ORIGINAL ARTICLE

PNEUMONIA IN CHILDREN AT A UNIVERSITY HOSPITAL IN ADDIS ABABA, ETHIOPIA: ANALYSIS OF POTENTIAL RISK FACTORS

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ABSTRACT

Background: *Pneumonia is the single most important cause of morbidity and mortality in children below 5 years in developing countries including Ethiopia. However, much is not known about the specific risk factors of childhood pneumonia.*
Objective*: To identify childhood, parental sociodemographic and household characteristics as risk factors of pneumonia in children under 5 years of age.*
Methods: *A case control study was conducted at a tertiary teaching hospital in Addis Ababa. Cases were children below 5 years with a diagnosis of pneumonia (n=67). For each case, two controls admitted for other reasons to the same hospital during the same period were selected.*
Results: *Children who were not vaccinated at all had a higher risk of developing pneumonia (OR=4.12). The odds of developing pneumonia in malnourished children was significantly high (OR=14.89). Children whose fathers were unemployed had 2.72 times higher risk of developing pneumonia compared to those whose fathers were employed. Low monthly income was also significantly associated with pneumonia. Use of cooking materials such as wood, charcoal, dung and kerosene were significantly associated with pneumonia. The presence of acute respiratory infections in the household within two weeks of the occurrence of pneumonia was strongly associated with this acute lower respiratory tract infection (p=0.00001).*
Conclusion*: Malnutrition, presence of ARI in the household, use of cooking materials such as wood, charcoal, kerosene in the household and paternal unemployment were found to be risk factors for childhood pneumonia. In addition to integrated effort with other sectors, strengthening the health extension program is recommended to apply interventions targeted at the identified risk factors.*

Key words: *Pneumonia, Children, Ethiopia*

INTRODUCTION

Pneumonia is the single most important cause of morbidity and mortality in children below 5 years in developing countries, and accounts for about 30% of the estimated 12.4 million deaths in these children (1). In Ethiopia, the under five mortality rate of children is one of the highest in the world (140.1 per 10,000 under five children) and pneumonia accounts for 39% of deaths in infants (2). Pneumonia accounted for 6% of all admissions to a paediatrics ward of the teaching hospital in Addis Ababa (3).

Studies in different developing countries tried to identify epidemiological risk factors for acute lower respiratory tract infections (ALRI) including pneumonia (4-8). Kebede and Willet (4) showed an association between ALRI in which the majority of the cases were pneumonia and indoor air pollution.

The risk factors of childhood pneumonia may act independently or in concert with other variables to influence its incidence and severity. In the majority of previous studies, risk factors were assessed for ALRI in general (4,5,7,9), and in Ethiopia few studies were done that tried to identify risk factors of pneumonia in particular (10,11).

This study was, therefore, conducted to determine the relationship between childhood, parental sociodemographic and household characteristics and the risk of pneumonia in children aged under 5 years.

METHODS

A case control study design was employed at Tikur Anbessa Hospital which is a tertiary level teaching referral hospital in Addis Ababa. The cases were children below five years admitted to Tikur Anbessa Hospital between Sept. 1, 2003 and January 30,

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2004, with a diagnosis of Pneumonia. Pneumonia was defined by fast breathing (respiratory rate >= 50/ min in children aged 2-11 months or >= 40/min in children 1 to 5 years), with or without chest indrawing, with crackles on chest auscultation and /or radiographic findings of alveolar infiltrates, consolidation or air bronchograms.

Sample size determination of the cases was performed using EPI-INFO version 6 software program. For each case, two controls (without pneumonia) admitted to the same hospital for other reasons during the same period of case admission were selected. The assumption taken to calculate the sample size was the Odds Ratio of 2.5 with a 95% confidence interval obtained from a previous study (4).

Data collection

Data on childhood characteristics, household characteristics, and parental socio-demographic factors were obtained from the medical records of all cases and controls. The clinical data included admission weight, length/height, and clinical or radiological evidence of pneumonia. The clinical decision for the diagnosis of the cases was made by
a senior paediatric resident, and a consultant paediatrician was involved during a diagnostic difficulty. Radiologic diagnosis of pneumonia was made by radiologists blinded to the cases.

Weight was measured to the nearest 100 grams using a standard child weighing scale, and height was measured to the nearest 0.5 cm using a height stick with a movable head piece against a flat surface. For children less than 3 years of age, length was measured in a recumbent position using a measuring board on which a measuring tape is attached. A structured questionnaire was used to collect data that were missing in the medical records. Nutritional status of each patient was assessed using the Welcome classification as normal weight, underweight, marasmus, kwashiorker, or marasmic-kwashiorker.

Statistical analysis

Data were entered into a computer using the SPSS.10 program and analyzed using the statistical analysis system. A probability level of 0.05 was taken as a cut -off for statistical significance. The odds ratio (OR) with 95% CI was used as a parameter for estimating the strength of association between risk factors and pneumonia. Scientific and ethical clearance for the study was given by the Research and Publication Committee of the Department of Pediatrics & Child Health, Faculty of Medicine, Addis Ababa University.

RESULTS

A total of 67 cases and 136 controls were involved in the study. Out of the total participants 119 (58.6%) were males and the remaining 84(41.4%) were females. Children under six months of age were 28, constituting 13.8% of the study participants (Table 1)

Although not statistically significant as the birth order of the child increased, the odds of pneumonia was found to increase. However, the reverse was observed when the age of children increased. Children who were not vaccinated at all had higher risk of developing pneumonia (OR=4.12, 95% CI 1.60,10.72). Although it failed to achieve statistical significance, the risk of pneumonia was lower in children with a relatively prolonged breast feeding (OR: 0.99 and 95%CI: 0.39,2.60). The odds of developing pneumonia in malnourished children was significantly high (OR=14.89, 95% CI 6.4,35.36) (Table 1).

Table 1: Pneumonia in under five Ethiopian children according to childhood characteristics, Tikur Anbessa Hospital, Addis Ababa, 2004.

Characteristics	Pneumonia (n = 67)	Controls (n = 136)	OR (95% CI)	P-value
Sex				
Females	35	49	1.94(1.03, 3.67)	
Males	32	87	1.00	0.04
Age				
< 6 mo	15	13	1.00	
6-12 mo	21	27	0.67(0.24, 1.90)	NS*
>=12 mo	31	96	0.28(0.11, 0.71)	0.004
Birth order				
First child	18	51	1.00	
2-5	46	82	1.59(0.79, 3.20)	NS
> 5	3	3	2.83(0.41, 19.92)	NS
Address				
Addis Ababa	47	80	1.65(0.84, 3.23)	NS
Out of Addis A.	20	56	1.00	
Place of delivery				
Home	26	44	1.33(0.69, 2.55)	NS
Health facility	41	92	1.00	
Vaccination status				
DPT3				
Yes	43	115	1.00	
No	22	21	2.68(1.27,5.65)	0.0076
Measles				
Yes	39	99	1.00	
No	28	37	1.92(0.99,3.72)	0.053
Not vaccinated at all				
Yes	14	10	4.12(1.60,10.72)	0.001
No	53	126	1.00	
Breast-feeding history				
Not breast fed	9	21	1.00	
< 6 mo	21	28	1.75(0.60,5.15)	NS
6 mo-2 yr	37	87	0.99(0.39,2.60)	NS
Nutritional status (welcome classification)				
Malnutrition	38	11	14.89(6.4,35.36)	
No malnutrition	29	125	1.00	0.00001

NS=Non significant*

Paternal employment was found to reduce the risk of childhood pneumonia. Children whose fathers were unemployed had 2.72 times higher risk of developing pneumonia compared to those whose fathers were employed. Low monthly income was also significantly associated with pneumonia (Table 2).

Table 2: Pneumonia in under five Ethiopian children according to parental sociodemographic characteristics, Tikur Anbessa Hospital, Addis Ababa, 2004.

Characteristics	Pneumonia (n = 67)	Controls (n = 136)	OR (95% CI)	P-value
Maternal characteristics				
Age				
Under 20	5	5	1.00	
20-29	34	85	0.40(0.09,1.73)	NS*
> 30	28	46	0.61(0.14,2.72)	
Education				
Illiterate	20	28	1.00	
Elementary and Secondary Educ.	44	96	0.64(0.31,1.33)	NS
Higher Educ.	3	12	0.51(0.11,2.02)	NS
Employment				
Unemployed	57	110	1.35(0.57,3.23)	
Employed	10	26	1.00	NS
Parental Employment				
Unemployed	43	54	2.72(1.42,5.23)	
Employed	24	82	1.00	0.002
Monthly income in Birr				
>1000	5	24	1.00	
500-999	10	23	2.09(0.54,8.40)	NS
251-499	11	34	1.55(0.42,5.96)	NS
< 250	41	55	3.58(116,11.75)	0.02

**NS=Non Significant*

Although it was not statistically significant, the odds of developing pneumonia was found to increase with increasing family size. Use of cooking materials that included wood, charcoal, dung and kerosene were significantly associated with pneumonia (Table 3).

The presence of acute respiratory infections in the household within two weeks of the occurrence of pneumonia was strongly associated with this acute lower respiratory tract infection (p=0.00001).

Table 3: Pneumonia in under five Ethiopian children according to household characteristics, Tikur Anbessa Hospital, Addis Ababa, 2004.

Characteristics	Pneumonia (n = 67)	Controls (n=136)	OR (95 % CI)	P-value
Family size				
< 4	13	28	1.00	
4-6	36	88	0.88(0.39,2.03)	NS
>= 6	18	20	1.94(0.71,5.38)	NS
Cooking materials (Indoor air contaminants)				
Wood				
Yes	35	41	2.53(1.33,4.85)	
No	32	95	1.00	0.003
Charcoal				
Yes	40	42	3.32(1.73,6.39)	
No	27	94	1.00	0.0001
Dung				
Yes	8	5	3.55(1.00,13.14)	
No	59	131	1.00	0.03
Kerosene				
Yes	46	59	2.86(1.48,5.56)	
No	21	77	1.00	
Electricity				
Yes	5	4	2.66(0.59,12.31)	NS
No	62	132		
Isolated kitchen				
Yes	0	31		
No	67	105		0.00005
Cigarette smoker in the household				
Yes	5	10	1.02	
No	62	126	1.00	NS
ARI in the last two weeks				
Yes	32	12	9.45(4.16,21.83)	
No	35	124		0.00001

DISCUSSION

Malnutrition, presence of acute respiratory infections in the household, and use of cooking materials such as wood, charcoal, kerosene and paternal unemployment were found to be significant risk factors for childhood pneumonia. Although it did not achieve statistical significance, prolonged breast feeding and delivery at a health institution were found to reduce the risk of pneumonia.When breastfeeding lasted less than six months; there was an increased risk of pneumonia although it was not statistically significant. Studies from Argentina (5) and Brazil (6,7) showed similar conditions. Not being vaccinated at all was found to increase the risk of pneumonia by four-fold. We also found incomplete DPT vaccination to be a significant risk factor for the occurrence of pneumonia. This is quite similar to the observations made by case control studies in other developing countries (5,6).

More than fifty percent of children with pneumonia were undernourished, and we found malnutrition to be strongly associated with childhood pneumonia. In a country like Ethiopia, where 47.2% of the children are underweight (2), such a result might not be surprising. Previous studies in Ethiopia (4) and elsewhere (7,8,12,12,13) showed consistent results with the current study. Such a striking association of malnutrition and pneumonia could be due to the fact that under nutrition predisposes to infections including pneumonia in children (13,14).

Parental employment and increased monthly income of the household have been found to decrease the risk

of developing pneumonia. This is in agreement with different previous studies as reviewed by Stansfield (15) and Lanata CF, et al (14). The presence of indoor air contaminants in the household was another significant risk factor we observed for the occurrence of pneumonia in children. These factors were the use of cooking materials like wood, charcoal, dung and kerosene in the household. This is parallel with observations in different studies (4, 13,15-18). Biomass smoke contains a high concentration of suspended particulates which might cause inhibition of the inflammatory response of the alveolar macrophages and increases the risk of pneumonia (13,14).

The presence of ARI in the household was observed to be a significant risk factor for the occurrence of pneumonia. A similar situation was observed in Argentina (5). This could be partly explained by an increased propagation of microbial agents as a result of crowding in children with underlying malnutrition. Nearly one-third of children with pneumonia were found to have rickets in this study. This is consistent with similar works in Ethiopia (10, 11).

Although the research is by no means free from limitations, particularly due to recall bias, most of our findings are in agreement with the results of similar studies in Ethiopia and elsewhere.

In conclusion, these findings provide evidence that malnutrition, indoor air contaminants, lack of immunization poor monthly income& ARI in the household are risk factors for the occurrence of pneumonia in infancy and childhood. In the Ethiopian context, health extension workers can be trained to teach parents about feasible interventions which can reduce the incidence of pneumonia. Further research is also recommended to elucidate the association between pneumonia and certain childhood characteristics, including various degrees of malnutrition and breast-feeding practices.

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REFERENCES

1. The World Bank. World Development Report 1993: investing in health. New York: Oxford University Press, 1993.
2. Ministry of Health. Federal Democratic Republic of Ethiopia, Health and Health Related Indicators. Planning and Programming Department, Addis Ababa, 2004.
3. Tafesse B. Analysis of Admissions of the Ethio-Swedish Paediatric Clinic (1970-71). Ethiop Med J 1973; 11: 3-12.
4. Kebede D,Willett WC. Socio-demographic characteristics and indoor air pollution as risk factors for acute lower respiratory infections in under-five children in Addis Ababa Ethiop. J Health Dev, 1997; 2: 315-325.
5. Corqueire MC, Murtgh P, Halac A, Avila A and Weissen bacher M. Epidemiologic risk factors for children with acute lower respiratory tract infection in Buenos Aires, Argentina: A match ed case-control study. Rev Infec Dis 1990; 12: s1021-s1027.
6. Fonsca W, Kirtwood BR, Victora CG, Fuchs SR, Flores JA,Misago C. Risk factors for childhood pneumonia among the urban poor in Fortaleza, Brazil: a case-control study. Bull WHO 1996; 74:199-208
7. Victora CG, Vaughan JP, Lombardi c, Fuchs SMC, Gigante LP, Smith PG, etal. Evidence for protection by breast feeding against infant deaths from infectious diseases from Brazil Lancet 1987; 2: 319-322.
8. Tupasi TE, Mangubat NV, Sunico ME, Magdangal DM, Navarro EE, Leonor ZA, et al. Malnutrition and acute respiratory tract infections in Filipino children. Rev Infec Dis 1990; 12: s1047-s1055.
9. Kebede D. Risk factors for acute lower respiratory infections in children in Addis Ababa: Review of the literature and description of the study setting. Ethiop J Health Dev, 1997; 2: 299-313.
10. Muhe L, Lulseged S, Mason KE, Simes EA. Case control study of the role of nutritional rickets in the risk of developing pneumonia in Ethiopian children. Lancet 1997; 349: 1801-04.
11. Lulseged S. Sever rickets in a children's Hospital in Addis Ababa. Ethiop Med J 1990; 28: 175-81.
12. Chhabar P,Gargs, Mittal SK, chhabra SK.Risk factors for acute respiratory tract infections in under five in a rural community. India J Matern Child Health 1997; 8: 13-16

13. Calder PC, Jackson AA. Undernutrition, infections and immune function. Nutrition Research Reviews 2000; 13: 3-29.
14. Lanta CF, Black RE. Acute respiratory tract infections. In Semba RD,Bloeb MW (editors) : Nutrition and health in developing countries, Humana Press Inc., 2001 PP. 131-163.
15. Stansfield SK. Acute respiratory tract infections in the developing world: strategies for prevention, treatment and control. Pediatr Infec. Dis J 1987; 6: 622-9.
16. Armstrong JR, Campbell H. Indoor air pollution exposure and lower respiratory infections in young Gambian children. Int J Epidemiol 1991; 20: 424-429.
17. Chen BH, Hong CJ, Pandey MR, Smith KR. Indoor air pollution in developing countries. World Health Statist Q 1990; 42: 127-138.
18. Mishra v, Retherford RD. Cooking smoke increases the risk of acute respiratory infection in children. Natal Fam Health surv Bull. 1997; 8: 1 - 4.