A., 2024. Investigating Neighbourhood Environmental Risk Factors Associated with Childhood Acute Respiratory Infection Symptoms in Ethiopia Mixed Effect and Multilevel Logistic Regression Analysis Based on EDHS 2016. *Frontiers in Public Health*, 12(August), pp.1–9.
- Bakchi, J., Rasel, R.A., Shammi, K.F., Ferdous, S., Sultana, S., & Rabeya, M.R., 2024. Effect

- of Housing Construction Material on Childhood Acute Respiratory Infection: A Hospital Based Case Control Study in Bangladesh. *Scientific Reports*, 14(1), pp.1–11.
- Bupu, F.K., Landi, S., & Ndoen, H.I., 2024. The Relationship between the Physical Environment of the House and Family Behavior with the Incidence of Acute Respiratory Disease in Toddlers in the Koeloda Health Center. *Journal of Public Health for Tropical and Coastal Region*, 7(2), pp.177–184.
- Choiriyah, S., & N, D.N.A., 2015. Evaluation of Surveillance System Input for Finding Pneumonia Sufferers in Toddlers at Community Health Centers. *Unnes Journal of Public Health*, 4(4), pp.136–145.
- Fadila, F.N., & Siyam, N., 2022. Risk Factors for Acute Respiratory Tract Infections (ARI) in Toddlers. *Higeia Journal of Public Health Research and Development*, 6(4), pp.320–331.
- Holden, K.A., Lee, A.R., Hawcutt, D.B., & Sinha, I.P., 2023. The Impact of Poor Housing and Indoor Air Quality on Respiratory Health in Children. *Breathe*, 19(2).
- Hu, Y., Lin, Z., Jiao, S., & Zhang, R., 2024. High-Density Communities and Infectious Disease Vulnerability: A Built Environment Perspective for Sustainable Health Development. *Journal Buildings*, 14(1).
- Ibiebele, J.C., Godonou, E.T., Callear, A.P., Smith, M.R., Truscon, R., Johnson, E., Eisenberg, M.C., Laurant, A.S., Monto, A.S., Cobey, S., & Martin, E.T., 2025. The Role of Viral Interaction in Household Transmission of Symptomatic Influenza and Respiratory Syncytial Virus. *Nature Communications*, 16(1).
- Islam, M., Islam, K., Dalal, K., & Hossain Hawlader, M.D., 2024. In-House Environmental Factors and Childhood Acute Respiratory Infections in Under-Five Children: A Hospital-Based Matched Case-Control Study in Bangladesh. *BMC Pediatrics*, 24(1), pp.1–10.
- Izmir, T.G., Hetherington, E., Barrett, E., & Altamirano, H. (2025). Exploring the Impact of Light Wavelength on Indoor Mould Growth. *Frontiers in Built Environment*, 11(June), pp.1–15.
- Jannah, M., 2019. Pneumonia Incidence in Toddlers in Fish Smoking Areas. *Higeia Journal of Public Health Research and Development*, 3(3), pp.454–468.
- Kek, H.Y., Saupi, S.B.M., Tan, H., Othman, M.H.D., Nyakuma, B.B., Goh, P.S., Altowayti, W.A.H., Qaid, A., Wahab, N.H.A., Lee, C.H., Lubis, A., Wong, S.L., & Wong, K.Y., 2023. Ventilation Strategies for mitigating airborne infection in healthcare facilities: A review and bibliometric analysis (1993–2022). *Energy and Buildings*, 295, pp.113323.
- Khawar, L., Donovan, B., Peeling, R.W., Guy, R.J., & McGregor, S., 2023. Elimination and Eradication Goals for Communicable Diseases: A Systematic Review. *Bulletin of the World Health Organization*, 101(10), pp.649–665.
- Kiros, K.M., Amare, T.A., Kidanu, K.G., Welu, S.G., Gerlase, D.B., & Ali, J.S., 2025. Emotional and Behavioral Problems and Its Associated Factors Among Pre-School Children of Mekelle, Tigray, Ethiopia: Community Based Cross Sectional Study. *Scientific Reports*, 15(36077), pp.1–13.
- Kuuyi, A., & Kogi, R., 2024. Factors Contributing to Immunization Coverage Among Children Less Than 5 Years in Nadowli-Kaleo District of Upper West Region, Ghana. *PLOS Global Public Health*, 4(8), pp.1–15.
- Lestiani, D.P., & Pawenang, E.T., 2018. Physical Environment that Influences the Existence of *Aspergillus* sp. in the Library Room. *Journal. Unnes*. 2(3), pp.476–487.
- Li, T., Zhou, X.N., & Tanner, M., 2025. One Health: Enabler of Effective Prevention, Control and Elimination of Emerging and Re-Emerging Infectious Diseases. *Infectious Diseases of Poverty*, 14(1), pp.1–7.
- Nabiha, P.Z., Azizah, R., Zulkarnain, O.F., Rizaldi, M.A., Febriani, A.K., Nugraheni, W.P., & Mahmudah, M., 2023. Risk Analysis of Temperature, Humidity, Ventilation, Use of Mosquito Repellent, and Smoking Behaviour on the Incidence of Acute Respiratory Infections (ARI) in Toddlers. *Journal of Air Pollution and Health*, 8(4), pp.501–516.
- Nurmalitasari, Y.K., & Indarjo, S., 2021. Pola Asuh Ibu dengan Kejadian ISPA Balita di Puskesmas Geyer. *Journal Unnes*, 1(3), pp.428–435.
- Nurwijayanti, N., Sandya, V.A.P., & Radono, P., 2024. Factors Associated with the Risk of Acute Respiratory Tract Infection (ARI) Symptoms in Toddlers Reviewed from the Home Environment in Bababan Village, Tulungagung Regency. *Journal Of Nursing Practice*, 8(2), pp.257–269.
- Oluwaseun, A., & Seun-Addie, F.K., 2025. Reducing Acute Respiratory Infections in Under-Five Children in Nigeria Through the Mirror of Risk Factors: A Cross-Sectional Study. *BMC*

- Public Health*, 25(1).
- Pawenang, E.T., & Munawaroh, R., 2024. Incidence of ISPA in Toddlers in the Work Area of Srandol Community Health Center, Semarang City. *Indonesian Journal of Public Health Research and Development*, 5(1).
- Pujiani, T.R., & Siwiendrayanti, A., 2017. Relationship Between Use Of Ppe Masks, Smoking Habits And Volume Of Used Paper With Ari. *Journal of Public Health*, 6(248), pp.6–10.
- Purnama, T.B., Wagatsuma, K., & Saito, R., 2025. Prevalence and Risk Factors of Acute Respiratory Infection and Diarrhea Among Children Under 5 Years Old in Low-Middle Wealth Household, Indonesia. *Infectious Diseases of Poverty*, 14(1), pp.1–10.
- Rizaldi, M.A., 2023. House Environmental Conditions with the Event of Acute Respiratory Infection (ARI) in Toddlers in Indonesian: A Meta-Analysis. *Journal of Air Pollution and Health*, 8(1), pp.103–116.
- Sakleshpur, S., & Steed, A.L., 2022. Influenza: Toward Understanding the Immune Response in the Young. *Frontiers in Pediatrics*, 10(2).
- Santri, I.N., Wardani, Y., Phiri, Y.V.A., Nyam, G., Putri, T.A., Isni, K., Suryani, D., & Sambo, G., 2023a. Associations Between Indoor Air Pollutants and Risk Factors for Acute Respiratory Infection Symptoms in Children Under 5: An Analysis of Data from the Indonesia Demographic Health Survey. *Journal of Preventive Medicine and Public Health*, 56(3), pp.255–263.
- Sohel, M.S., Alam, S., Adnan, Z.H., Hossain, M.A., Sifullah, M.K., & Happy, A.N., 2024. Household Waste Management Woes in Dhaka City: Current Challenges and Policy Directions. *International Journal of Community Well-Being*, 7(2), pp.237–264.
- Su, Z., Xie, Y., Huang, Z., Cheng, A., Zhou, X., Wang, M., Xia, X., Ji, T., Zhao, L., Liu, Z., Xiao, D., & Wang, C., 2025. Second Hand Smoke Attributable Disease Burden in 204 Countries and Territories, 1990–2021: A Systematic Analysis from the Global Burden of Disease Study 2021. *Respiratory Research*, 26(1).
- Sumariyah, S., Sutningsih, D., & Adi, M.S., 2024. Risk Factors for Pneumonia in Toddlers at a Regional General Hospital of Mappi Regency, South Papua Province. *BIO Web of Conferences*, 133, pp.1–13.
- Suparmi, S., Sasman, M.F., Ratnawati, R., & Rustanti, N., 2025. Hygiene and Food Safety Practices Among Mothers as Predictors of Diarrhea Risk in Toddlers in Purwawinangun Village, West Java, Indonesia. *Frontiers in Public Health*, 13(March), pp.1–6.
- Talluri, R., Shete, S.S., Shastri, S.S., & Shete, S., 2024. Secondhand Tobacco Smoke Exposure in Homes and Vehicles in Youth: Disparities Among Racial, and Sexual and Gender Minorities. *Frontiers in Public Health*, 12(July).
- Tan, Z., Zhong, W., Danielsson, H., Arzoomand, A., Lakshmikanth, T., Chen, Q., Mikes, J., Wang, J., Chen, Y., James, A., Nilsson, A.K., Elfvin, A., Brusselaers, N., Portlock, T., Lundgren, P., Sävman, K., Wackernagel, D., Hansen-Pupp, I., Ley, D., Uhlén, M., Hellström, A., & Brodin, P., 2025. Immune Development Differs Between Preterm Newborns Fed Mothers' Own Milk and Donor Milk. *IScience*, 28(7).
- Tang, R., Sahu, R., Su, Y., Milsom, A., Mishra, A., Berkemeier, T., & Pfrang, C., 2024. Impact of Cooking Methods on Indoor Air Quality: A Comparative Study of Particulate Matter (PM) and Volatile Organic Compound (VOC) Emissions. *Indoor Air*, 2024(1).
- Tombeq, Z., Erni Yetti, R., Hadi, A.J., Hasibuan, A.S., Rate, S., Handayani, F.R., & Permayasa, N., 2024. Determinants of the Incidence of Acute Respiratory Infections (ARIs) in Children Under Five at the Getengan Community Health Center, Tana Toraja Regency. *Journal of Public Health and Pharmacy*, 4(1), pp.10–18.
- Wang, X., Li, Y., Shi, T., Bont, L.J., Chu, H. Y., Zar, H.J., Wahi-Singh, B., Ma, Y., Cong, B., Sharland, E., Riley, R.D., Deng, J., Figueras-Aloy, J., Heikkinen, T., Jones, M.H., Liese, J.G., Markić, J., Mejias, A., Nunes, M.C., Resch, B., Satav, A., Yeo, K.T., Simões, E.A.F., & Nair, H., 2024. Global Disease Burden of and Risk Factors for Acute Lower Respiratory Infections Caused by Respiratory Syncytial Virus in Preterm Infants and Young Children in 2019: A Systematic Review and Meta-Analysis of Aggregated and Individual Participant Data. *The Lancet*, 403(10433), pp.1241–1253.
- Wati, N., Oktarianita., Ramon, A., Husin, H., & Harsismanto, J., 2021. Determinants of the Incident of Pneumonia in Toddlers in Bengkulu City in 2020. *Kemas*, 17(2), pp.180–186.
- Wimalasena, N.N., Chang-richards, A., & Wang, K.I., 2021. Housing Risk Factors Associated with Respiratory Disease: A Systematic Review. *Environmental Research and Public*

Health, 18(6), pp.1–24.

World Health Organization., 2020. *Pusat Pengobatan Infeksi Saluran Pernapasan Akut Berat*. World Health Organization.