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Factors Associated with Acute Respiratory Infections in Children Aged 0 - 5 Years in the Yénawa District of Cotonou (Benin) in 2023

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Abstract

Introduction: Acute respiratory infections remain one of the main causes of mortality in children aged 0 to 5. This work aimed to study the associated factors with the occurrence of acute respiratory infections in children 0 to 5 years old in Yénawa, Cotonou in 2023. **Subjects and Method:** It was an analytical cross-sectional study of children aged 0 - 5 years and their mothers in Yénawa, selected by four-degree random sampling. The sampling size, calculated using the Schwartz formula, was 126 children and 126 mothers. The dependent variable was the occurrence of acute respiratory infections. The independent variables were classified into four groups: socio-demographic and economic characteristics, behavioral factors, child-related factors, and environmental factors. Data collected by observation and questionnaire survey were analyzed using STATA version 15 software. Associated factors were investigated by bivariate analysis and multiple logistic regression, at the 5% significance level. **Results:** A total of 126 children aged 0 - 5 years and 126 mothers were surveyed, aged 23.5 (11 - 36) months and 30 (18 - 48) years respectively. The prevalence of acute respiratory infections was 74.60% (CI95% = 66.89 to 82.30). The associated factors were the mother's age between 18 and 28 (OR = 10.77; CI95% = 1.89 to 61.27; p = 0.007), the use of charcoal/wood for cooking (OR = 7.36; IC = 1.99 to 27.10; p = 0.003)), children's poor personal hygiene (OR = 8.87; IC = 2.92 to 26.97; p < 0.001)), and cohabitation with domestic animals (OR = 7.27; IC = 1.67 to 31.71; p = 0.015). **Conclusion:** Communicating with mothers about the factors identified will help reduce the prevalence of acute respiratory infections in children aged 0 to 5.

Keywords

Acute Respiratory Infections, Children Aged 0 - 5, Associated Factors, Yénawa, Benin

1. Background

Child mortality remains a real scourge in Africa. Indeed, in 2019, sub-Saharan Africa remains the region with the highest under-5 mortality rate in the world, with one child in 13 dying before their fifth birthday [1]. After the first 28 days of life, the greatest threat to children's survival is infectious diseases such as diarrhea, malaria and pneumonia [2]. Pneumonia is a form of Acute Respiratory Infection (ARI) affecting the lungs, and in 2021 was responsible for 14% of all deaths in children under 5. Reducing pneumonia-related mortality in children under five to less than 3 per 1,000 live births by 2025, as set by the United Nations Children's Fund (UNICEF) and the World Health Organization (WHO), means preventing ARIs [3].

Acute respiratory infections are diseases affecting the upper or lower respiratory tract, usually of infectious origin. Worldwide in 2019, ARIs caused the death of 740,180 children under the age of 5 [4]. Sub-Saharan Africa and South Asia remain the most affected regions. In Benin, according to the 2019 Annuaire des Statistiques Sanitaires, acute respiratory infections were the second most common reason for consultations among children aged 0 to 5 (17%) after malaria (48.8%) [5].

The heavy loss of young lives due to ARI infant mortality is a heavy burden on families and healthcare providers in Benin. In terms of the child's health, they can easily evolve into severe respiratory distress, generating expenses that affect the family financially and psychologically. According to the literature, several factors can influence the occurrence of acute respiratory infections in children aged 0 to 5. These include the age of the child and the caregiver, the caregiver's level of education, passive smoking and other toxic fumes (air pollution) and the notion of contagion, the child's vaccination status, the season, the use of wood fires, cohabitation with animals, environmental sanitation and the parents' income [6]-[15].

The WHO recommends four strategies for reducing child mortality, which are taken into account in the third Sustainable Development Goal, which aims to promote the health and well-being of all people, of all ages. These strategies are timely and appropriate home-based care and treatment for newborn complications, Integrated Management of Childhood Illness (IMCI) for all children under five, Expanded Programme of Immunization (EPI), and Infant and Young Child Feeding (IYCF). Integrated Management of Childhood Illness (IMCI), initiated by WHO and UNICEF, has been adopted by Benin as a strategy for reducing child morbidity and mortality [10] [11] (Merera, 2021; Rana, 2019).

Despite all these measures, the prevalence of ARI remains high in Benin. In Yénawa district, second arrondissement of Cotonou, a community diagnosis carried out in January 2023 reported a hospital incidence of ARI of 20.7% in children aged 0 to 5 in December 2022, compared with 19% in 2021 at the national level. What is the community prevalence of ARI among children aged 0 to 5 in the Yénawa district? And what factors explain the occurrence of ARI in children aged 0 to 5 in this neighborhood? This work aimed to study the associated factors with the occurrence of acute respiratory infections in children 0 to 5 years old in Yénawa, Cotonou in 2023. The results will help guide interventions to reduce morbidity and mortality due to ARI in children aged 0-5 in Yénawa.

2. Subjects and Method

1) Study Design

This was a cross-sectional study with an analytical focus that took place in the Yénawa district in the second arrondissement of Cotonou in the Republic of Benin from April 17, 2023 to May 4, 2023.

2) Population and Sample

The primary target was children aged 0 to 5 living in Yénawa in Cotonou's 2nd Arrondissement, and the secondary target was mothers or guardians (anyone capable of answering questions about the child in place of the mother) of children aged 0 to 5. Children aged 0 to 5, who had been living in the Yénawa district for at least three months and whose mothers or guardians had consented to take part in the survey, were included in the study.

The sample size was calculated using the Schwartz formula ($n = Z^2\alpha\ pq/i^2$) with a prevalence of 3% for ARI according to the Demographic and Health Survey, Benin, 2017 - 2018 [5] ($Z\alpha = 1.96$), the reduced difference for a confidence level of 95%, a desired power of 3.5% and a non-response rate margin of 10%.The children were selected by a four-stage random sample. The first stage corresponded to the selection, by area sampling, of two geographical areas from the four on the cadastral map of the Yénawa district. The second stage corresponded to the choice of the first concession to be surveyed in each of the selected geographical areas. To this end, a pen was turned in the center of the geographical area and the direction of the pen tip was identified. The concessions in this direction were numbered to serve as a sampling frame for selecting the first concession to be surveyed, by simple random sampling. The other concessions to be surveyed were identified from nearest to nearest. The third stage of sampling consisted of selecting households within the concessions. At this level, 50% of eligible households in each concession were selected by simple random sampling. In the fourth stage, one eligible child was selected by simple random sampling from all eligible children in each selected household.

3) Study Variables

The dependent variable was the occurrence of acute respiratory infections. The independent variables were classified into four groups: socio-demographic

and economic characteristics, behavioral factors, child-related factors and environmental factors.

4) Operational Definition of Variables

The occurrence of acute respiratory infections: was defined by a non-irritating cough lasting more than three days, or a runny nose or difficulty breathing, during the last two weeks prior to the survey.

Mother's age: was collected in revolute years and child's age in revolute months

Parental income: consisted of monthly household assets, estimated in FCFA.

Household size: was defined as the total number of permanent members of the household.

The mother's level of knowledge: was categorized into three modalities concerning four items such as the correct definition of ARI, knowledge of its symptoms, the factors that can lead to it, and the means of prevention in children aged 0 to 5 years. Each item was weighted at 3 points. Mothers' knowledge was judged good if all answers were correct, average for one or two correct answers, and poor if no answer was correct.

Exclusive breastfeeding: was defined as feeding only breast milk from birth to six months of age.

The child's immunization status: was assessed by compliance with the immunization schedule, based on the child's vaccination record.

Malnutrition: was assessed on the basis of the child's brachial perimeter (BP) and was declared malnourished if its weight was less than 12.5 centimeters (cm).

Birth weight: was categorized as low if less than 2500 grams (g) and normal if greater than or equal to 2500 g.

Hygiene and sanitation of the living environment: were assessed on the basis of garbage management, frequency of sweeping of the living environment, presence of closed garbage garbage cans, presence of garbage in the concession or immediate vicinity, presence of hand-washing facilities close to the toilets.

Children's passive smoking: obtained by declaration, was defined by their exposure to cigarette smoke from parents and/or neighbors.

5) Collection tools and techniques

Data were collected by questionnaire survey. Brachial circumference was measured using a graduated tape.

6) Data analysis

The data collected via the Kobo Collect application, downloaded onto the Kobo toolbox platform, were cleaned and analyzed using STATA version 15 software. Qualitative variables were expressed as proportions, and quantitative variables as mean and standard deviation or median with interquartile range, depending on their distribution normality.

Factors associated with acute respiratory infections were identified by bivariate and multivariate analysis. In the bivariate analysis, proportions were compared using Pearson's Chi-square test or Fisher's exact test. The multivariate analysis was a multiple step-down logistic regression, at a significance level of

5%. Variables that had a p-value of less than 20% in the bivariate analysis were included in the initial multiple logistic regression model. Interactions were checked. The adequacy of the model was verified by the Hosmer-Lemes how test, at the 5% significance level.

7) Research Ethics

In our study, all targets were informed of the nature and objectives of the study. Oral informed consent was obtained from respondents before the tools were administered. anonymity and confidentiality were respected during data collection and analysis.

3. Results

1) Sample Characteristics

A total of 126 children aged 0 to 5 and 126 mothers of children were surveyed as part of this study.

a. Children's characteristics

The children ranged in age from 0 to 60 months, with a median of 23 months (Q1 = 11; Q3 = 36), and had a mean brachial circumference of 15.00; SD = 2.50. Table 1 below describes the child population.

Half (50%) were between 24 and 60 months of age, 80.16% were up-to-date with their immunization status, and 15.65% were malnourished.

b. Mothers' characteristics

Mothers of children had a median age of 30 (Q1 = 25; Q3 = 35). Their characteristics are shown in Table 2 below.

Table 1. Distribution of children aged 0 - 5 years according to sociodemographic, biological, clinical, and vaccination characteristics, Yénawa (Cotonou) 2023 (n = 126).

Variables	Category	Frequency (n)	Percentage (%)
Child's age (months)	0 - 6	17	13.49
	6 - 24	46	36.51
	24 - 60	63	50.00
Sex	Male	61	48.41
	Female	65	51.59
Birth weight (n = 116)	< 2500 g	19	16.38
	≥ 2500 g	97	83.62
Nutritional status of the child (n = 115)	malnourished (Bp* < 12.5 cm)	18	15.65
	Not malnourished (Bp ≥ 12.5 cm)	97	84.35
Age-specific vaccination status	Updated	101	80.16
	not up-to-date	25	19.84

* Bp = Brachial Perimeter.

Table 2. Socio-demographic and economic characteristics of mothers of children aged 0 - 5 Yénawa (Cotonou) 2023 (n = 126).

Variables	Category	Frequency (n)	Percentage (%)
Age (year)	18 - 28	44	34.92
	28 - 38	66	52.38
	38 - 48	16	12.70
Marital status	Married	64	50.79
	Concubinage	41	32.54
	Divorced/Widowed/Single	21	16.67
Education level	None	40	31.74
	Primary	38	30.16
	Secondary	43	34.13
	Higher	5	3.97
Occupation	Reseller/saleswoman	72	57.14
	Housekeeper	21	16.67
	Employee	4	3.17
	Ocasionnal worker	29	23.02
Number of persons in household	<5	104	82.54
	≥5	22	17.46
Monthly income in fcfa (n = 99)	<40000	73	73.74
	≥40000	26	26.26
ARI Knowledge*	Mauvaise	111	88 .10
	Moyenne/Bonne	15	11.90

* Acute Respiratory Infection.

Table 3. Summary of factors associated with acute respiratory infections in bivariate analysis, Yénawa (Cotonou) 2023 (n = 126)

Independent Variables	OR	95%CI		p
		Lower limit	Upper limit	
Mother's age (years)				
18 - 28	3.80	1.00	14.35	**0.049**
28 - 38	1.38	0.44	4.32	0.580
38 - 48	1		--	--
Marital status				
Married	1		--	--
Divorced/widowed/single	9.77	1.23	77.79	**0.031**
Concubinage	1.51	0.63	3.66	0.357
Energy source for cooking				
Gas	1		--	--
Charcoal/wood	8.8	2.97	26.27	**<0.001**
Child's situation during baking				
Salon	1		--	--
kitchen/backside	3.45	1.19	9.96	**0.022**

Continued

In room	2.12	0.71	6.31	0.176
Others	1.24	0.35	4.44	0.743
Personal hygiene				
Good	1		--	--
Bad	6.09	2.45	15.12	**<0.001**
Living with animals				
No	1		--	--
Yes	5.48	1.55	19.32	**0.008**
Presence of fence				
Yes	1		--	--
No	4.24	1.76	10.22	**0.001**
Type of floor in the courtyard				
Tile	1		--	--
Clay	7.20	1.22	42.19	**0.029**
Terrace	9.50	1.27	70.96	**0.028**
Others	0.50	0.03	7.99	0.624

Table 4. Factors associated with acute respiratory infections in multivariate analysis, Yénawa (Cotonou) 2023 (n = 126)

Independent Variables	Bivariate				Multivariate			
	OR	95% CI		p	aOR	95% CI		p
		Upper limit	Lower limit			Upper limit	Lower limit	
Mother's age (years)								
18 - 28	3.80	1.00	14.35	**0.049**	10.77	1.89	61.27	**0.007**
28 - 38	1.38	0.44	4.32	0.580	3.30	0.76	15.12	0.108
38 - 48	1.00	-	-	-	1.00	-	-	-
Energy sources for cooking								
Gas	1.00	-	-	-	1.00	-	-	-
Charcoal/wood	8.80	2.97	26.27	**<0.001**	7.36	1.99	27.10	**0.003**
Personal hygiene								
Good	1.00	-	-	-	1.00	-	-	-
Bad	6.09	2.45	15.12	**<0.001**	8.87	2.92	26.97	**<0.001**
Living with animals								
Yes	5.48	1.55	19.32	0.008	7.27	1.67	31.71	**0.015**
No	1.00	-	-	-	1.00	-	-	-

This table shows that the 28 to 38 age group was the most represented (52.38%), half of the mothers were married (50.79%), and 57.14% were smoked poison sellers. Knowledge of ARI was good in 11.90% of mothers.

c. Prevalence of acute respiratory infections in children aged 0 - 5 years

In all, 94 of the 126 children had at least one acute respiratory infection, with a prevalence of 74.60% (CI 95% = 66.89 to 82.30).

2. Bivariate Analysis

Table 3 shows the factors associated with acute respiratory infections in the bivariate analysis.

These factors were: The mother's age and marital status, the energy source for

cooking, child's professional hygiene, cohabitation with animals, the presence of a fence and type of soil in the living yard.

3. Multivariate Analysis

Table 4 shows that after adjustment, susceptibility to respiratory infections in children aged 0 to 5 decreased with the mother's age. Indeed, children of mothers aged 18 to 27 were 10.77 times more susceptible to ARI than children of mothers aged 38 to 47 (aOR = 10.77; 95% CI = 1.89 to 61.27; p = 0.007). This same susceptibility to ARI increased significantly with the use of charcoal or even wood as an energy source for cooking, compared with domestic gas (aOR = 7.36; 95%CI = 1.99 to 27.10; p = 0.003). Similarly, poor personal hygiene multiplied the child's susceptibility to ARI by 8.87 compared with good hygiene (aOR = 8.87; 95%CI = 2.92 to 26.97; p < 0.001). The same was true for living with animals (aOR = 7.27; 95% = 1.67 to 31.71; p = 0.015).

4. Discussion

1) Prevalence of ARI

The prevalence of ARI among children aged 0 to 5 in the Yénawa neighborhood was (74.60%) compared with a national prevalence of 3% through the 2017 - 2018 Demographic and Health Survey (DHS) in Benin [5]. This high prevalence could be explained, on the one hand, by the period of data collection for the present work and, on the other, by the diagnostic criteria used. Azonhe, in his study of climatic parameters and acute respiratory infections in Benin, showed that during the rainy season (May to October), there is a progressive increase in cases of ARI [16] in the EDS, the diagnostic criteria were very specific: short, rapid breathing associated with chest problems, and/or breathing difficulties associated with chest problems [17], and could exclude mild forms of ARF and high ARF.

These results are similar to those found by Chilot *et al*., who obtained a prevalence of 64.4% for East Africa from 2012 to 2020 [18].On the other hand, lower prevalences were reported by Demissie *et al*. in Ethiopia in 2019 (58.7%) and Nshimiyimana *et al*. in Uganda in 2016 with a prevalence of 40.3% for a sample of 13493 children under 5 years of age [19] [20].

The prevalence obtained in our study is clearly higher than those obtained in Ethiopia in 2020 by Dagne *et al* (27.3%)and in 2016 by Merera *et al* (14.50%) [21] [22]. These differences could be explained by our much smaller sample size, the seasonal timing of data collection in the different countries, and the operational definition of ARI in each study.

2) Factors associated with acute respiratory infection

The associated factors with ARI found in our study were the mother's age, between 18 and 28, the use of wood and charcoal for cooking, children's poor personal hygiene and cohabitation with domestic animals.

a. Mother's age

Children of mothers aged between 18 and 28 were 10.77 times more susceptible to ARI than children of mothers over 35. This same trend is reinforced by the

study by Nshimiyimana *et al* in Uganda, which found that susceptibility to ARI in children under 5 years of age was higher in teenage mothers (OR = 1.28; 95% CI = 1.06 to 1.53) [20]. This could be explained by the fact that older mothers have more experience (knowledge, attitudes and practices) of child health in general, since the parity that concedes childcare experience to mothers increases with age. The same results were observed in a study carried out by Diop *et al* at the Donka National Hospital in Guinea Conakry in 2020. In this study, children under 5 from mothers aged under 20 were 1.97 times more likely to suffer from ARI than those aged over 20 (OR = 1.97; 95% CI = 1.00 to 3.90) [23]. Hassen *et al* in Ethiopia in 2019 in a study carried out in the Legambo district zones, found that children of mothers aged under 35 were more susceptible to ARIs compared to others [24].

b. Energy source for cooking

This study revealed that susceptibility to ARI was multiplied by 7.36 in children living in households where the main source of energy used for cooking was wood or charcoal. Indeed, smoke irritates children's airways (which are not yet mature), increasing their susceptibility to ARI compared with unexposed children and adults. Kafando *et al* in Burkina Faso in 2017 in a study on indoor air pollution and prevalence of acute respiratory infections in children in Ouagadougou reported that children living in households using traditional stoves were more susceptible to ARI, compared to those living in households using gas stoves (OR = 2.17; 95% CI = 1.11 to 4.28) [25]. Similarly, Enyew *et al* in 2015 in Ethiopia, reported a significant association between the use of biomass fuels and ARI (OR = 1.57; 95% CI = 1.06 to 2.33) [7]. In Parakou, Benin's second-largest commune, a similar association was highlighted by Adedemy *et al* [26]. Demissie *et al* also reached the same conclusion in Ethiopia in 2019 (aOR = 2.12; 95%CI = 1.07 to 4.19), as did Adesanya *et al* in Nigeria in 2013 (aOR = 1.42; 95% CI = 1.01 to 1.99) [19] [27].

c. Presence of domestic animals

According to the present study, ARI was 7.27 times more frequent in children under 5, living in contact with pets. Indeed, allergens linked to pet hair in children's environments can be sources of ARI, as can the possible infectious risks during contact with these animals. Adedemy *et al* reported in 2017 in a study carried out at the CHU/D Borgou in Parakou, that children who didn't live with animals were 0.92 times less likely to develop ARI than those who did since animals are a source of allergy [26].

d. Poor child hygiene

Susceptibility to ARI was multiplied by 8.87 in children with poor personal hygiene. This same relationship was highlighted by Dagne *et al* in Ethiopia through a lack of awareness of hand hygiene on the part of the mother (aOR = 2.79; 95%CI = 1.15 to 6.76) [21].

This study carried out a cross-sectional, analytical study, which was the most appropriate type of study, given the lack of control over the anteriority between the occurrence of ARI and the explanatory factors identified. The sample sizes of

126 children aged 0 to 5 years and 126 mothers or child respondents, estimated using the Schwartz formula with a threshold of 5% and increased by a non-response rate of 10%, are sufficient for adequate analyses. Similarly, probability sampling was used to extrapolate results to the entire study population. In addition, a multivariate analysis was carried out to identify potential explanatory factors for the occurrence of ARI. All these precautions ensured that the results of the study were validated.

However, the global diagnosis of ARF, taking into account all forms in children aged 0 to 5, probably justifies the high prevalence found. Further studies should be considered, with specific criteria for diagnosing forms of ARF (low or high ARF). Despite these limitations, we have reached conclusions that are of great scientific interest.

5. Conclusion

This study shows that the prevalence of ARI remains high in the study area. In-depth analysis enabled us to identify non-modifiable factors such as the mother's age, and modifiable factors such as the source of energy for cooking, cohabitation with wild animals and poor personal hygiene, which explain the occurrence of ARI in children under 5. Strategies to combat ARI in this vulnerable segment of the population must focus on these factors.

6. Author Contribution

Drs. Mongbo Virginie, Luc Béhanzin, Lamidhi Salam, and Professor Edgard-Marius Ouendo have worked together on the research concept and design; Drs. Mongbo Virginie, Luc Béhanzin and Lamidhi Salam worked on data collection and analysis. Dr Mongbo Virginie and Mr. Nicolas Hamondji Amegan worked on the draft, review and correction of the manuscript, under supervision of Professor Edgard-Marius Ouendo. Mr. Nicolas Hamondji Amegan has translated the manuscript

Conflicts of Interest

The authors declare that the study was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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