Original Article

Risk Factors for Acute Respiratory Tract Infections in Under-five Children in Enugu Southeast Nigeria

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Abstract

Background: Acute respiratory tract infections (ARIs) constitute the major causes of mortality and morbidity among under-five children of the developing world. The prevalence of ARIs is determined individually or collectively by a number of factors which may be prevalent in our environment. **Aim:** The present study is aimed to determine the risk factors that affect the prevalence of ARIs in under-five children in Enugu. **Subjects and Methods:** A cross-sectional study of 436 under-five children diagnosed with ARI was carried out in three hospitals in Enugu. Participants were consecutively enrolled after being diagnosed as a case of ARI. Structured pro foma was used to collect sociodemographic characteristics, anthropometric data and risk profile. Data were analyzed using Epi info version 6.0 and significant probability value was 5%. **Results:** A total of 436 patients were enrolled for the study 224 males and 212 females M: F 1.06:1. The mean age of the population was 18.75(13.38) months and there were 31.6%(138/436) cases of pneumonia 6.9%(30/436) cases of bronchiolitis and 61.5%(268/436) cases of acute upper respiratory tract infections. Children less than 20 months accounted for 60.9% (84/138 cases) of pneumonia, 86.7% (26/30 cases) of bronchiolitis, and 64.5% (173/268 cases) of acute upper respiratory tract infections. Pneumonia was noted in about 75.7% (56/74) of inadequately nourished children compared to 22.6% (82/362) in adequately nourished children. Other risk factors identified in the study include inadequate breast feeding, poor immunization statues, attendance to daycare centers, large family size, poor parental educational statues, parental smoking, living in the urban area and use of biofuels. **Conclusion:** ARIs are affected by socio-demographic and socio-cultural risk factors, which can be modified with simple strategies. It is recommended that control program for ARIs should be multifaceted with a strong political will.

Keywords: Acute, Respiratory tract infections, Risk factors, Under-five children

Introduction

Acute respiratory tract infections (ARIs) are heterogeneous and complex group of diseases caused by a wide range of pathogens in which the possible anatomic site (s) extend from the pharynx to the alveoli.[1] In conjunction with diarrheal diseases and malnutrition, ARIs constitute the major causes of mortality and morbidity among under-five children of the developing world.[1,2] 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.[3] ARI constitute one-third of the deaths in under-five in developing countries.[3] They contributed 67 million disability adjusted life years in the year 2000.[4] They also account for 30-40% of the attendance to children out patient and 20-30% of hospital admissions.[2,5] It has been shown that they consume significant health sector resources and long-term empiric treatment of ARIs contributes to the world-wide antibiotics resistance.[1]

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The overall reported incidence of ARIs is 6-8 episodes during the first 5 years of life.[6,7] The prevalence of ARIs are determined individually or collectively by a number of factors, which include age, sex, nutritional status, breastfeeding (type and duration), socio-economic status, overcrowding, indoor pollution, passive smoking, etc.[3] These risk factors are said to be prevalent in our environment and may be possible areas

of intervention in implementing ARI control program.[1] The aim of this study is to determine and assess the risk factors that affect the prevalence of ARIs in under-five in Enugu. This will create a reference for possible areas of intervention.

Subjects and Methods

The study was a cross-sectional study carried out in three hospitals in Enugu popularly known to serve the metropolis and its catchment areas. These were University of Nigeria Teaching Hospital Enugu a Tertiary Institution, Mother of Christ Hospital and St Leo's Specialist Hospital Enugu both offer primary and secondary health services.

Ethical clearance was obtained from University of Nigeria Teaching Hospital Ethical and Research Committee and approval was obtained from the respective management of the hospitals prior to commencement of the study. Informed consent was obtained from the caregivers/parents of the respondents as part of the study protocol. Sample size was determined using an estimated prevalence of 50% for ARIs at a power of 95%.[8]

Four hundred thirty-six under-five children who were clinically diagnosed of any form of acute respiratory infections were consecutively enrolled for the study. Children who were above 5 years, but had ARIs were excluded. Children who had chronic respiratory infections or diseases, foreign body aspiration and non-respiratory pathologies were also excluded. This was carried out at presentation or within 48 h of admission for admitted cases by the doctors in charge. The enrolment was performed over a period of 6 months October 2007 to March 2008.

Case definition was according to World Health Organization working group on case management of ARIs, which defined ARI as a clinical state presenting with rapid breathing more than expected upper limit for age with or without chest in drawing, too sick to feed, nasal discharge, cough, fever with or without auscultatory findings of less than 2 weeks.[9] Severe episode was defined as ARI with rapid breathing more than the upper limit for age, lower chest in-drawing, feeding difficulties, respiratory distress, and pulse oximetry reading of less than 90% that required in-hospital treatment with intravenous medications and management with oxygen therapy.[10,11] Pneumonia was defined as a case, which had fast breathing more than expected for age, breathing difficulty, cough, fever, chest in-drawing with or without auscultatory findings such as inspiratory and expiratory crackles, rhonchi or bronchial breath sounds of less than or equal to 2 weeks duration.[1] Bronchiolitis was defined as a case, which had respiratory distress, low grade fever and expiratory wheeze.[1] Acute upper respiratory tract infections were grouped as syndromes involving the upper airways such as nasopharyngitis, sinusitis, otitis media, epiglottis, and tonsillitis.[1] All cases of pneumonia and bronchiolitis were treated as severe episodes since all cases of pneumonia and bronchiolitis required in-hospital stay and intravenous medications.

Structured pro forma was used to collect socio-demographic characteristic, anthropometric data, and risk profile history including retroviral statues of the subjects if available. The risk factors were defined as follows: Malnutrition was assessed with the use of Shakir's strip measurement of the mid arm circumference (mid arm circumference less than 12.5 cm as severe malnutrition while borderline malnutrition was taken as mid arm circumference between 12.5 cm and 13 cm) were applicable or weight less than 80% for expected weight for age as moderate and less than 60%with or without edema as severe.[11]

Adequate breast feeding was defined as exclusive breast feeding for at least 6 months with complimentary feeding afterward in an infant while inadequate breast feeding was taken as no breastfeeding or mixed feeding in the first 6 months of an infant.[11] Inadequate immunization was defined as no immunization for a child or history of lack of age commensurate immunization status. Large family size was defined as any household with more than six members in the household. Rural areas were assigned to areas outside the metropolis.

Parental educational status was determined according to level of educational attainment, which was group as tertiary, secondary, primary or no education. History of child's attendance to day care centers or pre-nursery school was taken as attendance to day care center while history of smoking any amount cigarette by either of the parent in the home was noted as exposure to partial smoking. Data were analyzed with Epi info version 6.0 (Atlanta). Frequency tables were developed with the same package and percentage contributions of the specific acute respiratory infections to the burden of ARI in children calculated; Chi-squared test was used to test for association of the discreet variables. Relative risk and confidence interval were also calculated. Significant probability was 5% ($P < 0.05$).

Results

Out of a total of 436 subjects there were 51.4% (224/436) males and 48.6% (212/436) females M: F 1.06:1 [Table 1]. The mean age of the children in months was 18.75 (13.38), with 80% of the subjects being less than 29 months. There were 31.6%(138/436) cases of pneumonia, 6.9% (30/436) cases of bronchiolitis, and 61.5% (268/436) cases of acute upper respiratory tract infections. The most frequent associated diagnosis was malaria constituting 54.4%(237/436) of the secondary diagnosis, gastroenteritis constituted 9.2%(40/436) of the secondary diagnosis while atopic cough constituted 7.3%(32/436). Children less than 20 months accounted for 60.9% (84/138 cases) of pneumonia, 86.7% (26/30) of bronchiolitis, and 64.5% (173/268) of acute upper respiratory

tract infections. A total of 74 males 33.0%(74/224) and 64 females 30.2% (64/212) had pneumonia (P = 0.40), 6.3% (14/224) of the males and 7.5% (16/212) females had bronchiolitis (P = 0.72) while 60.7% (136/224) of males and 62.3% (132/212) females had acute upper respiratory tract infections (P = 0.80).

All cases of bronchiolitis and 75.4% (202/268) of cases of acute upper respiratory infections occurred in children less than 30 months. It was noted that 14.2% (62/436) were undernourished, 13.8% (60/436) had borderline malnutrition while 72.0%(314/436) were adequately nourished. About 75.7% (56/74) of inadequately nourished children had pneumonia compared to 22.7% (82/362) of the adequately nourished as shown in Table 2.

Other risk factors for ARI identified in the study include inadequate breast feeding, poor immunization, attendance to day care centers, large family size, poor parental educational status, parental smoking living in the urban area, and use of biofuels. $P < 0.05$.The relative risk associated with various risk factors for developing various form of ARI is shown in Table 3. Severe forms of ARI such as pneumonia were found to be more affected significantly by malnutrition, inadequate breast feeding, poor immunization, poor housing, large family size, and low parental education while attendance to day care centers, low maternal education, living in urban area affected the prevalence of bronchiolitis $P < 0.01$.

Table 1: Sex distribution of ARIs among children

Sex	Pneumonia (%)	Bronchiolitis (%)	AURI (%)
Male	74 (33.0)	14 (6.3)	136 (60.7)
Female	64 (30.2)	16 (7.5)	132 (62.3)
Total	138 (31.6)	30 (6.9)	268 (61.5)

ARIs: Acute respiratory tract infections, AURI: Acute upper respiratory infections

Discussion

Acute respiratory infections are among the top five childhood killer diseases, the risk factors identified in this study such as age, sex, poor breast feeding practice, overcrowding, malnutrition, poor socio-economic status, attendance to day care centers and passive smoking were similar to the documented risk factors in the previous studies.[1,3,12] This shows the need for adequate prevention of some of these modifiable risk factors in our environment. The age group affected most was 10-19 months this is similar to the documented age group by Oyejide and Osinusi,[6] in Western Nigeria. This age group falls within the age of introduction of complementary feeds, decreasing breast feeding with its attendant risks and weaning of passive maternal immunity. This may have affected the incidence of ARI in this age group due to exposure of these children to the risk factors, which are prevalent during this period. This also highlights the importance of protective immunoglobulin found in breast milk in preventing ARIs.

The presence of bronchiolitis in only children less than 30 months was consistent with previous reports.[1,13] This is probably due to poor compliance of the immature bronchioles in the very young children. Severe malnutrition was found to

Table 2: Distribution and relationship between ARI and nutritional status

Weight for age	Frequency (%)	Pneumonia (%)	Bronchiolitis (%)	AURI (%)
Adequate for age	362 (83.0)	82 (18.8)	22 (5.0)	258 (59.2)
Inadequate for age	74 (17.0)	56 (12.9)	8 (1.8)	10 (2.3)
χ^2		79.85	2.15	86.84
P value		0.01	0.01	0.01
Relative risk		3.33	1.88	0.19

ARI: Acute respiratory tract infection, AURI: Acute upper respiratory infections

Table 3: The risk factors for ARI and their relative risk

Risk factors	Relative risk for pneumonia (CI)	*P*	Relative risk for bronchiolitis (CI)	*P*	Relative risk for AURI (CI)	*P*
Young age (<30 months)	1.15 (0.59-1.16)	0.28	1 (28.79-1)	0.01	0.82 (0.70-0.95)	0.02
Inadequate nutrition	3.33 (2.65-4.21)	0.01	1.88 (0.82-3.84)	0.14	0.19 (0.11-0.34)	0.01
Inadequate breast feeding	2.94 (2.36-3.76)	0.01	0.5 (0.12-1.98)	0.30	0.32 (0.19-0.53)	0.01
Inadequate immunization	1.66 (1.18-2.34)	0.01	0.87 (0.17-2.86)	0.62	0.87 (0.5-1.01)	0.01
Living in urban area	0.36 (0.28-0.46)	0.01	0.46 (0.23-0.95)	0.03	3.2 (2.13-4.86)	0.01
Passive smoking	1.39 (1.05-1.83)	0.02	0.35 (0.1262-0.99)	0.04	0.91 (0.76-1.08)	0.27
Large family size	1.56 (1.12-2.17)	0.01	0.59 (0.13-2.14)	0.55	0.79 (0.59-1.05)	0.01
Poor maternal education	1.88 (1.35-2.66)	0.01	2.78 (0.36-2.78)	0.02	0.43 (0.25-0.73)	0.01
Poor paternal education	3.05 (2.43-3.83)	0.01	1.01 (0.36-2.78)	0.90	0.25 (0.14-0.44)	0.01
Rural area	2.77 (2.17-3.54)	0.01	2.17 (0.13-2.14)	0.04	0.31 (0.21-0.47)	0.01
Attendance to day care center	0.77 (0.54-1.10)	0.14	2.02 (1.08-4.0)	0.04	1.03 (0.81-1.12)	0.70
Use of wood biofuel	2.09 (1.39-3.14)	0.01	1.09 (0.5-2.39)	0.89	0.74 (0.64-0.85	0.01

ARI: Acute respiratory tract infection, AURI: Acute upper respiratory infections, CI: Confidence interval. Significant $P<0.05$

affect the prevalence of severe forms of ARI; the relative risk of malnourished children developing pneumonia was 3 times higher than the well-nourished children. This is also consistent with findings of previous authors who have shown the association between third degree malnutrition and severe acute lower respiratory tract infections.[14,15] Malnutrition has been shown to adversely affect the development of cellular, innate and humoral immunity.[16,17] Poor breast feeding practices such as mixed feeding from birth, contributed to malnutrition noted in this study. This in turn affected significantly the prevalence of pneumonia. Though most women who did not breast feed their children were found to be retroviral positive, pediatric human immunodeficiency virus (HIV) has also been shown to contribute to the increase prevalence of pneumonia in children.[18] In this study, 12.6% of cases of ARI had HIV infection as a co-morbid condition.

Poor immunization status were found to significantly affect the prevalence of ARI, 50% of poorly immunized subjects had severe forms of ARI. This is consistent with previous reports[3,19] and it shows the importance of adequate childhood immunization in prevention of diseases, which may be complicated by pneumonia such as measles, tuberculosis, and pertussis. This may reflect poor compliance or ignorance of the need for routine immunization. This informs the need to strengthen efforts to sensitize the people to appreciate the importance of immunization and avail their children the opportunity of receiving expanded childhood immunization. Tangentially health talks on routine immunization and appropriate child rearing practices must target mothers and women of child bearing ages in order to limit the risks of ARI in children. Family size of more than 5 siblings living in a home was shown to affect significantly the prevalence of pneumonia; this is probably due to overcrowding, which encourages the transmission of droplets of infective organisms. This is similar to the previous reports in Greenland and Kenya.[20,21]

More of the subjects with ARI were from the urban areas than the rural areas; this may probably be due to the location of the study area in the urban region making it more accessible to the urban dwellers. It may also reflect a greater health seeking behavior from the urban areas than the rural areas. This view is however contrary to that of Kossove,[22] who argued that rural women carry their children on their back hence tend to report early to a health facility whenever they notice sudden change in their breathing pattern.[22] Further, studies in this area should be encouraged. Exposure to smoke either by use of smoke producing cooking fuel or passive smoking was also shown to contribute to the prevalence of severe forms of ARI, this may be due to effect of smoke on cilliary activity of the lung parenchyma of these children, which will cause poor activity and encourage secondary infection.[3,23,24] This has also been demonstrated in previous studies.[3,22] The effect of smoke on the prevalence of ARI is usually encouraged by poor housing, overcrowding and low socio-economic factors.[25] This buttresses the need for multi prong approach in planning preventing practices. There is thus the need to encourage family planning and appropriate house ventilation. Ignorance and poverty often form the bedrock of some of these diseases and alleviation from these must be advocated for by all the stakeholders in child care.

The study also showed that more cases of ARI were noted among children who attended day care centers than their counterparts who did not attend day care centers. This may be attributed to overcrowding at some of these centers, poor hygiene practices, and early exposure of these children to infection outside the home. This was similar to the findings of Oyejide,[3] and in Greenland Study.[26] This may call for school health intervention in day care centers, to maintain and improve the health of the children in such centers. Parental education was shown to affect the prevalence of ARI; these are conditions, which require proper recognition and application of simple home care and early presentation to health-care providers. Education helps to improve the socio-economic lives of the individuals; hence helping in avoidance of some of the risk factors responsible for ARIs. More cases of acute upper respiratory tract infections were noted among children of well-educated mothers probably due to their greater health seeking behavior. This has also been reported by Sreeramareddy *et al*. in India.[27]

Our study was limited by lack of culture proven diagnosis of pneumonia leaving room for false positive cases, hospital based cross-sectional study may not entirely represent the prevalence of community acquired respiratory tract infections, but may give an insight of the possible risk factors for the disease process.

This study has demonstrated that the identified risk factors for ARI such as lack of adequate immunization, malnutrition, poor breast feeding practices, and poor parental education were similar to those which have been previously demonstrated,[1,28,29] cultural, and environmental factors tend to modify these risk factors. These risk factors can be modified with simple strategies such as adequate nutrition, immunization, avoidance of pollution, parental education, and environmental sanitation. Proper counseling of caregivers on the effects of these modifiable risk factors will help in proper patient care and prevention of further ARIs in children. It is recommended that control program for ARIs should be multi-faceted with a strong political will. Adequate legislation should be put in place in housing construction and in establishing day care centers. Public awareness campaigns against risk factors responsible for ARIs should be sponsored as it is carried out for other infectious diseases such as HIV/AIDS, malaria, and tuberculosis. Primary health-care services must be emphasized with particular reference to its essential components such as nutrition immunization and environmental management.[30]

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