RISK FACTORS OF ACUTE LOWER RESPIRATORY TRACT INFECTIONS IN CHILDREN UNDER FIVE YEARS OF AGE

Shyamali Chandrika Dharmage, Lalani Chandrika Rajapaksa and Dulitha N Fernando

Department of Community Medicine, Faculty of Medicine, University of Colombo, Colombo 8, Sri Lanka

Abstract. This study attempted to identify the determinants of acute lower respiratory-tract infections (ALRI) among children under five years of age, by comparing hundred children hospitalized with ALRI with a control group.

Data on socio-demographic, biological and environmental characteristics were collected by interviewing mothers and anthropometric measurements were carried out to assess the nutritional status of the children. Risk of disease in the presence of each exposure was calculated in the univariate analysis and the best explanatory variables among them were identified in the multivariate analysis.

The following variables were found to increase the risk of ALRI: (1) history of wheezing, (2) low birth weight, (3) passive smoking, (4) male sex, (5) delivery by cesarean section (6) sharing of sleeping space, (7) not being exclusively breast fed upto the completion of four months, (8) stunting, (9) having pets.

The findings highlight some simple strategies which would help in prevention of ALRI.

INTRODUCTION

It is estimated that over four million children under five years of age die from acute respiratory infections (ARI) every year, ninety percent of them being from developing countries (Roger, 1991). In Sri Lanka during 1985, 16% of deaths in children under five years were due to respiratory tract infections. Bronchitis, bronchiolitis and pneumonia accounted for 75% of these deaths (World Health Statistics Annual, 1990).

Although ALRI is predominantly a problem in the developing world, most studies of risk factors of ALRI have been conducted in the developed countries. The present study aims at identifying risk factors of ALRI requiring hospitalization, in children under 5 years of age in Sri Lanka.

MATERIALS AND METHODS

The study was carried out in the Children's Hospital, Colombo. A case control approach was used. A case of ALRI was defined as a patient under five years of age, who had been diagnosed as having lobar pneumonia, bronchopneumonia, or bronchiolitis by a pediatrician. Patients who had ALRI secondary to any other underlying cause such as congenital heart disease were excluded. One hundred cases of ALRI admitted consecutively to a randomly selected ward were included in the study. A control was defined as a patient admitted to a surgical ward immediately after the case as recorded in the main admission register. A control was selected for each case and was matched for age individually. Any child who gave a history of ever being admitted to a hospital with ALRI was excluded from the control group.

The data collected included information on socio-demographic, biological and environmental characteristics obtained from the mother using an interviewer administered questionnaire. Measurements of height and weight of the child were carried out using standardized procedures.

Matching of cases with controls for age helped to minimize recall bias which may arise in obtaining retrospective data. The use of structured questionnaire and standardized procudures in the data collection helped to minimize within observer variation.

Odds ratios (OR) which indicate the risk of developing the disease in the presence of a risk factor were calculated using matched pairs. Logistic regression analysis was carried out to examine the relative importance of factors studied.

RESULTS

A total of one hundred cases of ALRI which satisfied the entry criteria were included in the study. The age of the ALRI cases ranged from 0.9 months to 59.6 months, with 60% being under one year and 90% under three years.

Characteristics of this group of patients with ALRI were compared with the control group *ie* a) socio-demographic, b) biological, c) housing and overcrowding, d) environmental. Factors that were significantly associated with an increased risk of ALRI as identified in the univariate analysis are shown in Tables 1 to 4.

A significantly increased risk of ALRI were found to be associated with being a male child, an urban resident and belonging to an ethnic group other than Sinhalese, the Odds Ratios (OR) being 2.2, 4.6 and 2.0, respectively (Table 1).

A cesarean delivery and a birth weight of less than 2.5 kg were seen to increase the risk of ALRI by 2.7 and 2.6 times respectively. Past history of wheezing was found to be associated with an increased risk (OR = 10). In children where exclusive breast feeding had been stopped before the age of four months the risk of ALRI was seen to be increased ten fold. Early introduction of formula feeds and early weaning before four months of age also showed statistically significantly increased risk, the Odds Ratios being 2.5 and 2.3 respectively.

Table 1

Matched analysis of some socio-demographic factors between cases and controls.

Socio-demographic determinants	Matched odd	Confidence interval	p-value
Sex being male	2.19	1.21-3.95	0.01
Urban residence	4.57	2.02-10.36	0.0001
Ethnicity other than Sinhala	2.08	1.07-4.03	0.04
Father's age ≥ 40 yrs	2.75	0.88-8.75	0.12
Mother's age ≥ 30 yrs	1.47	0.76-2.83	0.32
Father's education ≤ Gr 8	1.43	0.84-2.44	0.23
Mother's education ≤ Gr 8	1.25	0.69-2.29	0.55
Paternal occupation unskilled	1.47	0.82-2.64	0.24
Income ≤ Rs 3,000	0.81	0.46-1.43	0.56
House hold possessions score = 0	1.94	1.08-3.48	0.03
Social class 5	2	0.81-4.96	0.19

Being stunted (*ie* weight for age < 2 SD) increased the risk of ALRI four fold (Table 2).

The risk of ALRI is seen to increase three fold when there were overcrowding at home, *ie* more than two residents per room. The risk increased to 2.4 times when a mat or bed was shared by more than two people (Table 3).

A five fold increase in risk of infection was seen when a household reported having more than one pet. Absence of a separate kitchen and absence of a chimney both showed increased risk; OR being 2.5 and 2.0 respectively. A five fold increase in risk was seen among those where a member of the extended family was reported as smoking (Table 4).

Due to the confounding nature of the variables studied, their relative importance was assesed using a logistic regression model. After performing a stepwise logistic regression, the best fit model was determined. The parameter estimates and the significance of the explanatory variables in the best fitting model are given in Table 5. Past history of wheezing, child being born as a low birth weight

Table 2

Matched analysis of some biological risk factors between cases and controls.

Some biological risk factors	Matched odd	Confidence interval	p-value
Period of gestation < 37 weeks	2.25	0.69-7.31	0.27
Cesarean delivery	2.67	1.04-6.84	0.049
Birth weight < 2.5 Kg	2.55	1.27-5.11	0.01
More than 2 children in the family	1.32	0.72-2.39	0.45
Birth rank > 2	1.56	0.83-2.93	0.21
Previous birth interval less than 24 months	1.43	0.11-1.66	0.34
Having more than one sib over 3 years	2.35	0.8-2.9	0.26
P/HO wheezing	10.5	5.58-30.78	< 0.0001
Exclusive breast feeding < 4 months	9.67	2.9-31.7	0.00001
Total duration of breast feeding < 9 months	1.08	0.51-2.29	1.0
Time of introduction of formula milk < 4 months	2.53	1.27-5.11	0.01
Time of introduction of complementary feeds < 4 months	2.23	1.16-4.29	0.02
Height/age ≤ 2SD	4	1.5-10.6	0.005
Weight/height ≤ 2SD	1.6	0.84-3.05	0.20

Table 3

Matched analysis of some risk related to housing and over crowding between cases and controls.

Housing and overcrowding	Matched odd	Confidence interval	p-value
Absence of a ceiling	1.75	0.51-5.98	0.54
Uncemented floor	0.76	0.54-1.6	0.55
Other than plastered walls	1.30	0.73-2.33	0.46
Other than tiled roofs	1.73	1.12-2.13	0.11
Average persons per room > 2	3	1.6-5.6	0.001
Number sharing place of sleep of the child > 2	2.38	1.25-4.56	0.01
Child sleeping on the floor	1.28	0.76-2.16	0.42

Table 4

Matched analysis of some risk factors related to indoor air pollution between cases and controls.

Indoor air pollutants	Matched odd	Confidence interval	p-value
Regular mosquito coil use	1.44	0.79-2.63	0.29
Presence of more than 1 pet at home	5.0	1.10-22.8	0.04
Absence of a separate kitchen	2.5	1.10-5.68	0.03
Absence of a chimney	2	1.03-3.89	0.049
Use of gas as fuel	2.6	0.93-7.29	0.09
Use of kerosene oil as fuel	2.14	0.87-5.26	0.10
Father smokes at home	1.76	0.97-3.2	0.08
Presence of a smoker within the household other than father	5.0	1.7-14.6	0.002

baby and the presence of a smoker within the household were found to have over 10 fold risk of ALRI when the other factors were accounted for.

DISCUSSION

The age distribution of cases showed a peak during late infancy, with a slow decline up to the age of three years followed by a rapid decline towards the fifth year. This is similar to the pattern described by Berman *et al* (1983).

A previous history of wheezing was found to have the highest risk of ALRI. Bronchial hyperactivity is described as a predisposing factor for acute respiratory infections by others (Cerqueiro *et al*, 1990; Mok and Simpson, 1982).

Table 5

Logistic regression - best fit model.

	Coefficient	p-value	OR
Presence of wheeze	2.99	< 0.001	19.9
Low birth weight	2.33	< 0.001	10.3
%GM	-16.78	< 0.001	
Presence of a smoker within the household other than father	2.42	< 0.001	11.2
Sex being male	0.94	0.04	2.5
Delivered by a cesarean section	1.35	0.039	3.8
Sharing of sleeping place with more than two	0.92	0.04	2.5
Exclusive breast feeding for less than 4 months	1.17	0.008	3.2
Height for age < -2SD	1.55	0.017	4.7
Presence of more than one pet at home	1.96	0.048	7.1

Deviance on 189 DF = 150.7
Likelihood ratio statistic on 1 DF = 4.2, p = 0.039

Importance of birth weight as a risk factor for ALRI in the present study is similar to the previous finding of high incidence of hospital admissions due to pneumonia and bronchitis among the low birth weight children (Harlap and Davies, 1974).

Many studies have shown an association between passive smoking and ALRI mainly among infants (Colley and Corkhill 1974; Fergusson *et al*, 1981). Even though the present study failed to demonstrate a significant association between ALRI and father's smoking, an increased risk of infection was seen where there were other smokers within the household. Majority of these were grandparents of the child who spend more time at home than the father thus prolonging the time of exposure. This is important in the Sri Lankan context where the traditional extended family system still exists.

The statistically significant increase in risk of ALRI associated with being a male is compatible with findings of many workers (Berman *et al*, 1983; Irwig and Holland, 1976).

The increased risk of being a case if the baby was delivered by cesarean section may be because such

a baby is more likely to aspirate, or be subjected to procedures which may result in respiratory complications. Similar exposure may be relevant to preterm babies making them more susceptible to ALRI as shown by Vathanophas *et al* (1990) and Cerqueiro *et al* (1990). However, in the present study being a preterm baby was not an important risk factor, the likely reason being the small number of preterm deliveries in the study group (6.5%).

The association observed between sharing of bedding and ALRI is important in the Sri Lankan context as it is common to find parents and young children sleeping together even when space is available. Similar findings have been reported (Cerqueiro *et al*, 1990).

The higher risk of infection in those not breast fed exclusively for four completed months indicates a strong protective influence of exclusive breast feeding towards ALRI, as reported by Chandra (1979).

The observation that low height for age *ie* stunting was associated with a higher risk of ALRI compares well with the previous studies (Vathanophas *et al*, 1990). However low weight for height, *ie* wasting was not found to increase the risk of ALRI.

A higher risk of ALRI observed in the group having more than one pet at home, may be related to the hypersensitivity that is believed to be developed due to inhalation of fur of the pets. Similar relationship between the presence of cats at home and ALRI was reported by Cerqueiro *et al* (1990).

Several interventions can be identified to minimize the influence of risk factors identified in the present study. Parents could be educated with regard to risk factors of ALRI, especially those which are amenable to change at individual and household level even without out concurrent socioeconomic development, *eg* improved feeding practices, avoid sharing the place of sleep with the child, minimizing the number of pets. Provision of facilities to working mothers to continue with exclusive breast feeding up to the completion of the fourth month is another relevant measure.

ACKNOWLEDGEMENTS

We thank the University of Colombo for funding the study and Dr M Fernandopulle, Consultant Pediatrician, Lady Ridgeway Hospital Colombo for granting permission to carry out this study in his ward.

REFERENCES

Berman S, Duanos A, Bedoya A, *et al.* Acute Lower Respiratory illness in Cali, Colombia: A two year ambulatory study. *Pediatrics* 1983; 71 : 210-8.

Cerqueiro MC, Murtagh P, Halac A, Avilla M, Weissenbacher M. Epidemiology of acute respiratory tract infections in children. *Rev Infect Dis* 1990; 12 : 1021-31.

Chandra RK. Prospective studies of the effect of breast feeding on incidence of infection and allergy. *Acta Paediatr Scand* 1979; 68 : 691-4.

Colley JRT, Corkhill RT. Influence of passive smoking and parental phlegm on pneumonia and bronchitis in early childhood. *Lancet* 1974; 2 : 1031-4.

Cunningham AS, Cooperstown NY. Morbidity in breastfed and artificially-fed infants. *J Pediatr* 1979; 95 : 685-9.

Fergusson DM, Horwood LJ, Shannon FT, Taylor B. Parental smoking and lower respiratory illness in the first three years of life. *J Epidemiol Commun Health* 1981; 35 : 180-4.

Harlap S, Davies AM. Infant admissions to hospital and maternal smoking. *Lancet* 1974; 1 : 529-32.

Irwig LM, Holland WW. Influence of family factors on the incidence of lower respiratory illness during the first year of life. *Br J Prevent Soc Med* 1976; 30 : 203-24.

Mok JYQ, Simpson H. Outcome of acute lower respiratory tract infection in infants: preliminary report of seven year follow up study. *Br Med J* 1982; 285 : 331-7.

Roger S. Pneumonia is a killer disease. *ARI News* 1991; Nov 21 : 2.

Vathanophas K, Sangchai R, Raktham S, *et al.* A community-based study of acute respiratory tract infections in Thai children. *Rev Infect Dis* 1990; 12 : 957-65.

World Health Statistics Annual: 1990: 192.