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Original article

Risk factors of Acute Respiratory Infection (ARI) in under-fives in a rural hospital of Central India

Amar M. Taksande[1], Mayuri Yeole[2]

[1]Datta Meghe Institute of Medical Sciences (DMIMS), Sawangi, Wardha, Maharashtra, India
[2]Jawaharlal Nehru Medical College (JNMC), Belagavi, Karnataka, India

Abstract

Introduction: Acute Respiratory Infection (ARI) is a major cause of morbidity and mortality in developing countries in children especially in under-fives. Every year in the world, about 13 million under-5 children dies, 95% from developing countries; one third of total deaths are due to ARI. The aim of this study was to identify the significant risk factors for ARI in children less than five years of age living in rural areas of Central India.

Methods: A hospital based case control study was undertaken to determine risk factors associated with respiratory tract infections in children. Children less than 5 years admitted in a pediatric ward with diagnosis of ARI were enrolled in the study as cases (n = 300) while the same number of controls (n = 300) were selected from neighborhood and were matched for age, sex and religion. Details of risk factors in cases and controls were recorded in pre-designed proforma.

Results: A significant association was found between ARI and lack of breastfeeding, nutritional status, immunization status, delayed weaning, prelactal feeding, living in overcrowded conditions, mothers' literacy status, low birth weight and prematurity. Among the environmental variables, inadequate ventilation, improper housing condition, exposure to indoor air pollution in form of combustion from fuel used for cooking were found as significant risk factors for ARI in under-fives.

Conclusions: ARIs are affected by socio-demographic and socio-cultural risk factors, which can be modified with simple interventions. The various risk factors identified in this study were lack of breastfeeding, undernutrition, delayed weaning, overcrowding and prelactal feeding.

Keywords

Respiratory infection, children, risk factors, rural.

Corresponding author

Amar M. Taksande, DMIMS Sawangi, Sawangi (Meghe), Wardha – 442005, Maharashtra, India; email: amar.taksande@gmail.com.

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Introduction

Acute Respiratory Infection (ARI) continues to be the leading cause of acute illness worldwide and remain the most important cause of infant and young children mortality [1-4]. ARI in young children is responsible for an estimated 3.9 million deaths every year worldwide. It is reported that Bangladesh, India, Indonesia and Nepal together account for 40% of the global ARI mortality. ARI deaths about 90% are due to pneumonia which is usually bacterial in origin. The incidence of pneumonia in developed countries may be as low as 3-4%, whereas in developing countries range between 20-30%. The difference is due to high prevalence of malnutrition, low birth weight and indoor air pollution in developing countries [5, 6]. ARI is a serious threat to infant and child survival in India. Hospital records from states with high infant mortality rates show that up to 13% of the inpatient deaths in pediatric ward are due to ARI [7]. Whereas, outpatient attendance attributing to ARI is as high as 20-40% of all outpatients and 12-35% of in-patients [8]. It has been reported that there are links between environmental risk factors (such as overcrowding, outdoor air pollution, and indoor pollution) and risk factors in the child (such as breastfeeding, low birth weight, malnutrition, and vitamin A deficiency) with ARI [9-10]. In India, most of the population is integrated in rural area and therefore there is a need to have knowledge of these risk factors related to acquisition of ARI, as it will help in its prevention, through community health education. This study was done to know the risk factors in the routine habitat of the Indian rural setup leading to ARI.

Material and methods

This study was a case-control, study, conducted in Department of Pediatrics, Acharya Vinoba Bhave Rural Hospital, Sawangi (Meghe), Wardha, from August 2010 to July 2012. Children of less than 5 years admitted in ward with diagnosis of ARI were enrolled in the study as cases (n = 300) while the same number of controls (n = 300) were selected from neighborhood and were matched for age, sex and religion. Detailed history of the patient was taken, with presenting complaints, helping to differentiate between Upper Respiratory Tract Infection (URTI) and Lower Respiratory Tract Infection (LRTI). Chief complaints included history of fever, cough, throat pain, nasal obstruction, bad breath, running nose, stridor, ear ache and ear discharge were considered as URTI, whereas cough, increased respiratory rate, difficulty in breathing, wheeze, chest in drawing were labeled as LRTI. Past history included history of choking, or history of recurrent respiratory tract infection, and the frequency of infection in past, signifying the severity of the condition. Recurrent ARI was defined as at least two episodes in one year or three or more episodes any time with radiographic clearing between episodes, requiring further investigation. Dietary history was asked in details from the parents of the patient. Method used for calculation of the diet was "24 hours recall with emphasis on the diet of a representative day". Calories and proteins were calculated and compared with total calorie and protein intake recommended for each age and deficit was calculated. Feeding patterns was noted. Immunization history was asked in detail from the parents. A child was assessed to be completely immunized if he/she had received all vaccinations due for the age according to national immunization schedule (BCG, OPV, DPT and measles). Age, education, occupation of the parents were inquired along with details of the siblings regarding similar complaints if any. Socioeconomic status was determined using Modified Kuppuswami Scale [11]. Details of housing conditions, medium of fuel used for cooking was obtained. Anthropometry included weight, length/height, and head circumference. Assessment was done as per the standardized methods. Respiratory system was emphasized on and other systems were also evaluated. Ethical approval for the study was obtained from the Jawaharlal Nehru Medical College (JNMC) ethical review Committee. The statistical software Epi Info™, version 6, was used for statistical analysis. Association of each of the categorical variable with ARI was assessed with chi-square test and the strength of their association was calculated by unadjusted odds ratio; p-value < 0.05 was considered as statistically significant.

Results

Out of 300 cases, 200 were males and 100 were females. Among 300 cases, 50 were below age of 2 months, 100 were between 2 to < 12 months and

150 between 12 to < 60 months age. Out of 300 cases 42 had normal nutritional status and 258 were undernourished. Among 300 cases only 128 were fully immunized while 10 were not immunized at all and 162 were partially immunized. The corresponding figures for control were 210, 3, and 87 (X^2 9.45; p-value 0.004; OR [CI]: 2.17 [1.32-4.04]). Among the 220 cases above the age of 6 months, 46 had not started weaning yet, 52 had started late i.e. after 9 months and 122 had started weaning at 6 months of age while out of 220 controls above the age of 6 months 18 had not started yet, 21 started late i.e. after 9 months, and 181 had started weaning at 6 months. (X^2 12.45; p-value 0.0005; OR [CI]: 3.27 [1.67-9.34]). Among controls, 54% who did not start prelactals feeding and 46% started prelactals feeding while only 30% did not start prelactals feeding and 70% started prelactals feeding among cases (X^2 = 11.19, p < 0.002). Amongst the four nutritional variables considered in this study, lack of breastfeeding, malnutrition, and inadequate caloric intake were significantly associated with ARI. Among cases 54% had illiterate mother and 46% had literate mother while only 30% had illiterate mother and 70% had literate mother among controls (X^2 8.95; p-value 0.003; OR [CI]: 2.57 [1.47-4.34]). When father's literacy was considered 30% had illiterate father and 70% had literate father among the cases and 25% had illiterate father and 75% had literate father among the controls (X^2 0.35; p-value 0.63). Majority of case belonged to the low socioeconomic group 65.8% compared to 55.2% in control group, low socioeconomic class being significantly (p < 0.0001) associated with ARI. 53.2% of case with history of overcrowding in family had high risk of ARI compared to the control group 22.8%, (p < 0.0001, OR = 3.84). Among 300 cases only 9% were premature and 91% were full term mature while among the 300 controls only 2% was premature and 98% were full term mature. Patient staying in house with mud floor or cement floor did not prove to be significant in occurrence of ARI. 44.2% of cases staying in houses with inadequate ventilation had high risk of ARI as compared to those staying in houses with adequate ventilation facility. Exposure to kerosene smoke in children proved to be of significance in causing ARI. 17% of study population who had exposure to kerosene smoke had high risk of ARI. X^2 = 22.57; p < 0.0001). Study group with exposure to firewood smoke were found to be 44.4%, who had higher risk of ARI (X^2 = 46.23; p < 0.0001). 49.8% of the study population did not have a separate kitchen and had high risk of ARI (X^2 = 89.31; p < 0.0001). Exposure to passive smoking proved to be highly significant risk factor (X^2 = 149.5 p < 0.0001; OR = 6.92) with 45.6% of cases presenting with ARI.

Discussion

Every year ARI in young children is responsible for an estimate 3.9 million deaths worldwide. The incidence of pneumonia in developing countries is high due to increased prevalence of malnutrition, low birth weight and indoor air pollution in developing countries [5]. Risk factors that would specifically manifest themselves during crisis include: malnutrition; indoor air pollution from use of solid fuels; overcrowding and decreased coverage of immunization [12]. It has been found that lack of breastfeeding is associated with increased risk of development of severe pneumonia

Table 1. Socio-demographic and nutritional variables in ARI cases and controls.

Variables	Cases	Controls	P-value	OR	95% CI
Mother's education					
Illiterate	138	210	0.0003	2.57	1.47-4.34
Literate	162	90			
Immunization					
Incomplete for age	172	90	0.004	2.17	1.32-4.04
Complete for age	128	210			
Weaning started at					
Inappropriate age	98	39	0.0001	3.27	2.40-5.76
Appropriate age	122	181			
Prelacteal feeds					
Given	210	138	0.0001	2.73	1.95-3.83
Not given	90	162			

by 1.5 to 2.6 times [13, 14]. Yoon et al. [15] had found that lack of breastfeeding increased the chances of mortality by 5.7 times in infant with acute lower respiratory infection and diarrhea in the first 6 months of life. Studies in developed countries have shown that higher rate of infection is common in younger sibling of school going children who introduce infection into the household. Severe underweight was another predictor of pneumonia, since severely malnourished children are often immuno-compromised, and their respiratory tract mucosa lacks an adequate protective ability against pathogenic microbes that commonly cause pneumonia [15-17]. Low birth weight has been associated with development of pneumonia [18, 19]. Infection leads to malnutrition and malnourished children are more prone for various infections. The same thing was found in these cases. The present study found a significant association between ARI and nutritional status ($p < 0.001$) with odds ratio 4.17. Other studies done by Fonseca et al. [14], Rahman et al. [20] found similar association. A significant association was found between ARI and prelactal feeding. Occurrence of ARI was more in those children who started prelactal feeding (70%) as compare to (30%) not started prelactal feeding. Similar finding was observed in study carried out by Deb [21] and Savitha [10]. Timely started complementary feeding has impact on nutritional status of children which in turn affects occurrence of ARI and other communicable disease during childhood [22, 23]. A significant association was found between ARI and complementary feeding. The fully immunized children are less in cases. The fully immunized child is protected against various respiratory infections like diphtheria, pertussis and complications of measles. Children who are not fully immunized are at risk of development of these infections. In the present study, a significant association was found between ARI and immunization ($p < 0.005$), which is also reported by Fonseca et al. [14] and Shah et al. [18]. The odds ratio is 2.17, revealing 2.17 times more risk of ARI for partially immunized or unimmunized as compared to fully immunized. The present study found a significant association between weaning status and ARI ($p < 0.05$). Odds ratio 3.27 revealed 3.27 times risk of ARI if weaning was not started at right time. Shah et al. [18] revealed weaning delay as a probable risk factor for ARI. As weaning is delayed or not started at proper time there are chances of malnutrition development, which is an important risk factor for ARI. Low socio-economic class is associated with increased risk of infections, due to less annual income of the family compared to the number of living family members and inadequacy of benefits of health care facility. Our study shows that majority of cases belonged to the low socioeconomic group 65.8% compared to 55.2% in control group, low socioeconomic class being significantly ($p < 0.0001$) associated with ARI. Overcrowding also proves to be a significant risk factor, resulting in high risk of acquisition of ARI in children. Study done by Savitha et al. [10] showed slightly more cases associated with ARI, 91.35% and 80.87%, respectively. Our study found that 53.2% of cases with history of overcrowding in family had a high risk of ARI compared to the control group 22.8% ($p < 0.0001$, OR = 3.84).

A significant association was found between maternal literacy status and ARI ($p < 0.01$) but not with father's literacy ($p > 0.05$). Victora et al. [24] revealed risk of pneumonia declined with education of parents. Usually father remains outside for job most of the times but mother is always in the home taking care of children and household activities. Mother due to her close association with child recognizes the minor changes in child's health than father. Because of such factors mother's literacy might play important role in child's disease than father's literacy. The premature children are more prone for various infections like respiratory infections. Thus present study found nutritional status, immunization status, delayed weaning, mother's literacy, and prematurity as significant risk factors for ARI in under-fives. In our study, we found that the environmental variables, inadequate ventilation (OR 3.5; 95% CI 2.51-5.16), improper housing condition (OR 2.5; 95% CI 1.91-5.16), exposure to indoor air pollution in form of combustion from fuel used for cooking (OR 6.5; 95% CI 2.51-7.16) were significant risk factors for ARI. This risk factor was considered as other studies showed an association of presence of mud floor with increased risk of ARI. A study conducted by Savitha et al. [10] proved that type of floor had strong (61.54%) association with ARI. However, type of floor in the house did not prove to be significantly associated with ARI in our study. Due to availability of electricity, usage of kerosene lamp has been decreased these days. However, we could find children exposed to kerosene smoke and proved to be a significant risk factor in occurrence of ARI in children. Use of biomass fuels (wood, animal dung), coal and other media (kerosene) are significant contributors to indoor air pollution. Nearly half the

world's households, mainly in developing countries (90%), use these fuels for cooking. These are burnt in simple stoves with very incomplete combustion generating toxic products that adversely affect local defenses of the respiratory tract [25, 26]. The risk is highest for young children and mothers due to longer indoors stay and close proximity during cooking. The measure which decreases this risk is provision of clean fuels, householder's education and modification of stoves [26].

In conclusion, ARIs are affected by socio-demographic and socio-cultural risk factors, which can be modified with simple interventions. The various risk factors identified in this study were lack of breastfeeding, undernutrition, delayed weaning, overcrowding and prelactal feeding. So, for the prevention of ARI, the basic health promotional measures like proper infant feeding practices, proper nutrition and socio-economic improvement is needed.

The appropriate measure which decreases the risk of ARI is provision of clean fuels, householder's education and modification of stoves. The promotion of breastfeeding in first six months and appropriate nutritional supplements is highly recommended as a strategy to reduce the risk of ARIs in infants.

Declaration of interest

The Authors declare that there is no conflict of interest.

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