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Original Research Article

Clinico-epidemiological profile of acute respiratory infections and malnutrition in urban and rural population of central India

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ABSTRACT

Background: Acute respiratory infections (ARI) and Malnutrition in children have tremendous burden on the health care sector of developing nations including India. The intensity with which these conditions are holding grip in the community is indeed a matter of concern and hence developing nations should develop an insight to assess the severity of it has become a necessity.
Methods: A hospital based cross sectional study was carried out in children aged 0-14 years. Children were clinically assessed and diagnosis was made as URTI or LRTI Also anthropometry was performed and accordingly children were divided into categories of no malnutrition (NM), severe acute malnutrition (SAM) and moderate acute malnutrition (MAM) in 'under 5' years age children according to WHO guidelines, whereas children aged 'above 5' years were categorized as per the IAP guidelines.
Results: It was observed that most of the mothers of children were illiterate with inadequate or absent ventilation and use of biomass fuels (chulha) for cooking purpose in households of rural children. The proportion of malnutrition was found to be equal in Under 5 children. In 'above 5 years' age study subjects, 52.4% of urban study subjects were normal as compared to 16.7% of rural study subjects.
Conclusions: Our study implies that ARI and Malnutrition definitely is more prevalent in the pediatric population. Prevalence of URTI was found to be on a higher side in the rural population and LRTI prevalence was found to be higher in the urban population. Similarly, the prevalence of malnutrition was almost similar in 'Under 5' aged children, whereas the prevalence of malnutrition in 'Above 5' aged children was higher in the rural population than urban population.

Keywords: ARI, Environmental, Malnutrition, Rural, Socio-demographic, Urban

INTRODUCTION

Acute Respiratory Infections in pediatric age group is a major concern in developing countries like India.[1,2] Lower respiratory tract infections (LRTI) are basically leading cause of death among children under 5 years of age in such developing countries like India.[3,4] Child health is a matter of concern in developing countries like India. Predominantly, pneumonia and bronchiolitis comprising the lower respiratory tract infections along with upper respiratory tract infections have some severe implications on the health of pediatric population when

they occur recurrently. Pneumonias can prove fatal at times especially in the rural areas where immediate health care facilities remain unavailable as compared to urban areas where immediate interventions are possible due to presence of tertiary health care centers. Malnutrition is another serious health related hazard, which can have devastating effects on the overall growth and development of the child and also is quite rampant in our society. ARI and Malnutrition affects the physical growth, morbidity, mortality, cognitive development, reproduction and physical work capacity and it consequently impacts on human performance, health and survival. There is very less documented work on the clinico-epidemiological aspect of the ARI and Malnutrition in the Urban and Rural population of India. By studying and assessing the relation between socio-demographic and environmental factors with acute respiratory infections and malnutrition we can certainly establish a relation between them and can therefore formulate a policy, which can reduce the disease burden significantly in these patients.

The objective of this study was to study the clinical profile of hospital based children with acute respiratory infections and malnutrition from urban and rural population of central India, and to study some epidemiological factors responsible for acute respiratory infections and malnutrition in children.

METHODS

The design of this study was a hospital based cross sectional study conducted at a tertiary care center, which is IGGMCH (Indira Gandhi Government Medical College and Hospital), Nagpur, Maharashtra, India.

Total 100 children participants [admitted to Pediatric wards, Pediatric intensive care unit (PICU) as well as children visiting Pediatric OPD] fulfilling the following criteria was interviewed.

Data collection

The structured questionnaire was designed to seek the information related to detailed socio-demographic profile like age, gender, residence, education of child as well as parents, religion, socio-economic status, attendance to day care centers/anganwadi, type of diet and breast feeding/weaning practices. Environment of the residence of each study subject, particularly cooking environment of the kitchen with regards to size of the kitchen, type of construction, type of floor, roof, walls, number of rooms, windows, site where kitchen was located, presence or absence of chimney/smoke vent in the kitchen and presence or absence of soot deposits in kitchen was noted. Also noted were other characteristics like adequacy of kitchen ventilation, overcrowding, time spent (hours) in household cooking per day and number of years of cooking experience. Exposure index (EI) was calculated by multiplying the number of hours spent in a day on cooking and the number of years of cooking experience. Details of environmental exposure to tobacco smoke (ETS) exposure were obtained using a structured questionnaire. The study subjects were also inquired regarding the number of smokers in family, type of tobacco product smoked and approximate number of cigarettes/bidis smoked per day and years of passive exposure to tobacco smoke. Overall exposure to ETS was estimated by multiplying number of cigarettes/bidis smoked daily in the household and years of exposure. Socio-economic status (SES) was estimated according to a 'Modified Kuppuswamy's Scale' for children belonging to urban areas and Prasad scale for rural areas.

In addition, anthropometric measurements like length/ height, weight, head circumference, chest circumference, mid arm circumference (MAC) were estimated by means of measuring tape. On similar lines weight for age was determined for all subjects by observed weight in kilograms divided by expected weight in kilograms for the same age were calculated. Along with this general examination including the respiratory rate, heart rate, blood pressure, clubbing, cyanosis, pallor, icterus, lymphadenopathy, edema feet, jugular venous pressure (JVP) was also seen. Systemic examination was also performed with special emphasis on respiratory system in patients of ARI along with treatment history. The entire data was collected with the aid of preformed structured questionnaire.

Statistical analysis

The collected data was analysed statistically by using percentages, Chi square test trend, student t test using 'Open Epi Info statistical package programme version 2.3 year 2014'. Statistical significance was assessed at a type I error rate of 0.05.

RESULTS

Assessment of socio-demographic factors in children belonging to urban and rural areas was done for which, several factors like age group, sex, education of mother and father, socio-economic status and environmental tobacco exposure were taken under consideration. For all the factors similar results were obtained except for status of education of mother where it was found that 54.5% of rural study subjects' mothers were illiterate as compared to 21.8% of urban study subjects. On applying the chi-square test, it was found to be statistically significant as ($P<0.001$). Distribution of study subjects according to respiratory morbidities was also studied and it was found that the incidence of URTI was on a higher side in children belonging to rural areas (36.3%) as compared to urban areas (29.4%). Also in case of LRTI the incidence was on a higher side in urban side study subjects (70.5%) as compared to rural study subjects (63.6%). Also the past history of pulmonary tuberculosis and ATT (anti-tuberculosis treatment) was another important aspect studied and it was found that (10.25%) of urban study

had this history as compared to (4.5%) of rural study subjects and also it was found to be statistical significant (P<0.001).

Distribution of urban and rural study subjects on the basis of malnutrition status was also studied. Study subjects were distributed as Under 5 and Above 5 and WHO and Indian Academy of Pediatrics (IAP) classifications were used for them respectively. However, there was no statistically significant result obtained and incidence of malnutrition was found to be equal in Under 5 children. In case of Above 5 age group study subjects, 52.9% of urban study subjects were normal as compared to 16.7% of rural study subjects. 33.3% of rural study subjects had Grade 2 malnutrition as compared to 9.5% of urban study subjects. 16.7% of rural study subjects had Grade 3 malnutrition as compared to 9.5% of urban study subjects.

Table 1: Socio-demographic correlates of children in urban and rural areas.

Socio-demographic correlate	Urban N = 78	Rural N = 22	χ^2 test, P value
Age group			
Less than or equal to 5 years	57 (73.08)	16 (72.73)	0.48
More than 5 years	21 (26.92)	6 (27.27)	
Sex			
Male	44 (56.41)	15 (68.19)	0.16
Female	34 (43.59)	7 (31.81)	
Education of mother			
Illiterate	17 (21.80)	12 (54.54)	P<0.01
Primary	14 (19.23)	3 (13.63)	
Middle school	16 (20.51)	5 (22.73)	
High school	18 (23.08)	2 (9.1)	
Post high school	8 (10.25)	0	
Graduate	5 (6.41)	0	
Pg/ professional	0	0	
Education of father			
Illiterate	15 (19.23)	6 (27.27)	0.20
Primary	4 (5.12)	5 (22.72)	
Middle school	15 (19.23)	7 (31.81)	
High school	22 (28.20)	4 (18.18)	
Post high school	12 (15.38)	0	
Graduate	10 (12.82)	0	
Pg/professional	0	0	
Occupation of father			
Unemployed	0	0	P<0.01
Unskilled	18 (23.07)	6 (27.27)	
Skilled	3 (3.84)	0	
Semi-skilled	22 (28.20)	13 (59.1)	
Clerical/shop	24 (30.76)	3 (13.63)	
Semi-professional	4 (5.12)	0	
Professional	7 (8.97)	0	
Socio-economic status			
High- (grade i, ii) (upper, upper middle)	4 (5.12)	0	0.13
Low- (grade iii, iv, v) (lower middle, upper lower, lower)	74 (94.88)	22 (100)	

Considering the effects of environmental factors among study subjects, it was found that overcrowding was almost equal in both urban and rural study subjects. Ventilation was inadequate in 72.7% of rural study subjects as compared to 51.3% urban study subjects. It was also found to be statistically significant (P<0.03). Cross ventilation was found to be absent in 77.3% of rural study subjects as compared to 50% of urban study subjects and it was also found to be statistically significant (P<0.01). Assessment of the types of cooking fuels used including chulha, LPG, kerosene stove was also done and it was found that the chulha was being used in the households of 59.1% of rural study subjects as

compared to 12.8% of urban study subjects. On the contrary LPG was being used as a cooking fuel in the households of 57.7% of urban study subjects as compared to 13.6% of rural study subjects. On applying the chi-square test, the difference was found to be statistically significant as (P<0.001). On Anthropometric assessment of children among urban and rural study subjects, observed mean height, mean weight, mean height/age, mean weight/age were studied and was found to be almost equal among urban and rural study subjects.

Similarly the relationship between pneumonia and environmental factors in urban and rural study subjects was also studied. In 72.7% of the rural study subjects inadequate ventilation was present as compared to 51.3% of rural study subjects. On applying the chi-square test the difference was found to be statistically significant (P<0.03). Similarly absent cross ventilation was found to be present in 77.3% of rural study subjects as compared to 50% of the urban study subjects. The difference was again found to be statistically significant as (P<0.01). In the households of 86.4% of the rural study subjects, chulla was found to be present as compared to 26.9% of the urban study subjects and the difference was found to be statistically significant as (P<0.001).

Table 2: Distribution of study subjects according to respiratory morbidities.

Respiratory morbidity	Urban (N = 78)	Rural (N = 22)	χ^2 test P Value
URTI	23 (29.48)	8 (36.36)	0.26
LRTI	55 (70.52)	14 (63.64)	
Past H/o PTB and AKT	8 (10.25)	1 (4.54)	P<0.001

Table 3: Distribution of children according to malnutrition.

Classification	Urban (N = 78)	Rural (N = 22)	χ^2 Test P Value
Under 5 (WHO)	**(N = 57)**	**(N = 16)**	
SAM	22 (38.59)	6 (37.5)	0.46
MAM	10 (17.54)	3 (18.75)	
No malnutrition	25 (43.85)	7 (43.75)	0.45
Above 5 (IAP)	**(N = 21)**	**(N = 6)**	
Normal	11 (52.38)	1 (16.66)	
Grade I	3 (14.28)	1 (16.66)	0.06
Grade II	2 (9.5)	2 (33.33)	
Grade III	2 (9.5)	1 (16.66)	
Grade IV	3 (14.28)	1 (16.66)	

Table 4: Distribution of environmental factors among study subjects.

Environmental factors	Urban (N = 78)	Rural (N = 22)	χ^2 Test p Value
Overcrowding			
Present	39 (50)	12 (54.55)	0.35
Absent	39 (50)	10 (45.45)	
Ventilation			
Adequate	38 (48.72)	6 (27.27)	0.03
Inadequate	40 (51.28)	16 (72.73)	
Cross ventilation			
Present	39 (50)	5 (22.73)	0.01
Absent	39 (50)	17 (77.27)	
Cooking fuel			
Chulla	10 (12.82)	13 (59.09)	
LPG	45 (57.70)	3 (13.64)	
Kerosene stove	9 (11.54)	0	P < 0.001
Chulla + LPG	8 (10.25)	4 (18.18)	
Chulla + kerosene stove	3 (3.84)	2 (9.09)	
Lpg + kerosene stove	3 (3.84)	0	
ETS			
Present	45 (57.7)	14 (63.64)	0.30
Absent	33 (42.30)	8 (36.36)	

Table 5: Distribution of study subjects on the basis of mean anthropometric measurements.

Anthropometric measurements	Mea ±SD		T test P value
	Urban (N = 78)	Rural (N = 22)	
Mean height (observed)	88.62±21.62	87.40±21.09	0.81
Mean weight (observed)	11.46±6.09	11.07±5.81	0.78
Mean height/age	90.98±6	90.84±6.05	0.92
Mean weight/age	72.22±15.02	71.63±15.03	0.87

Table 6: Relationship between pneumonia and environmental factors in urban and rural study subjects.

Environmental factors	Urban (N = 78)	Rural (N = 22)	χ^2 P value
Overcrowding present	39 (50)	12 (54.55)	0.35
Inadequate ventilation	40 (51.28)	16 (72.73)	0.03
Absent cross ventilation	39 (50)	17 (77.27)	0.01
Chulla present	21 (26.92)	19 (86.36)	P < 0.001
Ets present	45 (57.70)	14 (63.64)	0.30

DISCUSSION

Acute respiratory infections and malnutrition is one of the most commonly seen diseases in the pediatric age group. Estimated childhood deaths due to LRTI, is almost 1.9 million per year of which almost 20% are estimated to occur in India.[5,6] Similarly, URTI constitute 85-88% of the ARI and the remaining part is the LRTI worldwide.[7-9] In the most recent estimate of the ARI associated mortality in India, pneumonia was held to responsible for 369,000 deaths among 'under 5' age group children making it the single most fatal disease in this age group.[10] More number of deaths due to pneumonia was reported from central India.[11] ARI surely imposes tremendous burden on the health system of several developing countries like India.

A recent review study on pneumonia in India identified the lack of evidence on epidemiology and etiology of pneumonia as important barriers to effective planning and implementation of preventive measures.[12] A meta-analysis of ARI among under 5 children based on 12 Indian studies conducted since 1994, estimated incidence rates between 2.4 to 7.4 episodes per child per year and also highlighted the lack of community based studies on etiology of ARI from pneumonia.[13] In developing countries like India on an average every child has five episodes of ARI / year accounting for 30% -50% of total pediatric outpatient visits and 20-30% of pediatric admissions.[14]

Another study conducted by Krishnan et al, which was a comprehensive community based ARI study, 3000 children were under surveillance. The study reported an incidence of pneumonia between 0.25 to 0.50 episodes per child per year in the South-Asia region.[15] This is the first study to provide community based ARI incidence among 5-10 years olds in India. A rural study from Haryana by Broor et al, reported 2387, 536, 43 episodes of acute upper respiratory infections, acute lower respiratory infections and severe lower respiratory infections respectively per 1000 child years.[16] Similarly, a study conducted by Gladstone et al an urban slum of Vellore district showed 7.4 episodes of ARI per child year.[17] Another study conducted by Gladstone et al in urban slums around Vellore suggested that ARI contributed to 58.2% of childhood morbidities.[18] In a study conducted by Sarkar et al in semi-urban slums surrounding the Vellore district showed that ARI contributed to 60.2% of self-reported morbidities among children. It also showed an occurrence of 7.5 episodes of ARI/child year and another interesting finding was that 98% of the ARIs were actually URTIs.[19]

Several 'small scale' community based studies over the years have reported that poor socio-economic factors; low level of literacy, suboptimal breast feeding malnutrition, unsatisfactory level of immunization coverage, cooking fuel used other than liquefied petroleum gas as risk factors contributing to increased burden of ARI among children.[20-22]

Identification of severe respiratory infections by health care workers from rural area, wide access to antibiotics and its administration by health care workers was seen as successful model by Gadchiroli project management of childhood illness by holistic approach of Integrated management of neonatal and childhood illnesses (IMNCI).[23]

Malnutrition is an important concern for the developing countries like India and is a major a burden on the health sector as well. Prevalence of malnutrition/underweight children in India is among the highest in the world, and is nearly double that of Sub-Saharan Africa. Interestingly, malnutrition in India is concentrated to a relatively small number of states and districts, which is contrary to villages, which shares relatively larger burden. Almost

states and 50% villages account for about 80% of the total malnutrition burden.[24] In a review article published by Sahu et al, it was quoted that prevalence of malnutrition among 'under 5' children was very high and had a high variation. Following findings were noted in this review, underweight: 39-75%, stunting: 15.4-74%, wasting: 10.6-42.3%.[25]

A recent study which was conducted among children in the age group of 3 months to 3 years in 130 districts through demographic and health surveys in 53 countries over a period of 1986 to 2006 found that the variance in the mild underweight has a larger and more robust correlation with child mortality than the variance in severe under-weight. The study also concluded that the prevalence of mild under-weight deserves greater attention than the severe under-weight and also stated it to be a useful signal of changing public health conditions among preschool children in developing countries.[26] The burden of malnutrition is actually not changing despite of induction of various intervention programs, which are operating since quite a long time. Changing dietary patterns, increased prevalence of metabolic disorders like hypertension, diabetes mellitus-type 1 and 2, coronary heart disease and obesity have all lead to increased prevalence of malnutrition and also has affected the nutrition status of the children of the country.

A nation-wide study conducted by National Family Health Survey-3 (NFHS-3) showed a 40.4% prevalence of malnutrition in children less than 3 years of age in the country. It also showed a prevalence of 1.5% overweight children in the same age group.[27] A study conducted by Kapur et al in urban slum of Delhi in children between the age groups of 9-36 months showed a prevalence of 74% stunting, 75% underweight, 19% wasting.[28] In another study conducted by Rao et al, in Jabalpur district of Madhya Pradesh, which also included tribal villages in the nearby region showed 51.6% children to be stunted, 61.6% to be underweight and 32.9% to be wasted according to the WHO criteria.[29] In another study conducted by Bisai S et al in West Bengal's Mednipur district in the children of 1-14 age group it was found that 26.1% children are stunted, 33.9% children are underweight and 19.4% are wasted.[30] In a study conducted by Espie et al in Darbhanga district of North Bihar in under 5 children showed some striking results. Apparently the prevalence of Global Acute Malnutrition (GAM) or Severe Acute Malnutrition (SAM) was 15.4% and 19.4% respectively according to NCHS child growth references and WHO references. This study also suggested that children in Darbhanga district were in a borderline food crisis with few food resources.[31] This is more or less the similar picture in other parts of the country as well. In another study by Anurag et al, which was conducted in an urban slum of Bareilly district, Uttar Pradesh showed that 66.3% of children were under weight in the age group of 0-5 years according to IAP standards.[32] A study conducted in Ernakulam district of Kerala among '5-16 years' age group highlighted that childhood obesity showed an increasing trend.[33]

It is an established concept that the residing area of the children, socio-economic background, awareness and knowledge regarding diarrheal diseases and ARI control, maternal education, number of 'under 5' years children and source of drinking water were strong predictors of child nutritional status in developing countries.[34] Maternal factors like age, weight, and anemia also significantly affect child's nutritional status.[35]

Recommendations

Studies have shown that prevalence of malnutrition is more amongst the slum dwellers, tribal people and remote rural areas and thus it is need of the time to give impetus to newer and more effective strategies in combating this serious problem of malnutrition. For this it is important to emphasize more on the extended coverage of various government schemes and quality delivery services to the target population and children. Hence we recommend low-cost interventions such as hand washing, breast feeding, and promotion of low cost sustainable solutions like optimal infant and young child feeding practices through the means of mass communication which will significantly help in preventing the occurrence of acute respiratory infections and severe acute malnutrition.

Reduction in the burden of ARI by low-cost interventions such as hand washing, breast feeding, availability of rapid and feasible array of diagnostics and introduction of pentavalent and potent vaccine like influenza and pneumococcal vaccines under national immunization schedule are definitely important and necessary to reduce the incidence of ARI. Recent evidences suggest that chlamydia, *E.coli* and mycoplasma cause more than 10% pneumonia individually, where the past evidences suggest them to be rare pathogens. This shift in etiology from gram positive to gram negative organisms needs to be considered and is an important concern in the clinical practice. Improved laboratory diagnostic methods like antigen assays, rapid diagnostic kits and noninvasive procedures like urinary antigen detection test have demonstrated successful identification of respiratory pathogens and hence must be inducted in the clinical practice.[36-38] Incidence of ARI and malnutrition can be reduced with necessary and timely interventions. We need to teach proper hand-washing techniques to the concerned caretakers of the children as data suggests a strong relation between hand-washing and respiratory infections.[39] Exposure to indoor air pollution has 2.3 times increased risk of respiratory infections predominantly, LRTI in rural areas Indoor air pollution from bio mass fuel must be reduced to great extent and should be replaced with other alternatives cooking fuel and similarly programs must be held to develop this awareness among residents of rural areas.[40] In case of malnutrition as low BMI is an indicator of current energy

deficit, early detection of low BMI for age and subsequent correction of the same by the concerned health care authorities is one of the most effective measures for controlling stunting.[41] Similarly, integration of anganwadi workers under ICDS, and of ASHA workers under NRHM should be encouraged to greater extent in rural areas in order to increase awareness about health and balanced diet in rural families.[42]

CONCLUSION

Education of mother was found to be an important socio-demographic factor responsible for the development of respiratory infections in rural study subjects as children having illiterate mothers had higher incidence of URTI/LRTI.

Prevalence of URTI was slightly higher in rural study subjects whereas the prevalence of LRTI was slightly higher in urban study subjects. Urban study subjects had a significant past history of pulmonary tuberculosis and AKT than rural study subjects.

Also the prevalence of malnutrition as per the WHO classification in under 5 age group Study subjects was found to be equal among the urban and rural study subjects. Prevalence of malnutrition as per the IAP classification in above 5 age group Study subjects was varied and prevalence of Grade 2 and Grade 3 malnutrition was higher in rural study subjects than urban study subjects. Much more of the urban study subjects were normal than the rural study subjects. Prevalence of Grade 1 and Grade 4 malnutrition was almost similar in urban and rural study subjects.

Inadequate ventilation and absent cross ventilation were predominantly seen in the households of the rural study subjects as compared to urban study subjects. Chulha was being used as a cooking fuel in the households of in majority of rural study subjects whereas LPG was being used in the households of urban study subjects

There was no significant difference in the anthropometric measurements of both the urban and rural study subjects.

On assessing the relationship between pneumonia and environmental factors it was found that overcrowding was equally present in the households of urban and rural study subjects and was also responsible for pneumonia in them equally. However, inadequate ventilation was more responsible for pneumonia in rural study subjects than the urban study subjects. Similarly, absent cross ventilation was also accountable for pneumonia in rural study subjects than the urban study subjects. There was significant correlation between use of chulha and pneumonia among the rural study subjects as the prevalence of pneumonia was much higher in the households of rural study subjects where chulha was being used as a cooking fuel.

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