Original Article

Family Health Behavior: Preventive Measures against Acute Respiratory Infections in Under-5 Children

Abstract

Background: The under-5 mortality rate in Indonesia is 32 per 1,000 live births, still higher than the SDG target. Acute respiratory infections (ARIs), as one of the leading causes of death, must be prevented. Arguments emerge concerning the association of home crowding, health behavior, and the incidence of ARI. **Methods:** A cross-section analysis with the Indonesia Demographic and Health Survey (IDHS) 2017 dataset is performed. Samples are restricted to 16,555 children aged 0–59 months who lived with their mother (eligible women interviewed) during the survey. For each of the variables observed during this study, missing data must be omitted as exclusion criteria. A 100 per cent answer rate was achieved. Logistic regression was used to determine ARI-associated factors, by examining the effect of each explanatory factor (independent variables) on the odds ratio of ARI (one dependent binary variable). **Results:** The prevalence of ARI was more common among children living in the poorest households (AOR 1.66; 95% CI, 1.20 – 2.28) and those exposed to indoor tobacco smoke pollution (AOR 1.27; 95% CI, 1.04–1.56). On the other hand, those aged 0–5 months (AOR 0.59; 95% CI, 0.43–0.82), living at home with improved sanitation (AOR 0.74; 95% CI, 0.61–0.89), and exclusively breastfed (AOR 0.85; 95% CI, 0.73–0.99) were less likely to have ARI. **Conclusions:** Home crowding is not associated with ARI. Efforts should be focused on preserving family health behavior. The family functioned as a health-support system for their under-5 children by establishing an indoor tobacco smoking-free zone, practicing exclusive breastfeeding, and enhancing hygiene facilities.

Keywords: *Breastfeeding, crowding, family health, tobacco smoke pollution*

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Introduction

Pneumonia, a serious type of acute respiratory infection (ARI) that directly affects the lungs, is the leading cause of death in children under-5 worldwide.[1,2] Indonesia is one of the 15 countries with the highest burden of pneumonia deaths among children under-5.[3] Data showed that Indonesia's under-5 mortality rate was 32 per 1,000 live births which was still higher than the 2030 SDGs target.[4]

There are some literature debates in evidence that focus on the incidence and associated factors of ARI in children under-5 years of age. Previous studies reported the association between home crowding and children with ARI.[5-9] Housings that lack sufficient living area may have a direct adverse health impact on children, as the lack of personal space may lead to the transfer of infection-based illness from one household member to another. On the other hand, it has been reported that the relationship between housing and health has not been completely clarified.[10] Health behaviors should be a link between housing and health.[10-12] In addition, another study identified a negligible association between housing conditions and ARI.[13]

Based on Bronfenbrenner's ecological system theory, a family should be included as a family health-care system and its members.[14] As for children who spend a significant amount of time indoors, the family is their primary environment. The McMaster model of family functioning strongly encourages the development of the family and its members together by performing a set of family activities, including the preservation of healthy behavior to complete family function.[15,16]

Evidence has shown that health-related family activities, such as tobacco smoking and exclusive breastfeeding, are associated with the incidence of ARI in children under-5 years of age. Indoor exposure to tobacco smoke pollution was prevalent in

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Indonesian housing with just around 28% of households enforcing a tobacco smoking-free home rule.[4] However, studies have reported that tobacco smoke pollution has adversely affected children's respiratory health.[17-19] The tobacco smoking-free zone was required to mitigate the risk of respiratory infection in children.[20] Furthermore, exclusive breastfeeding until 6 months of age played a beneficial role in minimizing the risk of children suffering from ARI.[21-23]

Considering some controversy, the present study aims to examine the incidence of ARI in Indonesian children under-5 years of age with its associated factors.

Methods

Data and participants

The current dataset comes from the 2017 Indonesia Demographic and Health Survey (IDHS),[24] a national survey conducted in 34 provinces. A two-stage stratified sampling design was drawn from the 2010 Population Census. The first stage involves a systematic sampling proportional to the size (PPS) of the set of 1,970 census blocks and the second is a random selection of 25 ordinary households from each of the selected census blocks. Totally, 49,261 households were sampled. The IDHS 2017 has a response rate of 99.5% for the household interviewed (47,963). Of the 47,963 households interviewed, 50,730 women were eligible, but only 49,627 eligible women were interviewed (97.8%).

This present study is limited to children under 5 years of age who resided with their mother (eligible women interviewed) during the survey. There are 16,555 children under 5 years of age recorded in 2017 IDHS. For each of the variables observed in this study, we do not find missing data that must be excluded as exclusion criteria in this analysis. Therefore, the final sample consisted of 16,555 children aged between 0 and 59 months (100% response rate). Data is obtained through direct interviews with women's questionnaires administered to eligible women interviewed with respect to their most recent children born in the last five years before the survey.

Variables

1. Child health status
   Child health status is divided into two groups of participants in this study. The first group is children aged 0–59 months with ARI and the second group is otherwise. The DHS-7 guide identifies children with ARI as children under-5 years of age who had cough, accompanied by short, rapid, and/or difficult breathing, two weeks preceding the survey.[25] Questions on child health status were administered to the mother.
2. Sociodemographic characteristics
   The sociodemographic predictors include individual children, household, and environmental characteristics in our study. A child's age is listed as 0–5, 6–23, and 24–59 months of age. The household wealth index describes household characteristics and lists them as the poorest, poor, middle, rich, and the richest. The household wealth index is calculated on the basis of the household ownership of assets and facilities. The DHS standardized each household score for each asset and then established the factor score using principal components analysis to classify the wealth quintiles into five categories. Environmental predictors include the region and the place of residence. Previous research recorded zone based on the basis of ambient air quality and community activities to determine its association with the incidence of ARI.[26-28] Java island is a heavily populated area, while the outer island is not.[29] Therefore, the region is classified as the island of Java and the outer islands. The place of residence is listed as urban and rural areas.
3. Housing characteristics
   Housing amenities include water supply, sanitation, and crowding. The UN Habitat is used to define the variables listed above.[8,30] A household was deemed to have access to the improved water supply if it had access to protected water from outside contamination at a distance of 7 meters or more to the nearest septic tank and garbage disposal for cooking and washing, and bottled water/refilled water for drinking. Improved sanitation facilities were defined as a household with a private toilet and a septic tank. UN-Habitat defines home crowding as more than three persons per bedroom. However, because of the intent of our study which is tailored to family characteristics, such as relationship status, we used a norm of up to two people per bedroom.
4. Family Health behavior
   Taking into account the family functioning, this study uses indoor exposure to tobacco smoke pollution and breastfeeding as family health behaviors. Tobacco smoke pollution exposure is categorized as a tobacco smoking-free home zone and otherwise. The DHS-7 guide describes exclusive breastfeeding as infants between 0–6 months of age who are exclusively breastfed without receiving complimentary food.[25]

Analysis

The data is analyzed in two phases. First, a descriptive analysis is used to display the distribution of children aged 0–59 months according to the explanatory variables and the ARI status of these children. The proportion of children under-5 who suffered from ARI is recorded in percentages as a result of the Chi-square test. The Chi-square test is performed to assess the significant correlation between ARI and each explanatory variable.[31]

Second, the likelihood ratio test and Wald test are used in a multivariate logistic regression analysis. Multivariate

logistic regression analysis of ARI-associated determinants is performed. All predictors are included in the model, following the integrated model.[2] Dependent binary variable meets the Bernoulli distribution[32] as seen in the formula:

$$y \sim Bernoulli$$

$$\left(P(y=1) = \frac{exp\{\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n\}}{1 + exp\{\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n\}} \right)$$

The likelihood ratio is used to calculate the effect of all independent variables on the dependent variable of the model, using the G formula as follows:

$$G^2 = -2ln\frac{L_0}{L_p}$$

The G formula follows a Chi-square distribution with a degree of freedom (p-value) in such a way that the hypothesis is rejected if P value $<\alpha$ is used, which implies that the independent variables jointly influence the dependent variable.

The Wald test is used to partially measure the effect of each independent variable on the dependent variable. The analysis compares the Wald test statistical value to the Chi-square value. The statistical formula for the Wald test is as follows:

$$W = \left[\frac{\beta_j}{Se(\beta_j)} \right]^2$$

The hypothesis is dismissed if P value $<\alpha$ is used, which means that the independent variables partially affect the dependent variable. The odds ratio (OR) along with 95% confidence intervals (CI) is used to calculate association.

Ethical consideration

The IDHS 2017 data collection was downloaded from the DHS website in compliance with the Access Policy (https://microdata.worldbank.org/index.php/catalog/3477). The procedures and questionnaires for 2017 IDHS are in accordance with the Standard DHS survey protocol approved by the ICF Institutional Review Board (IRB) and conform with the U.S. Department of Health and Human Services regulations for the Protection of Human Subjects (45 CFR 46) (https://dhsprogram.com/methodology/Protecting-the-Privacy-of-DHS-Survey-Respondents.cfm).

Results

Sociodemographic characteristics and correlation test

Of the 16,555 children under-5 years of age who were living with their mother, 693 children had ARI.

Table 1 provides the demographic distribution of under-5 children. The descriptive analysis shows an almost equal distribution of children by region, place of residence, household wealth index, bedroom dwelling, and breastfeeding practice. The majority (86.7%) of under-5 children lived in houses with improved water supply. About 74.4% of children lived in houses with improved sanitation, while only around 25.6% of children lived in households without improved sanitation. Approximately, 76.3% of children were exposed to indoor tobacco smoke pollution, while only 23.7% of children were living in a tobacco smoking-free household. The majority (60.1%) of children were aged 24–59 months, whereas 30.4% and 9.5% were aged 6–23 months and 0–5 months, respectively.

The Chi-square test shows that the place of residence, household wealth index, bedroom dwelling, improved water supply, improved sanitation, tobacco smoke pollution, and child age are significantly correlated with ARI in children under-5 years of age (P-value <0.05).

In the final model with adjustment for other variables [Table 2], children aged 0–5 months were 1.69 times less likely to be at risk for ARI compared to those aged 24–59 months. Based on the economic status, children living in the poorest households had the highest odds of being infected (AOR 1.66; 95% CI, 1.20–2.28). Children living at home with improved sanitation were 1.35 times more likely to reduce ARI than those living at home with unimproved sanitation. Concerning family health behavior, children exposed to tobacco smoke pollution at home had higher odds of developing ARI (AOR 1.27; 95% CI, 1.04 – 1.56) than those living in a tobacco smoking-free household. Children who were exclusively breastfed were 1.17 times more likely to experience ARI than those who were not.

Discussion

The present study clarifies the association between home crowding and the prevalence of ARI in children under-5 years of age. Findings indicate that home crowding has been reported to no longer be taken into account in children's health following changes in demographic and socioeconomic determinants.[12] In contrast, indoor exposure to tobacco smoke pollution[17,19] and the practice of exclusive breastfeeding[33,34] are significantly associated with ARI. Thus family acts as a health-support system for its members.[35]

Some factors, such as improved household sanitation,[36,37] younger age, and higher economic status, are associated with a decrease in the risk of under-5 children suffering from ARI. As age increased, the children are more likely to develop ARI. The explanation may be due to complementary feeding practices that need to be followed by the family as the child was growing up from 6 months of age.[38,39] The IDHS 2017 found that only around 40% of young children aged 6–23 months had sufficient infant and young child feeding practice.[4] IDHS 2012 also reported high prevalence of smoking in poor families in Indonesia.[40]

On the other hand, improved water supply is not significantly associated with ARI in children under-5 years

Table l: Sociodemographic characteristics and Correlation test of under-5 children according to ARI status, Indonesia 2017

Characteristics	Children under-5				χ^2 *(p-value)*
	Yes ARI (*n*=693)		No ARI (*n*=15,862)		
	Number	%	Number	%	
Region					0.305 (0.581)
Java island	364	4.1	8,491	95.9	
Outer Java islands	329	4.3	7,371	95.7	
Place of residence					5.216 (0.022)
Urban	307	3.8	7,730	96.2	
Rural	386	4.5	8,132	95.5	
Household wealth index					52.908 (0.000)
The poorest	204	6.0	3,180	94.0	
Poor	164	4.9	3,173	95.1	
Middle	113	3.4	3,236	96.6	
Rich	116	3.5	3,218	96.5	
The richest	96	3.0	3,055	97.0	
Bedroom dwelling					7.573 (0.006)
≤2	308	3.7	7,908	96.3	
>2	384	4.6	7,955	95.4	
Improved water supply					4.519 (0.034)
Yes	582	4.1	13,767	95.9	
No	111	5.0	2,095	95.0	
Improved sanitation					44.974 (0.000)
Yes	440	3.6	11,874	96.4	
No	253	6.0	3,988	94.0	
Indoor exposure to tobacco smoke pollution					12.363 (0.000)
Yes	567	4.5	12,057	95.5	
No	126	3.2	3,805	96.8	
Breastfeeding					2.664 (0.103)
Yes	292	3.9	7,184	96.1	
No	401	4.4	8,678	95.6	
Child age					
0-5	41	2.6	1,530	97.4	10.750 (0.005)
6-23	217	4.3	4,822	95.7	
24-59	435	4.4	9,510	95.6	

of age. This finding is in contrast to a study on the need for in-home piped water, which is unlikely to be contaminated by the virus to reduce the risk of infection.[41] Contaminated bottled water has been found in some areas of Indonesia.[42] Our result is likely as there is a lack of control over the hygiene of the refilled drinking water source in Indonesia as one of the metrics for improved water supply in the DHS measure.

The region and the place of residence are statistically insignificant. Controversy on the results of previous studies relates to the association of children living in urban or rural areas at risk of acute respiratory infection.[43-46] The impact of regional heterogeneity on the risk of ARI in children cannot also be explained as a high prevalence of tobacco smoking in most regions of Indonesia.[47]

The strength of this study is the large nationally representative data that make it possible to generalize the results to the national level. However, the data on ARI status relies on retrospective information provided by mothers which might be subject to revocation bias. It is also difficult to assert a cause-and-effect relationship. The cross-section design analysis does not determine the causality of variables, but only calculate the association of the variables.

Conclusions

This cross-section analysis shows that home crowding is not associated with the risk of acute respiratory infection in children under-5 years of age after consideration of other factors. The findings suggested that the role of the family as the primary environment is to support their under-5 children by maintaining a tobacco smoking-free zone at home and by breastfeeding exclusively up to 6 months of age. In addition, improved household sanitation must be ensured to prevent children from contracting ARI. Evidence can be used in particular to motivate families to

Table 2: Logistic regression model for the predictors of under-5 children with ARI status, Indonesia (*n*=16,555)

Covariates	Adjusted OR (95% CI)	*(p-value)*
Region		
Java Island	1.13 (0.96-1.34)	0.141
Outer Java Islands	1	
Place of residence		
Urban	1.03 (0.87-1.23)	0.717
Rural	1	
Household wealth index		
The poorest	1.66 (1.20-2.28)	0.000
Poor	1.42 (1.07-1.89)	0.000
Middle	1.01 (0.76-1.35)	0.954
Rich	1.08 (0.82-1.43)	0.575
The richest	1	
Bedroom dwelling		
≤2	0.91 (0.77-1.06)	0.222
>2	1	
Improved water supply		
Yes	1.01 (0.81-1.27)	0.134
No	1	
Improved sanitation		
Yes	0.74 (0.61-0.89)	0.002
No	1	
Indoor exposure to tobacco smoke pollution		
Yes	1.27 (1.04-1.56)	0.019
No	1	
Breastfeeding		
Yes	0.85 (0.73-0.98)	0.048
No	1	
Child age		
0-5	0.59 (0.43-0.82)	0.002
6-23	1.01 (0.85-1.19)	0.986
24 59	1	
-2 log likelihood	6259,407	
df	13	
Sig.	0.000	

preserve family health behavior in support of child health promotion.

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Conflicts of interest

There are no conflicts of interest.

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