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Prevalence of acute respiratory infections among under-five children and its association with sociodemographic factors and housing conditions in a rural area of the Bundelkhand region: A cross-sectional study

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ABSTRACT

Background: Acute respiratory infections (ARIs) are a significant public health concern in India, accounting for 15–30% of all fatalities among children younger than 5 years. **Aims and Objectives:** This study estimated the prevalence of ARI and its association with sociodemographic variables and housing conditions in under-five children in rural Jhansi, Bundelkhand region. **Materials and Methods:** This community-based cross-sectional analytical study was conducted in the selected Anganwadi Centers in Badagaon Block, Jhansi. Data for sociodemographic factors and housing conditions were collected by interviewing parents or caretakers of under-five children using a semi-structured predesigned and pretested pro forma during a house-to-house visit. The sociodemographic factors considered were the educational status of the parents, occupation of the father, religion of the child, socioeconomic class of the family, age of the child, type of family, and sex of the child. The parameters of housing conditions evaluated were overcrowding, ventilation type of chulha, and type of house. **Results:** The overall prevalence of ARI was found to be 48.88%. Significant sociodemographic factors for ARIs have been the educational level of the mother ($\chi^2 = 18.69$, $P < 0.001$) and father ($\chi^2 = 12.02$, $P < 0.001$), the working status of the fathers ($\chi^2 = 17.95$, $P = 0.001$), the type of family ($\chi^2 = 23.88$, $P < 0.001$), and the gender ($\chi^2 = 16.57$, $P < 0.001$) of the studied children and the significant environmental housing factors associated with ARIs were overcrowding ($\chi^2 = 13.61$, $P \leq 0.001$), ill-ventilated houses ($\chi^2 = 54.63$, $P < 0.001$), type of chulha ($\chi^2 = 164.31$, $P \leq 0.001$), and type of house ($\chi^2 = 4.69$, $P = 0.030$). **Conclusion:** The prevalence of ARI as observed in this study is noteworthy. The study's findings underscore the significance of enhancing sociodemographic indicators and housing conditions as effective measures for preventing ARI in children.

Key words: Acute respiratory infections; Prevalence; Educational status; Housing conditions

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INTRODUCTION

Respiratory infections, as reported by the World Health Organization, contribute to approximately 6% of the overall global disease burden. The global under-five mortality rate remains a pressing concern, with approximately 6.6 million children in this age group succumbing to various causes each year. Notably, a staggering 95% of these fatalities occur in low-income countries. Among the leading causes of death in this vulnerable population, acute respiratory infections (ARI) account for approximately one-third of all under-five deaths.[1]

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ARIs among children under the age of five represent a significant public health concern in India, contributing specifically to 15–30% of all deaths among children under the age of five, with the notable observation that a majority of these fatalities could have been prevented.[2] In developing nations such as India, ARIs account for 30–50% of health institution visits and 20–40% of admissions to hospitals for infants younger than age five.[3,4]

The availability of data on the prevalence and factors associated with ARIs is vital to achieving Sustainable Development Goal 3.2 on improving the health and well-being of children under 5 years of age. Regarding the morbidity burden of ARI in under-five children in India, there is limited data to evaluate this problem in the Bundelkhand region, especially in rural areas of Jhansi. Thus, this study was carried out in an effort to estimate the prevalence and determine the association of sociodemographic factors and the effect of housing conditions on the ARI among under-five children in rural areas of the Jhansi, Bundelkhand region.

Aims and objectives

The aim of the present study was to estimate the prevalence of acute respiratory infections (ARI) and investigate any potential association between ARI and various sociodemographic variables as well as housing conditions among children under the age of five in the rural Jhansi region of Bundelkhand.

MATERIALS AND METHODS

This community-based cross-sectional analytical study was initiated after getting approval from the Institution's Ethics Review Committee and it adhered to the principles enumerated in the Declaration of Helsinki. It was conducted in the selected Anganwadi Centers (AWCs) in the rural field practice area of the Department of Community Medicine of our tertiary care teaching facility from May 2021 to January 2023. Children under 5 years of age registered at various AWCs in Badagaon Block, Jhansi, were included. Any child of <60 months of age residing with their families in the Badagaon block area and whose parents were willing to participate in the study and enrolled in the selected AWCs was included in the study. The children of those parents who were unwilling to participate in the study with their child, those who were not permanent residents of the study area, and children under 5 years of age with heart disease, asthma, or TB disorders were excluded from the study. The sample size for the study was calculated using the formula $4\,pq/l^2$. Where p is the prevalence of ARI among under 5-year-old children, taken as 52% according to a previous study conducted on ARI by Goel et al.,[5] from Meerut, and q is 100-p which comes out to be 48%. The absolute error (l) for the study was kept at 5%. Considering the 10% non-response rate, the final sample size was calculated to be 439.3, and we rounded it off to 450, which was our final sample size (n=450) for the study. Jhansi district comprises eight blocks, of which two blocks (Badagaon and Chirgaon) are under the field practice area of the Department of Community Medicine of our tertiary care institute, and there are a total of 131 AWCs under the Badagaon Block.[6] Out of these two blocks and 131 AWCs, the Badagaon block and eleven AWCs were selected based on feasibility and considering constraints in logistics, time, and resources.

We visited the selected AWCs and, then, obtained the list of enrolled under 5-year-old children from the respective center. After which we visited each and every household of the child on the list, and judging the child on the basis of the inclusion criteria for the study, the child was either included or left out. We performed this procedure for each of the selected AWCs, and the children were recruited consecutively with the help of purposive sampling until the desired sample size for the study was reached. Data were collected by interviewing parents or caretakers of under-five children enrolled in selected AWCs using a semi-structured predesigned, and pretested pro forma during a house-to-house visit of these studied children. Each mother or caregiver was explained the purpose and possible benefits of the study and assured of confidentiality. Written and informed consent was obtained from the participating child's caretaker or mother after an oral explanation of the study.

For the present investigation, ARI has been defined as the occurrence of one or more of the following in the 2 weeks preceding the study, with or without fever: Cough, cold, runny or obstructed nose, sore throat, rapid or loud breathing, earache, discharge from the ear (in all children); cessation of feeding and or drinking for a minimum of 2 h (in children younger than 2 months).[7]

The sociodemographic factors considered for association with ARI in under 5-year-old children were the educational status of the parents, occupation of the father, religion of the child, socioeconomic class of the family, age of the child, type of family, and sex of the child. A person over the age of seven who can read and write with comprehension in any language was considered literate for this study.[8] For the father's occupation, categories such as professional, skilled, unskilled, business or self-employed, and unemployed were used. The updated Modified B. G. Prasad Classification for Socioeconomic Scale was used to assess the socioeconomic status of the family.[9] The types of families were categorized into two groups: nuclear families, which typically included a spouse, wife, as well as

their unmarried offspring living together, and joint families, which comprised three generations and extended families.

The parameters of housing conditions for which association with ARI was evaluated were overcrowding, ventilation type of chulha, and type of house. In the context of overcrowding, for the present study, we followed established criteria regarding the number of individuals allowed per room.[10] We used the criteria used by Gothankar et al.[11] in their study to figure out if a house had adequate ventilation. A house with less than 50 square feet of floor space per person, regardless of whether there was a fan, or 50–100 square feet of floor space per person without a fan was considered to have inadequate ventilation, while a house with 50–100 square feet of area per person and a fan or more than 100 square feet per person was considered to have adequate ventilation. For cooking, the type of challah was categorized as smokeless if using a liquefied petroleum gas cylinder or electrical induction all other various types of challahs were considered with smokey. The type of housing was categorized as Semi pucca or kutcha and Pucca. The walls and or roof of a kutcha house are made of materials such as unburnt bricks, bamboo, mud, grass, reeds, thatch, and loosely packed stones, while a semi-pucca house has fixed walls made of pucca material but a roof made of a different material. A pucca house is one that has walls and a roof made of the following materials: Wall material: burned bricks, stones (packed with lime or cement), cement concrete, timber, ekra, etc. Roof Material: Tiles, galvanized corrugated iron sheets, asbestos cement sheet, reinforced brick concrete, reinforced cement concrete, timber, etc.[12]

The prevalence of ARI was calculated by

Prevalence (%) = (Number of children having ARI/Total number of children participating in the study) × 100

The data were systematically collected, compiled, tabulated, and subsequently entered into a Microsoft Excel spreadsheet. To conduct the analysis, the Statistical Package for the Social Sciences version 23 was utilized. The results of the study are presented using descriptive statistics, specifically in terms of frequency and percentages. To investigate the potential association between categorical variables and ARI, the Chi-square test was employed. To determine the statistical significance of the association, a threshold of $P<0.05$ at the 95% confidence interval was employed.

RESULTS

The under-five children have been studied from 11 AWCs, and the maximum number of children was taken from Digara AWC (10.6%) followed by Phutera Baruwa Sagar AWC (10.2%) (Table 1).

Table 1: Distribution of under-five children studied from selected AWC

S. No.	Name of AWCs	Number of children	Percentage
1	Ambabai	42	9.3
2	Baratha	38	8.4
3	Bhojla	36	8.0
4	Digara	48	10.6
5	Garhmau	37	8.2
6	Goramachhiya	43	9.5
7	Mustara	45	10.0
8	Palar	39	8.6
9	Paricha	42	9.3
10	Phutera Baruwa Sagar	46	10.2
11	Rund Karari	34	7.5
	Total	450	100

AWCs: Anganwadi Centres

Out of 220 mothers whose children had ARI, 129 (58.60%) were illiterate while 91 (41.40%) were literate, and for mothers (n=230) whose children did not show signs of ARI, 88 (38.30%) were illiterate and 142 (61.70%) were literate. The proportion of ARI children has been found to be greater in mothers who were illiterate (58.6%) than literate (41.4%), and this relationship is found to be significant statistically ($\chi^2=18.69$, $P<0.001$) (Table 2).

With regard to the educational status of the father, 98 (44.50%) were literate, while 122 (55.50%) were literate of 220 children having ARI, 140 (60.90%) were illiterate, and 90 (39.10%) were literate of 230 children who were not having ARI. Although the proportion of ARI children is lower in fathers who were illiterate (44.5%) than in fathers who were literate (55.5%), there is a statistically significant association between ARI and the education of fathers ($\chi^2=12.02$, $P<0.001$) (Table 2).

In the study, the maximum number of children having ARIs had their father's occupation as an unskilled worker (n=101, 45.9%), followed by skilled worker and business or self-employed (n=50, 22.7%), and there was a statistically significant association between ARI and the occupation of their fathers ($\chi^2=17.95$, $P=0.001$) (Table 2).

The maximum number of children who had ARIs belonged to Hindu families (n=151, 68.6%), followed by Muslim families (n=60, 27.2%), and there was a statistically non-significant association between ARI and the religion of the family ($\chi^2=4.75$, $P=0.190$) (Table 2).

In the study, the maximum number of children having ARIs belonged to socioeconomic class III (n=103, 46.8%),

Table 2: Association of sociodemographic factors with ARI (n=450)

Parameters	ARI				Total	Chi-square, df	P-value
	Yes (n=220)		No (n=230)				
	n	%	n	%			
Education of mother							
Literate	91	41.40	142	61.70	233	18.69, 1	<0.001
Illiterate	129	58.60	88	38.30	217		
Education of father							
Literate	122	55.5	90	39.1	212	12.02, 1	<0.001
Illiterate	98	44.5	140	60.9	238		
Occupation of father							
Professional	15	6.8	24	10.4	39	17.95, 4	0.001
Skilled	50	22.7	85	36.9	135		
Unskilled	101	45.9	89	38.6	190		
Business or self employed	50	22.7	31	13.4	81		
Unemployed	4	1.8	1	0.4	5		
Religion							
Hindu	151	68.6	164	71.3	315	4.75, 3	0.190
Muslim	60	27.2	48	20.8	108		
Christian	02	1	03	1.3	05		
Other	07	3.18	15	6.5	22		
Socio econo mic class of family							
Class I	03	1.36	03	1.30	06	5.61, 4	0.229
Class II	09	4.09	12	5.20	21		
Class III	103	46.82	87	37.80	190		
Class IV	79	35.91	86	37.40	165		
Class V	26	11.82	42	18.20	68		
Age of child							
<12 months	56	25.50	45	19.60	101	2.24, 1	0.134
1–5 years	164	74.50	185	80.40	349		
Type of family							
Joint	131	59.55	84	36.50	215	23.88, 1	<0.001
Nuclear	89	40.45	146	63.50	235		
Gender of child							
Male	135	61.36	97	42.2	232	16.57, 1	<0.001
Female	85	38.64	133	57.8	218		

df: degrees of freedom, ARI: Acute respiratory infection

followed by socioeconomic class IV families (n=79, 35.9%), and there was a statistically non-significant association between ARI and socioeconomic class of family (χ^2=5.61, P=0.229) (Table 2).

The majority of studied children (n=164, 74.5%) having ARIs were of age group 1–5 years, and 56 (25.4%) were of age <1 year, and there was a statistically non-significant association between ARI and age of the child (χ^2=2.24, P=0.134) (Table 2).

The n=131 (59.5%) children having ARIs belonged to joint families and the n=89 (40.4%) belonged to nuclear families, and there was a statistically significant association between ARI and type of family (χ^2=23.88, P<0.001) (Table 2).

The current investigation examined a sample of 450 children, with approximately half (51.5%) identified as male and 48.5% identified as female. Furthermore, the n=135 (61.3%) children having ARIs were male and the n=85 (38.6%) children were female, and there was a statistically significant association between ARI and gender of child (χ^2=16.57, P<0.001) (Table 2).

The prevalence of ARI in houses with overcrowding was greater (60%) than in non-overcrowding houses (40%), and there was a statistically significant association between ARI and overcrowding (χ^2=13.61, P≤0.001) (Table 3).

The percentage of ARI occurrence was higher in houses with inadequate ventilation (70.45%), and this relationship is significant statistically (χ^2=54.63, P<0.001) (Table 3).

Although the ARI frequency of occurrence was found in only 21.82% of houses having smoke type of chullah, this relationship was statistically significant (χ^2=164.31, P≤0.001) (Table 3).

The ARI frequency percentage in semi-pucca/kutcha houses was 45% against 55% in pucca houses, with a

Table 3: Association of ARI with housing conditions (n=450)

Housing condition	ARI				Total	Chi-square, df	P-value
	Yes (n=220)		No (n=230)				
	n	%	n	%			
Over crowding							
Present	132	60	98	42.6	230	13.61, 1	<0.001
Absent	88	40	132	57.4	220		
Ventilation							
Adequate	65	29.5	148	64.4	213	54.63, 1	<0.001
Inadequate	155	70.4	82	35.6	237		
Type of chulha							
Smokeless	172	78.1	41	17.8	213	164.31, 1	<0.001
Smokey	48	21.8	189	82.2	237		
Type of house							
Semi pucca/kutcha	99	45	127	55.2	226	4.69, 1	0.030
Pucca	121	55	103	44.8	224		

df: degrees of freedom, ARIs: Acute respiratory infections

statistically significant association between ARI and type of house (χ^2=4.69, P=0.030) (Table 3).

DISCUSSION

The overall prevalence of ARI in under-five children residing in our institute's field practice area was found to be 48.88% by the current investigation. The study shows that the prevalence of ARIs in the studied children with illiterate mothers was 59.4%, which is higher than in literate mothers. This finding is similar to the past studies by Pore et al.,[13] and Goel et al.,[5] where the percentage of under-five children with ARI was found to be higher in less educated mothers, that is, 64.17% in illiterate mothers and 83.5% in illiterate mothers, respectively. Further, the finding of increased ARIs prevalence in children under five in less educated mothers in the present study is supported by the past studies of Savitha and Gopalakrishnan[14] and Ghimire et al.[15]

The ARI prevalence was greater in children whose fathers were literate (57.5%) than in children whose fathers were illiterate (41.2%). This is in contrast to the studies by Pore et al.,[13] and Ghimire et al.,[15] where the proportion of under-five children with ARIs was found to be higher in less educated fathers.

The study depicts that the prevalence of ARI in children having their fathers in a profession was 38.4%, in skilled fathers, it was 37%, in unskilled fathers, it was 53.1%, in Business or self-employed, it was 61.7%, and in the unemployed, it was 80%. Compared to a study done by Goel et al.,[5] in which the prevalence of ARI in children with the occupation of their father as laborers was 23.93%, in private service, it was 15.81%, in agriculture, it was 35.47%, in business, it was 20.51%, and in Govt. Service, it was 4.27% when compared to a study done by Ghimire et al.,[15] in which the prevalence of ARI in children whose occupation of their fathers were unemployed was 50%, which is lesser than the present study.

Contrary to our findings, the study done by Goel et al.,[5] revealed a lesser percentage of under-five children with ARI in socioeconomic class III, which was 20.94%, but a slightly similar proportion of children with ARI was revealed in socioeconomic class V, that is, 35.89%, which is at par with our study.

The present study shows that the frequency of ARI in children aged <12 months is 55.4%, unlike 46.9% in children aged >12 months. As compared to the studies by Goel et al.,[5] and Kumar et al.,[16] the authors revealed a greater percentage of under-five children with ARI in >12 months of age (58.11% and 57.7%, respectively), unlike the present study. Furthermore, as found in the studies by Murarkar et al.,[4] Savitha and Gopalakrishnan[14], and Ghimire et al.,[15] it was revealed that younger children had a higher predisposition for ARI occurrence as compared to older children under the age of five.

Regarding the type of family distribution in the studied under-five children, the majority of them (52.2%) belonged to a nuclear family and the remaining 47.7% hail from a joint family. This is in contrast to the studies by Murarkar et al.,[4] and Ghimire et al.,[15] where a greater proportion of children before completing their 5th birthday belonged to joint families (58.4% and 50.3%, respectively).

In the present study, the prevalence of ARI was greater in male under-five children (58.1%) than female children (38.9%). Similar observations are supported by the studies conducted by Goel et al.,[5] Kumar et al.,[16] Murarkar et al.,[4] Savitha and Gopalakrishnan[14], and Ghimire et al.,[15] where they found a higher percentage of ARI among male

counterparts under five with 53.84%, 62.9%, 51.4%, 50.6%, and 62.3%, respectively.

The present study revealed that the frequency of ARI was greater in the houses where overcrowding was present (57.3%) than in the houses where overcrowding was absent (40%). This finding matches the results of studies by Goel et al.,[5] Kumar et al.,[16] Kiranmai et al.,[17] and Ghimire et al.,[15] who all found that a higher percentage of children under five with ARI lived in houses with too many people in them. The percentage of under-five children with ARI was found to be lower in overcrowded houses, as done in the studies by Murarkar et al.,[4] and Savitha and Gopalakrishnan[14] where they reported that 49.12% and 42.3% of under-five children with ARI had overcrowding in their houses, respectively.

In the present study, the percentage of children under-five children with ARI was higher in the ill-ventilated houses (65.4%) than in the well-ventilated houses (30.5%). This finding backs up the results of studies by Goel et al.,[5] Kiranmai et al.,[17] and Ghimire et al.,[15] who all found that a higher percentage of children under five with ARI lived in houses with poor ventilation (74.35%, 90.3%, and 68.1%, respectively). However, Murarkar et al.,[4] and Savitha and Gopalakrishnan[14] observed a lesser percentage of under-five children in ill-ventilated houses, which was 50.6% and 39.7%, respectively.

The study depicts that the prevalence of ARI in smokeless types of chulha is 80.7%, unlike a lesser percentage in smokeless types of chulha in houses (20.2%). This observation is in contrast to the studies done by Goel et al.,[5] and Murarkar et al.,[4] which reported a higher percentage of under-five children with ARI in the smokey type of chulha. In a study by Savitha and Gopalakrishnan[14], the proportion of children having ARI in the smoke type of chulha was 48.6%, which is higher as compared to the present study. Whereas, Ghimire et al.,[15] results are in line with what our study found, as the authors found that there were more children under five with ARI in houses with smokeless types of chulhas (72.5%) than in houses with smokey types of chulhas (50%).

According to the study, the prevalence of ARI in semi-pucca and kutcha types of houses is 43.8%, and in pucca types of houses, it is 54%. This is higher than the prevalence of ARI in semi-pucca and kutcha types of houses observed in a study by Savitha and Gopalakrishnan[14] which was 50.3%. In a study done by Ghimire et al.,[15] the prevalence of ARI in semi-pucca, kutcha, and pucca-type houses was nearly 60%, which is a higher percentage as compared to the present study.

Limitations of the study

The other factors associated with ARIs, such as parental smoking history, and family history of ARIs, were not assessed in the present study. The results of the study can be extrapolated to the accessible population of under-five children residing in the selected AWCs of the Badagaon block in the rural field practice area of our tertiary care institute and not to the whole under-five population of Jhansi.

CONCLUSION

According to the present study, the significant social and demographic factors responsible for ARIs in under-five children have been the educational level of the parents, the working status of the fathers, the type of family, and the gender of the studied children. Regarding the significant environmental housing factors associated with ARIs, the study depicts that a higher proportion of children with ARIs were present in overcrowded and ill-ventilated houses. The prevalence of ARI among the group of children under the age of five, as observed in this study, is noteworthy. The study's findings underscore the significance of enhancing sociodemographic indicators and housing conditions as effective measures for preventing ARI in children. By addressing these factors, the burden on the healthcare infrastructure, resulting from the morbidity and mortality associated with ARI in children, can be alleviated.

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Authors' Contributions:
AmP- Definition of intellectual content, literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation; **SC** - Concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision; **MB and AdP**- Design of study, literature survey, statistical analysis and interpretation, manuscript preparation, review and submission of article.

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