Risk factors associated with acute respiratory infections among under-five children admitted to Arthur's Children Hospital, Ndola, Zambia.

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ABSTRACT

Background: Acute respiratory infections (ARI) are among the leading causes of acute illnesses worldwide and remain the most important cause of infant and young children mortality especially in developing countries. In Zambia, ARI are among the top ten leading causes of morbidity leading to hospital visitations and admissions of children under five years of age. The objective of the study was to determine the risk factors associated with acute respiratory infections. **Methods:** A case-control study of hospitalized under-five children at Arthur Davison children's hospital in Ndola was conducted. **Results:** The study comprised 220 participants of which 107 were cases and 113 were controls. A total of 126 (57.3%) were male children (56.1% of cases and 58.4% of controls). Factors associated with ARI were: mothers with history of ARI (AOR=2.31; 95%CI [1.57, 3.42]); siblings with a history of ARI (AOR=1.69; 95%CI [1.12, 2.55]); household with a separate room for cooking (AOR=2.86; 95% CI [1.54,5.32]); families that usually did not use any transport media (AOR=0.57;95% CI [0.32, 1.02]); families that used public transport (AOR=2.51; 95% CI [1.56, 4.05]); and households comprising of less or equal to 3 people (AOR=0.31;95% CI [0.16,0.63]).**Conclusion:** In a study of under-five children at Arthur Davison Children Hospital, ARIs were negatively associated with low socio-economic status and family history of respiratory infections. The present findings reiterate the need to intensify the administration of health education on the prevention measures for ARI.

Key words: Acute respiratory infections, children under 5 years old, risk factors, Zambia

Introduction

Acute respiratory infections (ARI) are among the leading cause of acute illnesses worldwide and remain the most important cause of infant and young children morbidity and mortality [1].Acute respiratory infections are due to bacterial, fungal or viral infections of the respiratory tract leading to breathing difficulties, fatigue, wheezing, pain on swallowing, fever, cough, nasal discharge, sputum production and sometimes complicating into infections of the ears and the membranes surrounding the brain and fatalities in the very young and older age-groups. ARI include diseases such as pneumonia, influenza, bronchiolitis, sinusitis, epiglottitis, laryngitis, and bronchitis to mention but a few [2]. About 13 Million children under-five years of age die every year in the world, 95% of them in developing countries, and one third of total deaths are due to ARI [3]. In addition, the World Health Organization (WHO) estimates that respiratory infections account for 6% of the total global burden of disease – a higher percentage than diarrheal disease, cancer, human immunodeficiency virus (HIV) infection, ischemic heart disease or malaria [4].The World Health Organization estimates that 20% of hospitalizations in children under the age of 5 years are attributable to severe acute respiratory illness with 90% of these illnesses resulting in pneumonia [5].In the developing countries, out of ten, seven deaths in under-five years of age group are due to ARI.The percentage of deaths due to all causes for ARI is between 2 times and 6 times higher in less developed countries than in developed countries [6]. They also account for 30-40%

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of the attendance to children out patient and 20-30% of hospital admissions [7,8].Zambia, a developing country in Africa has not been spared of a high burden of disease of which ARI are among the top 10 causes of morbidity and mortality in the country. In every town of the country, pneumonia is the leading cause of clinic visit and death for under-five children which is followed by malaria and diarrhea [5].Simusika et al confirms the most common clinical diagnosis, as determined by attending physicians, was pneumonia (77.4%), followed by bronchiolitis (11.3%)at the national hospital in Zambia [9].In Zambia the under-five mortality rate stands at 119 per 1000 live births. The principle causes of such a figure have been attributed to acute respiratory infections, malaria, diarrhea, malnutrition and anemia in accordance to UNICEF findings [1].Hospital records in Ndola at ADH [10], showed that acute respiratory infections are the major reason for children under the age of five attending the filter clinic at the hospital. For instance, in 2012, 6778 cases of acute respiratory infections including pneumonia and respiratory non pneumonia were recorded out of 24540 cases of top ten reasons for attending the filter clinic, of which in under one-year-old children respiratory infection non pneumonia represented 18.4% of the top ten reasons for filter clinic attendance and pneumonia was at 13% in the under one year. On the other hand, the same trend occurred in the children between the ages of one and four years in which the respiratory infections non pneumonia was at 16.8% of the top ten diseases while pneumonia cases were at 8.5%. The total number of admissions for ARIs among the under-five at ADH in 2012 was 8146 [10].Several studies have been done to identify the risk factors for ARI and include; household air pollution, parental smoking, crowding at home, respiratory infections among other siblings, education and socioeconomic factors of which the majority have been done in developed countries and outside Zambia [11-17].Therefore, the current study was designed to determine the risk factors associated with acute respiratory infections in under-five children admitted at Arthur Davison Children's Hospital, Ndola, Zambia.

Methods

Study Area and design

The study area was Arthur Davison Children's Hospital, a third level and only children's hospital in Zambia, located in the city of Ndola which consists of both low and high residential areas. A case-control study was conducted to identify risk factors for acute respiratory infections.

Sample size/sampling

In order to determine the sample size, a pilot study was conducted comprising of 30 cases and 30 controls. Data obtained from the pilot study on the proportion of having a separate room for cooking was used to compute the sample size. With 23.3% of the cases and 3.3% of the controls not having a separate room for cooking (used same room for cooking and other activities)and considering none response rate of 80% at 95% confidence level, with a power of 90%, the minimum sample size was found to be 87 for cases and 87 for controls. Cases included hospitalized under-five children with acute respiratory infection and controls included children that were admitted for other illness other than ARI. Sample of unmatched controls and cases were systematically randomly selected.

Variables

A standardized questionnaire was developed from questionnaires that have been previously used in similar studies and modifications were made to suit the study and objectives. Cases included under-five children admitted at ADH whose clinical diagnosis was made by the physician. Controls included under-five children admitted at ADH suffering from other illness other than ARI. Demographic, social and economic factors including age of the child, education level of caregivers, residential address, breastfeeding, siblings' history of respiratory infection, mother's history of respiratory infection, housing, crowding, source of light, energy for cooking, availability of separate kitchen, family mode of transport and passive smoking were considered in this study.

Data Analysis

Data was entered using Epi Data software and analyzed using SPSS version 11.5.Data entry was screened in terms of consistency and was double entered. Variables which were statistically significant at bivariate analyses were considered for potential confounders in a multivariate logistic regression analysis. The confidence level was set at 95%.

Ethical considerations

The study was approved by Tropical Diseases Research Center (TDRC) in Ndola, Zambia. Permission to conduct the study was given by the ADH administration. Parents consented to taking part in the survey after explaining what the study was all about. Participants were assured of confidentiality and that they may stop responding to the questions or withdraw from the study without affecting the treatment their children are receiving at the hospital.

Results

The study included a total number of 220 participants of which 107 were cases and 113 were controls. A total of 126 (57.3%) children were male (56.1% of cases and 58.4% of controls).

Factors associated with ARI in bivariate analyses

Table 1 shows associations of child factors with ARI. Cases tended to be older than controls (p<0.001).

Table 1: Child factors associated with acute respiratory infections among under five children admitted at Arthur Davison Children's Hospital in bivariate logistic regression analyses

	Total	Cases	Controls	
Factor	**n (%)**	**n (%)**	**n (%)**	**P value**
Sex of the child				
Male	126 (57.3)	60 (56.1)	66 (58.4)	0.727
Female	94 (42.7)	47 (43.9)	47 (41.6)	
Age of the child (years)				
<1	94 (42.7)	58 (54.2)	36 (31.9)	<0.001
1-2	86 (39.1)	39 (36.4)	47 (41.6)	
3-4	40 (18.2)	10 (9.3)	30 (26.5)	

In relation to caregiver factors associated with ARI, level of education and number of people in the household were significantly associated with ARI (Table 2).

Table 2: Caregiver factors associated with acute respiratory infections among under five children admitted at Arthur Davison Children's Hospital in bivariate logistic regression analyses

	Total	Cases	Controls	
Factor	**n (%)**	**n (%)**	**n (%)**	**P value**
Care giver				
Mother	207 (94.1)	104 (97.2)	103 (91.2)	0.057
Others	13 (5.9)	3 (2.8)	10 (8.8)	
Marital status of caregiver				
Single	11 (5)	7 (6.5)	4 (3.5)	0.381
Married	188 (85.5)	92 (86.0)	96 (85.0)	
Married before	21 (7.3)	8 (7.5)	13 (11.5)	
Care giver's level of education				
≤primary	104 (47.3)	68 (63.6)	36 (31.9)	<0.001
Secondary	72 (32.7)	23 (21.5)	49 (43.4)	
Tertiary	44 (20.0)	16 (15.0)	28 (24.8)	
Residential area				
High residential area	105 (47.7)	57 (53.3)	48 (42.5)	0.109
Low residential area	115 (52.3)	50 (46.7)	65 (57.5)	
Breastfeeding/breastfed				
Yes	191 (86.8)	97 (90.7)	94 (83.2)	0.102
No	29 (13.2)	10 (9.3)	19 (16.8)	
Number of people in the household				
≤3	65 (29.5)	17 (15.9)	48 (42.5)	<0.001
4-6	83 (37.7)	50 (46.7)	33 (29.2)	
7-9	55 (25.0)	29 (27.1)	26 (23.0)	
10 and above	17 (7.7)	11 (10.3)	6 (5.3)	

Table 3 shows associations of history of ARI among mothers and siblings with ARI. Mothers' and siblings' history of ARI were significantly associated with ARI. Age of siblings with history of ARI was also significantly associated with ARI.

Table 3: Associations of history of respiratory infections with acute respiratory infections among under five children admitted at Arthur Davison Children's Hospital in bivariate logistic regression analyses

	Total	Cases	Controls	
Factor	**n (%)**	**n (%)**	**n (%)**	**P value**
Mother's history of respiratory infection the past month				
Yes	72 (33.0)	53 (50.0)	19 (17.0)	<0.001
No	146 (67.0)	53 (50.0)	93 (83.0)	
Siblings with History of respiratory the previous one month				
Yes	57 (27.8)	42 (42.9)	15 (14.0)	<0.001
No	148 (72.2)	56 (57.1)	92 (86.0)	
Age of siblings with history of respiratory infection (years)				
<5	44 (81.5)	36 (87.8)	8 (61.5)	0.034
5+	10 (18.5)	5 (12.2)	5 (38.5)	

Among economic factors considered in the analysis, only type of energy used for cooking, cooking place and mode of transport used by the family were significantly associated with ARI (Table 4).

Table 4: Economic factors associated with acute respiratory infections among under five children admitted at Arthur Davison Children's Hospital in bivariate logistic regression analyses

	Total	Cases	Controls	
Factor	**n (%)**	**n (%)**	**n (%)**	**P value**
Floor of the house				
Cement	188 (85.5)	86 (80.4)	102 (90.3)	0.114
Earth	18 (8.2)	12 (11.2)	6 (5.3)	
Other	14 (6.4)	9 (8.4)	5 (4.4)	
Wall material of the house				
Cement blocks	162 (73.6)	80 (74.8)	82 (72.6)	0.882
Baked bricks	33 (15.0)	16 (15.0)	17 (15.0)	
Sun dried bricks/Pole and mud	25 (11.4)	11 (10.3)	14 (12.4)	
Roofing material of the house				
Iron sheet	177 (80.5)	88 (82.2)	89 (78.8)	0.515
Asbestos/Grass/thatch	43 (19.5)	19 (17.8)	24 (21.2)	
Source of light in house				
Candle/Fuel	17 (7.7)	11 (10.3)	6 (5.3)	0.102
Electricity	183 (83.2)	90 (84.10	93 (82.3)	
Other	20 (9.1)	6 (5.6)	14 (12.4)	
Energy for cooking				
Charcoal/Wood	131 (59.5)	79 (73.8)	52 (46.0)	<0.001
Electricity	89 (40.5)	28 (26.2)	61 (54.0)	
Cooking place				
Same room	33 (15.0)	27 (25.2)	6 (5.3)	<0.001
Separate room	187 (85.0)	80 (74.8)	107 (94.7)	

Mode of transport the family use				
Public	107 (48.6)	75 (70.1)	32 (28.3)	<0.001
Private	61 (27.7)	17 (15.9)	44 (38.9)	
None	52 (23.6)	15 (14.0)	37 (32.7)	

Table 5 shows associations between factors related to smoking with ARI. Parental smoking was significantly associated with ARI.

Table 5: Smoking factors associated with acute respiratory infections among under five children admitted at Arthur Davison Children's Hospital in bivariate logistic regression analyses

	Total	Cases	Controls	
Factor	**n (%)**	**n (%)**	**n (%)**	**P value**
Mother's smoking				
Yes	4 (1.8)	4 (3.7)	0 (0)	0.038
No	216 (98.2)	103 (96.3)	113 (100)	
Father's smoking				
Yes	10 (4.5)	8 (7.5)	2 (1.8)	0.042
No	210 (95.5)	99 (92.5)	111 (98.2)	
Others smoking				
Yes	5 (2.3)	3 (2.8)	2 (1.8)	0.607
No	215 (97.7)	104 (97.2)	111 (98.2)	

Factors associated with ARI in multivariate analysis

All significant factors associated with ARI in bivariate analyses were considered in a multivariate analysis. Factors independently associated with ARI were: mother's history of respiratory infections the past one month; sibling's history of respiratory infection the past one month, number of people in the household, cooking place and mode of transport. Children with mothers who had a history of respiratory infections in the past one month were 2.31 (95%CI [1.57, 3.42]) times more likely to have ARI as compared to children with mothers with no history of respiratory infections. Children with siblings who had a history of respiratory infections were 69% (AOR=1.69; 95%CI [1.12, 2.55]) more likely to have ARI than those children with sibling with no such history. Compared to children who belonged to household where they used a separate room for cooking, children belonging to household where they didn't have a separate room for cooking were 2.86(95% CI [1.54, 5.32]) times more likely to have ARI. While children who belonged to families where they didn't usually use any transport media were 43% (AOR=0.57 95% CI [0.32, 1.02]) less likely to have ARI, while children who belonged to families where they used public transport were 2.51(95% CI [1.56, 4.05]) times more likely to have ARI as compared to children whose mode of transport were private vehicles. Compared to children who belonged to households which consisted of more than 10 people, children who belonged to households comprising of less or equal to 3 people were 69% (AOR=0.31; 95% CI [0.16, 0.63]) less likely to have ARI.

Table 6: Independent factors associated with acute respiratory infection among under-five children admitted at Arthur Davison Children's Hospital

Factor	AOR 95% CI
Mother's history of respiratory infection the past month	
Yes	2.31(1.57,3.42)
No	1
Siblings with history of respiratory infections the previous one month	
Yes	1.69(1.12,2.55)
No	1

Number of people in the household	
≤3	0.31(0.16,0.63)
4-6	1.37(0.76,2.48)
7-9	1.12(0.60,2.10)
10+	1
Cooking place	
Same room	2.86(1.54,5.32)
Separate room	1
Mode of transport used by the family	
None	0.57(0.32,1.02)
Public	2.51(1.56,4.05)
Private	1

Discussion

In this study mother's history of respiratory infection in the past one month, sibling's history of respiratory infection in the past one month, crowding, cooking place and mode of transport were significantly associated with the occurrence of acute respiratory infections among under-five children admitted to ADH. There was a significant association between having siblings with a history of respiratory infection in the past one month and having acute respiratory infections. A study done by Leeder et al [12] agrees with our finding in which it was found that under-five children with a sibling with a history of bronchitis and pneumonia were more likely to have an episode of ARI. A similar finding was obtained in a study by Gupta [15] in which siblings below five years old with either history of ARI during the month prior to their admission or history of admission to hospital for ARI during last year increased the risk of having ARI among the under five children. The finding can be attributed to the fact that the siblings were transmitting infections to the under-five children. Having mothers with history of respiratory infections in the past one month was significantly associated with having acute respiratory infections in the under five children. Another similar finding is that having siblings with history of respiratory infections was associated with occurrence of ARI in under-five children. In both findings, ARI may have been transmitted from mother or sibling to the under-five child. The study found an association between the number of occupants and ARI. Children who lived in households with less number of occupants were less likely to develop ARI, however, the risk of having ARI increased as the occupants increased. This agrees with the findings of Berman et al [16] as well as that of Rahman [18].A significant association was observed between not having a separate room for cooking and occurrence of ARI in under-five children. Similar finding was obtained in a study in Kenya in which cooking near the bed was significantly associated with occurrence of ARI in under-five children [19]. Furthermore, the finding agrees with Berman's finding [16].The study also revealed a significant association between ARI and use of public transport. This agrees with the study done by Troko et al [20] which showed a significant association between the use of public buses or train with occurrence of ARI. This could be due to the fact that public buses carry people with different health status including those with respiratory infections hence tend to leave pathogens on the buses predisposing other passengers to these infectious agents.

Conclusion

In a study of under-five children at Arthur Davison Children's Hospital, we found that the occurrence of ARI was significantly associated with mother's and sibling's history of respiratory infections in the past one month prior to admission, number of occupants in household, not having a separate room for cooking and the use of public transport. In view of this study there is need for the caregivers to be given health education starting from antenatal visits on the prevention measures for ARI and also other members of the family to prevent the spread of ARI to under-five children and thereby reducing under-five child mortality. The use of public buses or trains by under-five children should be discouraged. More studies on the risk factors of ARI are needed in other settings and considering other factors not covered in the study.

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