

Household Air Pollution and Behavioral Risk Factors for Acute Respiratory Infections in Toddlers: a Case-Control Study in Maros, Indonesia

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ABSTRACT

Acute Respiratory Infection (ARI) remains a leading cause of morbidity among toddlers in Indonesia, with household environmental and behavioral factors playing a critical role in its transmission. This study aimed to analyze the risk factors associated with ARI incidence among toddlers in the working area of the Bantimurung Community Health Center, Maros Regency. An analytical observational study with a case-control design was conducted involving 158 toddlers (79 cases and 79 controls). Data were collected through structured interviews and observation, and analyzed using binary logistic regression to estimate crude and adjusted odds ratios (OR) with 95% confidence intervals (CI). The results showed that four variables were significantly associated with ARI incidence: occupancy density (adjusted OR = 4.137; 95% CI: 1.893–9.040; $p < 0.001$), family members' smoking habits (adjusted OR = 2.763; 95% CI: 1.289–5.925; $p = 0.009$), use of mosquito repellents (adjusted OR = 4.480; 95% CI: 2.045–9.818; $p < 0.001$), and personal hygiene (adjusted OR = 2.455; 95% CI: 1.154–5.224; $p = 0.020$). Nutritional status ($p = 0.074$) and immunization history ($p = 1.000$) were not statistically significant. The use of mosquito repellents was identified as the strongest risk factor, indicating that toddlers in households using mosquito repellents were 4.48 times more likely to develop ARI. Interventions should prioritize reducing exposure to indoor air pollutants, particularly from mosquito repellent combustion, and promoting smoke-free and hygienic household environments.

Keywords : acute respiratory infection; toddlers; household air pollution; mosquito repellent; case-control study

INTRODUCTION

Acute Respiratory Infection (ARI), particularly lower respiratory infections (LRIs), remains a major infectious disease burden among children under five years of age. The Global Burden of Disease 2023 analysis estimated that LRIs caused 2.50 million deaths globally in 2023, with children under five years and older adults carrying the highest burden ¹. A preceding GBD 2021 analysis also estimated 344 million non-COVID-19 LRI episodes and 2.18 million deaths globally in 2021, including approximately 502,000 deaths among children younger than five years ². In Indonesia, ARI remains a priority condition in primary health care surveillance. The 2023 Indonesian Health Survey recorded a national ARI prevalence of 4.8% among toddlers and a South Sulawesi prevalence of 0.79% among toddlers, indicating that ARI remains an important public health problem in the study context ³.

The susceptibility of toddlers to ARI is attributable to interrelated host, pathogen, and environmental determinants. Young children have developing immune and respiratory systems, smaller airways, and higher ventilation rates relative to body size, which increase vulnerability to respiratory pathogens and inhaled pollutants ^{4,5}. International evidence shows that major preventable contributors to childhood respiratory infection include household air pollution, tobacco smoke exposure, undernutrition, incomplete vaccination, poor hygiene, and inadequate housing conditions ^{2,6-8}. These determinants are particularly relevant in low- and middle-income settings, where environmental exposures and household transmission conditions often interact within the same domestic space ⁹.

Indoor air quality represents a critical dimension of ARI risk in toddlers. Household tobacco smoke remains a preventable contributor to respiratory morbidity among children, and recent global analyses continue to identify tobacco exposure and household air pollution as important contributors to lower respiratory infection burden ¹⁰. In addition, combustion-based mosquito repellents can contribute to indoor particulate and chemical exposure. Current air-quality guidance emphasizes that fine particulate matter and combustion-related indoor pollutants are harmful to respiratory health, while Indonesian evidence has reported a significant association between mosquito repellent use and respiratory tract infection among toddlers ^{8,9,11}. This exposure pathway is especially relevant in tropical regions where mosquito prevention is routine and domestic ventilation may be inadequate.

Bantimurung Subdistrict, located in Maros Regency, South Sulawesi, presents a distinctive epidemiological context for studying these risk factors. The area is characterized by a limestone karst landscape, high ambient humidity, and dense residential settlements, conditions that may amplify indoor pollutant

accumulation and facilitate respiratory pathogen transmission. Surveillance data from the Bantimurung Community Health Center recorded 689 ARI cases among toddlers from January to February 2025, indicating a high local disease burden within a short observation window¹². Although Indonesian studies have examined household density, smoking behavior, and hygiene as ARI risk factors^{13–15}, the simultaneous assessment of mosquito repellent use with other environmental and behavioral determinants remains limited. This study therefore aimed to analyze risk factors associated with ARI incidence among toddlers in the working area of the Bantimurung Community Health Center, Maros Regency, with particular emphasis on household environmental and behavioral determinants.

MATERIALS AND METHODS

Study Design and Setting

This study employed an analytical observational design with a case-control approach. The study was conducted in the working area of the Bantimurung Community Health Center, Maros Regency, South Sulawesi, Indonesia.

Population and Sample

The study population comprised all households with toddlers (children aged 0–59 months) registered in the working area of the Bantimurung Community Health Center. Sample size was calculated using the Lemeshow formula for unknown population size, yielding a minimum of 79 respondents per group ($Z\alpha = 1.96$; $Z\beta = 0.84$; $P1 = 0.4$; $P2 = 0.2$). The total sample consisted of 158 toddlers: 79 in the case group and 79 in the control group, with a case-to-control ratio of 1:1.

Case and Control Definition

Cases were defined as toddlers diagnosed with Acute Respiratory Infection (ARI) based on medical records at the Bantimurung Community Health Center during the study period. Controls were toddlers without an ARI diagnosis during the same period, selected from the same population registry to ensure comparability. Data on exposure variables were collected through direct observation and structured interviews with respondents using a pre-designed questionnaire.

Inclusion and Exclusion Criteria

Inclusion criteria: (1) mothers with toddlers aged 0–59 months in the working area of the Bantimurung Community Health Center; (2) residing in the working area for a minimum of six months prior to the study; (3) willing to participate and having signed an informed consent form; (4) no history of chronic respiratory disease other than ARI, such as asthma or tuberculosis.

Exclusion criteria: (1) toddlers with congenital abnormalities or conditions affecting the respiratory system; (2) mothers or guardians unable to communicate adequately; (3) respondents who did not complete the data collection process or withdrew before study completion; (4) households that had relocated from outside the working area within the three months prior to data collection.

Sampling Technique

Participants were selected using purposive sampling based on predefined inclusion and exclusion criteria. Cases were identified from ARI medical records at the Bantimurung Community Health Center, while controls were selected from the same population registry to ensure similarity in geographic and socio-demographic characteristics. Although probability sampling was not applied, strict eligibility criteria were used to minimize selection bias and ensure that both cases and controls originated from the same source population.

This study did not apply individual matching based on age and sex. However, the study population was restricted to toddlers aged 0–59 months to reduce variability in age distribution. The absence of matching is acknowledged as a potential source of confounding and is addressed in the discussion as a study limitation. The data collection instrument was developed based on relevant literature and validated through expert judgment by two public health academics with expertise in environmental health. The questionnaire was reviewed to ensure content validity, relevance, and clarity of its items. Although formal reliability testing such as Cronbach's alpha was not performed, this limitation is acknowledged in the discussion.

Data collection was conducted through household visits using structured interviews and direct observation. Trained enumerators were involved in data collection to ensure consistency in data recording and to minimize interviewer bias.

Ethical Considerations

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Health Research Ethics Committee Poltekkes Kemenkes Makassar with

registration number No.1504/M/KEPK-PTKMS/VII/2025 prior to data collection. All participants' parents or guardians provided written informed consent before enrollment.

Data Analysis

Data were analyzed using computer-assisted statistical software. Univariate analysis was conducted to describe the frequency distribution and percentage of each study variable. Bivariate analysis employed binary logistic regression to generate crude odds ratios (crude OR) with 95% confidence intervals (CI), examining the individual association of each independent variable with ARI incidence. Variables with a p-value < 0.25 in bivariate analysis were eligible for inclusion in multivariate analysis. Multivariate analysis employed multiple binary logistic regression to generate adjusted odds ratios (adjusted OR), identifying the dominant risk factor while simultaneously controlling for confounding variables. Statistical significance was defined as $p < 0.05$.

RESULTS

Based on research conducted at the Bantimurung Community Health Center in Maros Regency, the following results were obtained:

Table 1. Distribution of ARI Cases in Toddlers at the Bantimurung Community Health Center, Maros Regency

No	Criteria	Frequency	%
1	ARI	79	50.0
2	No ARI	79	50.0
Total		158	100

Source: Primary data

Based on Table 1, of the 158 respondents enrolled in this study, 79 toddlers (50%) were classified as cases (diagnosed with ARI) and 79 toddlers (50%) served as controls (without ARI diagnosis), reflecting the 1:1 case-to-control ratio predetermined by the study design. This equal distribution is a function of the sampling design and does not represent the prevalence or incidence of ARI in the Bantimurung community.

Table 2. Distribution of Respondents Based on Occupancy Density at the Bantimurung Community Health Center, Maros Regency

No	Criteria	Frequency	%
1	Not Qualified	85	53.8
2	Qualified	73	46.2
Total		158	100

Source: Primary data

Based on Table 2, 85 respondents (53.8%) lived in households that did not meet the standard occupancy density requirements, while 73 respondents (46.2%) lived in households that met the requirements.

Table 3. Distribution of Respondents Based on Family Members' Smoking Habits at the Bantimurung Community Health Center, Maros Regency

No	Criteria	Frequency	%
1	Smoking	84	53.2
2	Not Smoking	74	46.8
Total		158	100

Source: Primary data

Table 3 shows that 84 respondents (53.2%) had family members who smoked, while 74 respondents (46.8%) did not have family members who smoked.

Table 4. Distribution of Respondents Based on the Use of Mosquito Repellents at the Bantimurung Community Health Center, Maros Regency

No	Criteria	Frequency	%
1	Using Mosquito Repellent	86	54.4
2	Not Using Mosquito Repellent	72	45.6
Total		158	100

Source: Primary data

Based on Table 4, most respondents at the Bantimurung Community Health Center, Maros Regency, reported using mosquito repellents. A total of 86 respondents (54.4%) used mosquito repellents, while 72 respondents (45.6%) did not use mosquito repellents. These findings indicate that the proportion of respondents who used mosquito repellents was slightly higher than those who did not.

Table 5. Distribution of Toddlers Based on Immunization History at the Bantimurung Community Health Center, Maros Regency

No	Criteria	Frequency	%
1	Not Yet Immunized	4	2.5
2	Immunized	154	97.5
Total		158	100

Source: Primary data

Based on Table 5, 4 toddlers (2.5%) had not received immunization, while 154 toddlers (97.5%) had received complete immunization. The near-universal immunization coverage reflects the active immunization program at the Bantimurung Community Health Center.

Table 6. Distribution of Toddlers Based on Nutritional Status at the Bantimurung Community Health Center, Maros Regency

No	Criteria	Frequency	%
1	Abnormal Nutrition	89	56.3
2	Normal Nutrition	69	43.7
Total		158	100

Source: Primary data

Based on Table 6, 89 toddlers (56.3%) had abnormal nutritional status, while 69 toddlers (43.7%) had normal nutritional status.

Table 7. Distribution of Respondents Based on Personal Hygiene at the Bantimurung Community Health Center, Maros Regency

No	Criteria	Frequency	%
1	Poor Hygiene	68	43.0
2	Good Hygiene	90	57.0
Total		158	100

Source: Primary data

Based on Table 7, 68 respondents (43%) did not practice adequate personal hygiene, while 90 respondents (57%) maintained good personal hygiene practices.

Bivariate Analysis

Bivariate analysis was conducted using binary logistic regression to evaluate the individual association between each independent variable and ARI incidence, generating crude odds ratios (crude OR) with 95% confidence intervals. Results are presented in Tables 8 through 13.

Table 8. Association Between Occupancy Density and ARI Incidence in Toddlers at the Bantimurung Community Health Center, Maros Regency

Occupancy Density	ARI Cases n (%)	Controls n (%)	Total n (%)	Crude OR (95% CI)	p-value
Not Qualified	56 (70.9%)	29 (36.7%)	85 (53.8%)	4.198 (2.154–8.179)	0.000
Qualified	23 (29.1%)	50 (63.3%)	73 (46.2%)		
Total	79 (100%)	79 (100%)	158 (100%)		

Source: Primary data

Table 8 shows that 56 of 79 cases (70.9%) lived in overcrowded households, compared to 29 of 79 controls (36.7%). Occupancy density was a significant risk factor for ARI (crude OR = 4.198; 95% CI: 2.154–8.179; $p = 0.000$), indicating that toddlers in non-standard occupancy households were approximately 4.2 times more likely to develop ARI.

Table 9. Association Between Family Members' Smoking Habits and ARI Incidence in Toddlers at the Bantimurung Community Health Center, Maros Regency

Family Members' Smoking Habits	ARI Cases n (%)	Controls n (%)	Total n (%)	Crude OR (95% CI)	p-value
Smoking	52 (65.8%)	32 (40.5%)	84 (53.2%)	2.829 (1.482–5.399)	0.000
Not Smoking	27 (34.2%)	47 (59.5%)	74 (46.8%)		
Total	79 (100%)	79 (100%)	158 (100%)		

Source: Primary data

Table 9 shows that 52 of 79 cases (65.8%) had smoking family members, compared to 32 of 79 controls (40.5%). Smoking habits among family members were a significant risk factor for ARI (crude OR = 2.829; 95% CI: 1.482–5.399; $p = 0.000$), indicating that toddlers exposed to household tobacco smoke were approximately 2.8 times more likely to develop ARI.

Table 10. Association Between Use of Mosquito Repellents and ARI Incidence in Toddlers at the Bantimurung Community Health Center, Maros Regency

Use of Mosquito Repellents	ARI Cases n (%)	Controls n (%)	Total n (%)	Crude OR (95% CI)	p-value
Using Repellent	57 (72.2%)	29 (36.7%)	86 (54.4%)	4.467 (2.282–8.745)	0.000
Not Using Repellent	22 (27.8%)	50 (63.3%)	72 (45.6%)		
Total	79 (100%)	79 (100%)	158 (100%)		

Source: Primary data

Table 10 shows that 57 of 79 cases (72.2%) used mosquito repellents, compared to 29 of 79 controls (36.7%). Mosquito repellent use was a significant risk factor for ARI (crude OR = 4.467; 95% CI: 2.282–8.745; p = 0.000), indicating that toddlers in households using mosquito repellents were approximately 4.5 times more likely to develop ARI.

Table 11. Association Between Immunization History and ARI Incidence in Toddlers at the Bantimurung Community Health Center, Maros Regency

Immunization History	ARI Cases n (%)	Controls n (%)	Total n (%)	Crude OR (95% CI)	p-value
Not Yet Immunized	2 (2.5%)	2 (2.5%)	4 (2.5%)	1.000 (0.137–7.281)	1.000
Immunized	77 (97.5%)	77 (97.5%)	154 (97.5%)		
Total	79 (100%)	79 (100%)	158 (100%)		

Source: Primary data

Table 11 shows that only 4 toddlers in the entire sample had not received immunization, equally distributed between cases (n = 2) and controls (n = 2). Immunization history was not a statistically significant risk factor for ARI (crude OR = 1.000; 95% CI: 0.137–7.281; p = 1.000). The near-universal immunization coverage (97.5%) produces a ceiling effect that renders statistical analysis of this variable uninformative, as there is virtually no variance to detect. It should be explicitly noted that this non-significant result does not constitute evidence that immunization is unrelated to ARI risk; rather, it reflects insufficient statistical power caused by the extremely small number of unimmunized children in this sample (n = 4, 2.5%). This is acknowledged as a study limitation.

Table 12. Association Between Nutritional Status and ARI Incidence in Toddlers at the Bantimurung Community Health Center, Maros Regency

Nutritional Status	ARI Cases n (%)	Controls n (%)	Total n (%)	Crude OR (95% CI)	p-value
Abnormal Nutrition	51 (64.6%)	38 (48.1%)	89 (56.3%)	1.965 (1.038–3.720)	0.079
Normal Nutrition	28 (35.4%)	41 (51.9%)	69 (43.7%)		
Total	79 (100%)	79 (100%)	158 (100%)		

Source: Primary data

Table 12 shows that 51 of 79 cases (64.6%) had abnormal nutritional status, compared to 38 of 79 controls (48.1%). Nutritional status did not reach statistical significance (crude OR = 1.965; 95% CI: 1.038–3.720; p = 0.079). Although this variable was not significant at the 0.05 threshold, it was retained for multivariate analysis as its p-value was below 0.25.

Table 13. Association Between Personal Hygiene and ARI Incidence in Toddlers at the Bantimurung Community Health Center, Maros Regency

Personal Hygiene	ARI Cases n (%)	Controls n (%)	Total n (%)	Crude OR (95% CI)	p-value
Poor Hygiene	43 (54.4%)	25 (31.6%)	68 (43.0%)	2.580 (1.349–4.936)	0.004
Good Hygiene	36 (45.6%)	54 (68.4%)	90 (57.0%)		
Total	79 (100%)	79 (100%)	158 (100%)		

Source: Primary data

Table 13 shows that 43 of 79 cases (54.4%) practiced poor personal hygiene, compared to 25 of 79 controls (31.6%). Personal hygiene was a significant risk factor for ARI (crude OR = 2.580; 95% CI: 1.349–4.936; $p = 0.004$), indicating that toddlers from households with poor hygiene practices were approximately 2.6 times more likely to develop ARI.

Multivariate Analysis

Table 14. Determination of Variables Eligible for Multivariate Logistic Regression Analysis

Variables	p-value
Occupancy Density	0.000
Family Members' Smoking Habits	0.000
Use of Mosquito Repellents	0.000
Immunization History	1.000
Nutritional Status	0.079
Personal Hygiene	0.004

Source: Primary data

Table 14 shows that five variables met the $p < 0.25$ eligibility criterion for inclusion in multivariate analysis: occupancy density, family members' smoking habits, use of mosquito repellents, nutritional status, and personal hygiene. Immunization history ($p = 1.000$) did not meet this threshold and was excluded from multivariate analysis.

Table 15. Results of Multiple Binary Logistic Regression Analysis for ARI Risk Factors in Toddlers at the Bantimurung Community Health Center, Maros Regency

Variable	p-value	Adjusted OR	95% CI Lower	95% CI Upper
Occupancy Density	0.000	4.137	1.893	9.040
Family Members' Smoking Habits	0.009	2.763	1.289	5.925
Use of Mosquito Repellents	0.000	4.480	2.045	9.818
Nutritional Status	0.074	2.022	0.933	4.380
Personal Hygiene	0.020	2.455	1.154	5.224
Constant	0.000	0.000		

Source: Primary data

Table 15 presents the results of multiple binary logistic regression analysis simultaneously controlling for all eligible variables. Four variables were confirmed as statistically significant independent risk factors for ARI:

occupancy density (adjusted OR = 4.137; 95% CI: 1.893–9.040; $p = 0.000$), family members' smoking habits (adjusted OR = 2.763; 95% CI: 1.289–5.925; $p = 0.009$), use of mosquito repellents (adjusted OR = 4.480; 95% CI: 2.045–9.818; $p = 0.000$), and personal hygiene (adjusted OR = 2.455; 95% CI: 1.154–5.224; $p = 0.020$). Nutritional status did not reach statistical significance in the multivariate model (adjusted OR = 2.022; 95% CI: 0.933–4.380; $p = 0.074$). Use of mosquito repellents was the dominant risk factor, based on the highest Wald statistic (14.041) and the highest adjusted OR (4.480), indicating that toddlers in households using mosquito repellents were 4.48 times more likely to develop ARI after controlling for all other variables in the model.

DISCUSSION

This study identified four independent risk factors for ARI in toddlers through multivariate binary logistic regression analysis: occupancy density, family members' smoking habits, use of mosquito repellents, and personal hygiene. The findings are consistent with the broader environmental health framework in which respiratory infection risk is shaped by interaction among host susceptibility, pathogenic exposure, and household environmental conditions^{2,7}. Among all variables, mosquito repellent use emerged as the dominant risk factor based on the highest adjusted OR and Wald statistic in the model.

Overcrowded residential conditions facilitate respiratory pathogen transmission by increasing close contact, droplet exposure, and shared indoor air. The WHO Housing and Health Guidelines identify crowding and inadequate ventilation as housing-related hazards that can contribute to infectious disease transmission⁷. Ventilation is central to reducing airborne pathogen concentration in indoor environments, and recent reviews of respiratory infection transmission emphasize that source control, adequate ventilation, and cleaner indoor air reduce exposure to infectious aerosols^{16,17}. These findings are consistent with Indonesian studies reporting significant associations between occupancy density and ARI among toddlers^{13,15}. A practical intervention strategy should combine improvement of room layout, reduction of per-room crowding where feasible, cross-ventilation improvement, and community education on the health consequences of overcrowding.

Family members' smoking habits constituted a significant behavioral risk factor for ARI in toddlers. Tobacco smoke exposure impairs respiratory defense, increases airway inflammation, and contributes to preventable respiratory morbidity; global burden analyses show that smoking-related exposures remain a major contributor to health losses worldwide^{10,18}. Recent GBD-based evidence also indicates that secondhand smoke remains a contributor to lower respiratory infection burden among children. The present findings are consistent with Indonesian evidence showing a significant association between family smoking behavior and ARI incidence among toddlers¹⁴. Risk reduction should prioritize smoke-free homes, prohibition of smoking near children, handwashing and changing clothing after smoking, and cessation counseling through community health center programs.

The use of mosquito repellents was the dominant risk factor for ARI in this study, a finding consistent with the indoor air pollution framework. Combustion-based mosquito repellents may increase indoor exposure to fine particles and volatile chemical irritants, especially when used repeatedly in enclosed or poorly ventilated rooms^{6,8,9}. This finding is also consistent with an Indonesian study reporting a significant association between mosquito repellent use and respiratory tract infection among toddlers¹¹. Because the present study measured mosquito repellent use as a dichotomous exposure without distinguishing coils, electric vaporizers, sprays, and topical repellents, the estimate may combine exposure types with different risk profiles. Interventions should prioritize replacing combustion-based coils with bed nets, window screens, and other non-combustion mosquito control methods, particularly in enclosed rooms with poor ventilation.

Personal hygiene was a significant independent risk factor for ARI in toddlers in both bivariate and multivariate analyses. Hand hygiene reduces transmission of respiratory pathogens by interrupting contact and fomite pathways. A recent Cochrane review of physical interventions for respiratory virus transmission found that hand hygiene can contribute to reducing respiratory infection risk, particularly when implemented consistently with other preventive measures¹⁹. The present finding is consistent with Indonesian evidence linking parental hygiene practices with respiratory tract infection incidence among toddlers²⁰. Community health center interventions should therefore include structured education on handwashing technique, bedding hygiene, respiratory etiquette, and early recognition of ARI symptoms to reduce household transmission.

Immunization history and nutritional status did not reach statistical significance in this study. For immunization, the near-universal coverage of 97.5% produced a ceiling effect that limited statistical variability, meaning the non-significant result should not be interpreted as evidence that immunization is unrelated to ARI prevention. Global pneumonia control strategies emphasize vaccination as a core intervention for reducing preventable childhood pneumonia deaths, particularly pneumococcal, *Haemophilus influenzae* type b, measles, pertussis, and influenza-related disease pathways^{5,21}. For nutritional status, classification followed the Indonesian Child Anthropometric Standards, which use weight-for-age, length or height-for-age, and weight-for-length or height indices. The non-significant association may reflect limited contrast between cases and controls and the stronger effects of household environmental exposures in the multivariate model. Recent international guidance continues to identify child undernutrition and wasting as conditions that increase vulnerability to infectious disease

through impaired immune function and reduced physiological reserve^{22,23}, while local studies have reported inconsistent associations between nutritional status and ARI in toddlers^{24,25}

This study has several limitations. First, age and sex matching between cases and controls was not performed; although the study population was restricted to toddlers aged 0 to 59 months, which limits the degree of age-related confounding, the potential residual confounding effect of both variables is acknowledged. Second, the study instrument was validated through expert judgment by two academic supervisors but did not undergo formal psychometric testing, including pilot testing or reliability analysis; this limitation is particularly relevant for subjectively measured behavioral variables such as personal hygiene. Third, purposive sampling was applied to both case and control groups, which carries a risk of selection bias; although strict eligibility criteria were applied to ensure comparability, the absence of random sampling for the control group may limit the generalizability of findings. Fourth, the mosquito repellent variable was measured as a dichotomous exposure without distinguishing between repellent types, specifically combustion-based coils, electric vaporizers, and topical formulations; this may have attenuated the estimated effect size for the highest-risk exposure category and should be addressed in future research.

CONCLUSION AND RECOMMENDATIONS

Occupancy density, family members' smoking habits, use of mosquito repellents, and personal hygiene were identified as significant risk factors for ARI incidence among toddlers in the working area of the Bantimurung Community Health Center, Maros Regency. Among these, the use of mosquito repellents was the dominant risk factor. Immunization history and nutritional status were not statistically significant in this study; however, these results reflect methodological constraints related to sample homogeneity and limited statistical power rather than a true absence of association.

The Bantimurung Community Health Center is recommended to deliver specific counseling on the respiratory hazards of burning mosquito coils in closed rooms and to actively promote safer alternatives such as mosquito bed nets and topical repellents, alongside programs addressing smoking cessation, household crowding, and personal hygiene as modifiable ARI risk factors. Future researchers are recommended to apply random sampling for the control group, distinguish between mosquito repellent types in the exposure variable, include formal instrument reliability testing, and adjust statistically for potential confounding variables including age and sex.

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