International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Original Research Article

Seasonal Epidemiology of Acute Respiratory Infection among the Children in Kashmir Himalayan Region-India

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ABSTRACT

The study was carried to analyse the seasonal dynamics of respiratory infections among the children of Sopore Baramulla J&K North India. The study was prospective cross-sectional. The parents with their ailing children visiting to the pediatricians at Sub-District Hospital and Private Health Care clinics were questioned from1 June 2016 to 1 May 2017. Information regarding different socio-economic variables were also collected and noted on predesigned well-structured questionnaire in order to find the association between respiratory infections and variable socio-economic parameters. The obtained data was analyzed by Statistical Package for the Social Sciences (SPSS) software by adopting suitable statistical methods in order to find the association between the respiratory illness and socio-economic variables. During the clinical investigation, high cases of acute respiratory infection were diagnosed which constitutes 57.14% to wheezing associated with Lower Respiratory Tract Infection (WALRTI), followed by Bronchiolitis 28.57 % and Bronchopneumonia with 14.28%. The highest cases were found during winter and spring 44.34% and 32.60 % respectively within the age group of <6 years. The study also revealed that the highest cases were from rural areas 87.3 % of the total respondents with high cases of acute respiratory infections (ARI) in winter and spring season below the age groups 6 years.

Key Words: Seasonal appraisal, Socio-economic, Relative humidity, Lower respiratory tract infections.

INTRODUCTION

Seasonal variations in temperature, rainfall and resource availability are ubiquitous and can exert strong pressures on population dynamics. Infectious diseases provide some of the best-studied examples of the role of seasonality in shaping population fluctuations. Empirical evidence points to several biologically distinct mechanisms by which seasonality can impact host-pathogen interactions, including seasonal changes in host social behaviour and contact rates, variation in encounters with infective stages in the environment, annual pulses of host births and deaths and changes in host immune defenses. [1] Nine million children under 5 years of age die annually with lung diseases being the most common cause of these deaths. Pneumonia is the world's leading killer of young children. [2] Asthma is the most common chronic disease, affecting about 14 % of children globally and rising, no organ is more vital and no organ is more vulnerable

than the lung. [3] Being unable to breathe is one of the most distressing feelings one can witness. The lungs are the largest internal organ in the body and the only internal organ that is exposed constantly to the external environment. Everyone who breathes is vulnerable to the infectious and toxic agents in the air. While respiratory disease causes death in all regions of the globe and in all social classes, certain people are more vulnerable to environmental exposures than others. [4] Influenza is one of the most deadly of all airborne and upper-respiratory infections. On an average, 22,000 deaths and over 3 million hospitalizations in USA are attributed to influenza each year. The distinct seasonality of influenza suggests a climate connection. [5] According to Central Bureau of Health Intelligence India deaths due to respiratory causes rose up to 17.2 % in 1998, against 14.4 % in 1993. [6] Rank-wise distribution of all diseases during 1971-991, asthma and bronchitis were the leading causes in the three decades accounting about 9-11 % of all deaths. Tuberculosis (TB) was the third most killer during this time, which constitute about 5-6percent of all deaths. [7] Different aspects of climate such as humidity, amount of rainfall and temperature changes were related with URTI and LRTI during different months along with factors such as time of birth, age of the child, family size in relation to the prevalence of URTI and LRTI. [8] The effect of socio-demographic and nutritional factors on lung functions of African children is poorly studied, this study set out to determine the effects of these factors on lung functions of Nigerian school children. [9] Acute respiratory infection (ARI) is the major cause of mortality among children aged less than 5 years, especially in developing countries like India. [10] ARI poses a major challenge to the health system in developing countries because of high morbidity and mortality, it is estimated that together in Bangladesh, India, Indonesia, and Nepal accounts 40percent of the global ARI mortality. [11] Interestingly infants living in overcrowded surroundings and suboptimally breast-fed are more likely to suffer ARI related illnesses. [12] In India, ARI accounts for 30-50percent of visits to health facilities and 20-40percent of hospital admissions. [13] In urban slum areas, ARI constitutes over two-thirds of all childhood illnesses, despite these statistics majority of the reported evidences underestimate the actual burden of ARI in the community. [14] Hence, continued understanding of ARI prevalence and associated risk factors is essential. However, estimating the morbidity burden has inherent challenges due to lack of uniformity in study definitions, spectral nature of illness and misclassification errors. [15]

LITERATURE REVIEW

During the pre-historic times, ill health was considered to merely to a biological phenomenon. With the emergence of various experts from different fields such as Medical Geography, Sociologist and Anthropologist the concept of biological phenomenon got interlinked with the different existing physical and social environment. An enormous amount of work is being carried out by concerned experts on the existing physical and social environment on human health. Medical geography is one of the prime fields regarding the evaluation of existing physical and social environment on human health over a period of time and space. Impacts of seasonal changes in temperature, precipitation and relative humidity have a strong influence on the health of children along with varied socio-economic setup. Respiratory illness, especially among children, is seen to be the prime consequent from the fluctuation of seasonal changes in weather elements (temperature, precipitation and relative humidity). ARI among children being the serious concern globally has gain lot of attention from the researchers of every corner of the world to work on this.

MATERIALS AND METHODS

Study Area: The study has been carried in Sopore Baramulah J&K North India a Himalayan region of state of J&K, which is renowned for apple production and is also known as Apple Town . The Sopore town lies with geographical coordinates of $34^0 30^/$N and $74^0 47^/$ E. The total area of the study area is approximately estimated to 320 sq.kms. The total population of the region is 69498 persons sharing 6.89 percent of the total district with 9711 population between the age group of 0-6 years constitutes 13 percent of the total population with 52.10 per cent of children male population (census 2011).

Cohort cross-sectional study of patients below the age of 15 years was clinically investigated during their visit to Sub-District Hospital and at a Private Clinical set ups in the year 2017. Information related to existing socio-economic variables were collected from visitors were collected through a well-structured questionnaire in order to find an association with respiratory illnesses among children. During interviewing respondents special care has been maintained in order to obey the hospital ethics and saving time to the huge flow of parents or visitors. Sizeable samples were selected for interviewing, out of 26326 cases diagnosed with respiratory illness in a given calendar year, only 4 percent which constitutes 1050 visitors whose wards were diagnosed with respiratory illness were interviewed after their consent through predesigned questionnaire with filled variables such as family size, place of residence, caste, occupation, monthly income, mothers education, behavioral approaches such smoking, energy using for cooking washing hands after sneezing, covering mouth at the time sneezing, breastfeeding etc. The weather data which include temperature, rainfall and relative humidity was collected from weather station Kupwara which lies at the proximity to the study area. The data obtained was accessed in SPSS software for necessary statistical measures such as correlation matrix, odd ratio, standard error, Z value and level of significance in SPSS software.

RESULTS AND DISCUSSION

Table I highlights the incidence of acute respiratory infection among children who were clinically investigated during the year 2017. Highest patients were recorded in the winter and spring season i.e. 44.34 percent and 32.60 percent respectively. The reason behind the highest concentration in winter may be highly contributed low temperature, low humidity, poor ventilation, biomass burning, burning of charcoal from the residues of leaves and twigs from the orchards are significant factors contributing polluted atmosphere resulted in high amount of particulate matter and black carbon in the valley particularly during November and December months which in turn have significant impact on human health. While in spring season pollens mainly from various allergen pollens contribute to this cause such as grasses, cotton dispersion in the late spring highly conducive for respiratory infection especially among children as their immune system is weak and developing stage. During summer percentage of respiratory infection shows a decline trend with least patients visiting hospitals i.e. 8.12 percent of the total. During summer temperature improves with average temperature of 29.5 ^{0}C. Although during summer least rainfall is witnessing in the whole valley and a sharp increase in relative humidity which is conducive for the growth of mites and dust which in turn infiltrate through respiratory tract cause various inflammatory problems. Autumn season mainly dusty season in the valley with very least rainfall, a high concentration of aerosol in the atmosphere also shows an increased flow of patients i.e. 14.92 percent. The table also highlights the type of respiratory diseases mainly affecting the children in particular seasons. 57.14 cases of wheezing associated with Lower respiratory tract infection were diagnosed among children in the given calendar year 2017 with highest proportion rate in winter and

spring i.e. 47.47 percent and 31.92 percent, followed by Bronchiolitis with 28.57 percent while as 14. 28 percent children's were diagnosed with bronchi pneumonia.

Table I Seasonal Dynamics of Acute Respiratory Illness

Seasons	Average Temperature 0C		Average Diurnal range	Average rainfall (mm)	Average Relative Humidity	Acute Respiratory Infections			
	Maximum	Minimum				Wheezing Associated with LRTI (%age)	Bronchiolitis (%age)	Broncho pneumonia (%age)	Total (%age)
Winter	9.1	-1	10.1	296.6	60.37	7142 (47.47)	3017 (40.1)	1515 (40.28)	11674 (44.34)
Spring	20.7	8.2	12.2	289.1	61.73	4802 (31.92)	2556 (33.98)	1226 (32.59)	8584 (32.6)
Summer	29.5	17.2	12.3	132	79.41	945 (6.28)	785 (10.43)	410 (10.9)	2140 (8.12)
Autumn	23.5	6.6	16.9	27.4	63.45	2154 (14.31)	1164 (15.47)	610 (16.21)	3928 (14.92)
Total						15043 (57.14)	7522 (28.57)	3761 (14.28)	26326

Source: Weather Station Kupwara, Clinical investigation.
* LRTI=Lower Respiratory Tract Infection

Table II Correlation Matrix between meteorological parameters & respiratory illness

Parameters	Avg. Tempt.	Avg. Rainfall (mm)	Avg. RH	Wheezing (LRTI)	Bronchiolitis	Broncho Pneumonia	Total
Avg. Tempt.	1	-0.558	0.839	-0.931	-0.928	-0.888	-0.912
Avg. Rainfall (mm)	-0.558	1	-0.399	0.820	0.563	0.861	0.842
Avg. RH	0.839	-0.399	1	-0.775	-0.972	-0.779	-0.778
Wheezing (LRTI)	-0.931	0.820	-0.775	1	0.900	0.992	0.998
Bronchiolitis	-0.928	0.563	-0.972	0.900	1	0.896	0.900
Broncho Pneumonia	-0.888	0.861	-0.779	0.992	0.896	1	0.998
Total	-0.912	0.842	-0.778	0.998	0.900	0.998	1

Table II shows the correlation matrix between the different meteorological parameters and respiratory illness among children. As the table shows a strong negative relationship between avg. temperature and all respiratory illness which means if temperature decreases respiratory illness will increase and vice versa, while as diseases shows positive relationship with average rainfall which indicate that more the precipitation more is the prevalence of respiratory diseases as in both the cases i.e. lower temperature and maximum rainfall people prefer to be more inside with less ventilation makes them susceptible to infectious diseases such as respiratory infection. The study also showed the negative relationship of respiratory illness with relative humidity. As the studies suggest lower relative humidity will influence the respiratory infection more as compared to higher relative humidity. Low relative humidity favours the growth of the respiratory virus.

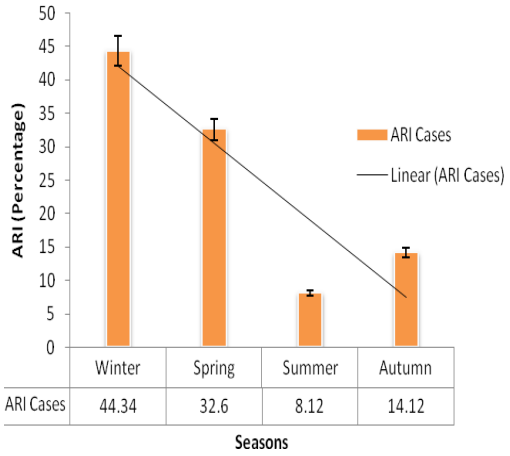

Fig I Seasonal Dynamics of Acute Respiratory Illness

Table III shows the distribution of children diagnosed with various respiratory infections of different age groups and gender. Bronchiolitis was mainly diagnosed in the age group of 0-2 years and showed a declining rate with increase in age in all seasons. Wheezing associated LRTI and Bronchopneumonia was also found high in the age group of 0-2 years and decrease with the increase in age. Male children were found more susceptible to respiratory illness

due to their biological set up. The highest incidence was witnessed in the winter (44.34 percent) and spring (32.60 percent) seasons with temperature dips to -0^0C and poor ventilation burning of twigs and leaves of trees in winter season resulted in the higher consumption of carbon. In the spring high disperse of allergen pollen in the air also contributes to causing of respiratory infection about 32.46 percent. Summer season with moderate climate incidence of respiratory infections was found less 8.12 percent of the total while as in autumn season sharp rise in the incidence rate of 14.92 percent. Autumn season mainly harvesting season in the whole Kashmir valley and probably the driest of all which resulted in lot of a dust in the lower layer of atmosphere from all around. The table also shows the higher incidence cases of respiratory infections in male children as mainly in their biologically set up are more vulnerable to infectious diseases.

Table III Age and Gender wise distribution of types of acute respiratory infection

Seasons	Age groups	Wheezing associated with LRTI (%age)			Bronchiolitis (%age)			Broncho pneumonia (%age)			Total (%age)
		M	F	T	M	F	T	M	F	T	
Winter	0-2	2242 (54)	1914 (46.0)	4156 (49.58)	1685 (55.86)	1332 (44.14)	3017 (35.99)	638 (42.82)	570 (47.18)	1208 (14.41)	8381 (71.79)
	3 to 6	1512 (51.2)	1439 (48.8)	2951 (90.71)	0	0	0	174 (57.61)	128 (52.39)	302 (9.29)	3253 (27.86)
	7 to 10	19 (79.16)	5 (20.84)	24 (82.75)	0	0	0	3 (60)	2 (40)	5 (17.25)	29 (0.24)
	11 to 15	8 (72.6)	3 (27.2)	11 (0.09)	0	0	0	0	0	0	11 (0.09)
Total		3781 (52.95)	3361 (47.05)	7142 (61.17)	1685 (55.86)	1332 (44.14)	3017 (25.84)	815 (53.79)	700 (46.21)	1515 (12.97)	11674 (44.34)
Spring	0-2	1351 (53.58)	1170 (46.42)	2521 (43.66)	1415 (65.36)	1141 (44.64)	2556 (44.27)	362 (52.02)	334 (47.98)	696 (12.05)	5773 (67.25)
	3 to 6	1241 (54.77)	1025 (45.23)	2266 (81.31)	0	0	0	279 (53.55)	242 (46.45)	521 (18.69)	2787 (32.46)
	7 to 10	7 (77.7)	2 (22.3)	9 (64.28)	0	0	0	3 (60)	2 (40)	5 (35.72)	14 (0.16)
	11 to 15	5 (83.34)	1 (16.66)	6 (60)	0	0	0	2 (50)	2 (50)	4 (40)	10 (0.11)
Total		2604 (54.23)	2198 (45.77)	4802 (55.94)	1415 (65.36)	1141 (44.64)	2556 (29.77)	646 (52.7)	580 (47.3)	1226 (14.28)	8584 (32.60)
Summer	0-2	303 (57.22)	222 (42.28)	525 (33.98)	432 (65.04)	353 (44.96)	785 (50.80)	129 (54.89)	106 (45.11)	235 (15.21)	1545 (72.19)
	3 to 6	232 (57.01)	175 (42.9)	407 (71.90)	0	0	0	85 (53.46)	74 (46.54)	159 (28.10)	566 (26.44)
	7 to 10	5 (62.5)	3 (37.5))	8 (44.5)	0	0	0	6 (60)	4 (40)	10 (55.5)	18 (0.84)
	11 to 15	2 (40)	3 (60)	5 (45.45)	0	0	0	4 (66.67)	2 (33.33)	6 (54.55)	11 (0.51)
Total		542 (57.35)	403 (42.65)	945 (44.15)	432 (65.04)	353 (44.96)	785 (36.68)	224 (54.64)	186 (45.36)	410 (19.15)	2140 (8.12)
Autumn	0-2	674 (55.66)	537 (44.34)	1211 (43.79)	642 (55.16)	522 (44.84)	1164 (42.09)	202 (51.80)	188 (48.20)	390 (14.10)	2765 (70.39)
	3 to 6	484 (53.31)	424 (46.69)	908 (81.66)	0	0	0	115 (56.38)	89 (43.62)	204 (18.34)	1112 (28.30)
	7 to 10	15 (62.5)	9 (37.5)	24 (75)	0	0	0	5 (62.5)	3 (37.5)	8 (25)	32 (0.81)
	11 to 15	8 (61.54)	5 (38.46)	13 (72.23)	0	0	0	3 (60)	2 (40)	5 (27.77)	18 (0.45)
Total		1179 (54.74)	975 (45.26)	2154 (54.83)	642 (55.16)	522 (44.84)	1164 (29.63)	325 (53.28)	285 (46.72)	610 (15.52)	3928 (14.92)

Source: Sub district hospital Sopore, Private clinic Sopore

*M=Male,*F= Female, LRTI= Lower Respiratory Tract Infection, T= Total

Table IV revealed the association of ARI with different socio-economic and behavioural variables. The data was generated by interviewing inwards who were visiting a private clinic along with their ailing kids below the age of 15 years. The prevalence of Acute Respiratory Infection is observed in all socio-economic groups, but the prevalence rate was found high in low socio-economic status. Table 3 indicates that most of the variables of in our model are highly significant at 5 % level of significance. Residence, sex, parental education, income, house type, family size, the source of energy used for cooking, behavioural attitude (smoking) have a

negative impact on ARI with an odd ratio greater than 1 significance that there is a difference between presence and essence of events .The table shows the percentage of ARI cases decreases from rural to urban areas as mainly their more disciplined approaches towards the behavioural attitude. Male sex group were found more vulnerable than their opposite counterparts as males are biologically more to infectious diseases with odd's ratio 2.33. The table also revealed that behavioural attitude of parents or other family members such as smoking mainly around their family shows a high percentage of ARI incidences among their children. As there is structural transformation from primary to secondary and tertiary sector, the percentage of people having chances of ARI decreases. Likewise as educational standard and level of income of the respondent's increases, the chances of ARI decreases. Same is the case with house type and as the number of people residing in pucca houses increases the percentage of people having ARI decreases. Insane behavioural activities such as smoking inside the room around the family especially children around, and unacceptable measures after sneezing such as open mouth sneezing, rarely washing their hands showed high positive relation associated with various respiratory illness among children as shown as reveled during scheduled interview to the respondents.

Table IV Relationship between socio-economic variables and acute respiratory infection (ARI)

Socio-economic Variables	Total Respondent	Prevalence of ARI (%age)	Odds ratio	Standard Error	Z Value	Level of Significance (P Value)
Place of Residence	N					
Rural	670	585 (87.3)	2.46	0.009	1.44	5%
Urban	380	280 (73.6)				
Total	1050	865 (82.3)				
Caste						
Upper	590	423 (71.6)	0.105	0.016	-1.92	5%
Lower	460	442 (96.0)				
Total	1050	865 (82.3)				
Sex						
Male	550	485 (88.1)	2.33	0.008	1.35	5%
Female	500	380 (76.0)				
Total	1050	865 (82.3)				
Parental Education						
Illiterate	450	429 (95.3)	1.84	0.005	-0.28	5%
Middle	273	249 (91.2)				
Secondary	195	120 (61.5)				
Graduation & above	132	67 (58.6)				
Total	1050	865 (18.0)				
Fathers Occupation						
Primary	512	612 (66.55)	0.63	0.016	-0.66	5%
Secondary	345	443 (74.95)				
Tertiary	NIL	NIL				
Total	1050	126 (82.3)				
Monthly Income						
<7k	371	338 (91.1)	1.29	0.013	0.14	5%
7k-30k	509	442 (80.5)				
>30k	170	117 (68.8)				
Total	1050	865 (82.3)				
House Type						
Kachha	623	554 (88.9)	2.99	0.01	1.53	5%
Pucca	427	311 (72.8)				
Total	1050	865 (82.3)				
Family Size						
Joint	495	465 (93.9)	5.6	0.013	1.8	5%
Nuclear	545	400 (73.3)				
Total	1050	865 (82.3)				
Breast feeding						
Yes	585	415(70.9)	0.08	0.017	1.97	5%
No	465	450 (96.7)				
Total	1050	865 (82.3)				
Separate Kitchen						
Yes	327	201 (61.4)	0.14	0.621	-0.38	5%
No	723	664 (91.8)				
Total	1050	865 (82.3)				

Table IV to be continued…						
Source of energy used for cooking						
Burning of twigs and cow dung	565	545 (96.4)	1.66	0.024	0.74	5%
LPG	485	278 (57.3)				
Other	NIL	NIL				
Total	1050	865 (82.3)				
Behavioral Attitude (Smoking)						
Yes	486	452(93.0)	4.86	0.013	1.82	5%
No	564	413 (73.2)				
Total	1050	865 (82.3)				
During Sneezing covering mouth						
Hands	519	344 (66.28)	0.037	0.021	-2.2	5%
Open	531	521 (98.1)				
Total	1050	865 (82.3)				
Washing hands after sneezing						
Yes	464	283 (60.9)	0.01	0.026	-2.38	5%
No	586	582 (99.3)				
Total	1050	865 (82.3)				

Source: Based on respondents interviews 2017 at private clinic

CONCLUSION

Acute respiratory infection intimately related to both physical and socio-economic factors. Physical factors such as seasonal fluctuation in weather elements (Temperature, Rainfall, Humidity), while as socio-economic factors such as (residence, sex, occupation, parental education, income, housing type, family size and different behavioral approaches) etc have strong influence on the incidence of ARI among all age groups and children in particular as their weak immune system. The present study concludes that a strong association was found between different physical and socio-economic parameters with the incidence of ARI among children below the age of 15 years. The study revealed that higher incidence of respiratory infections among children's were in winter and spring season mainly due to low temperature and poor ventilation in winter with more carbon generating sources to keep themselves warm in the chilly winter and during spring season mainly due to disperse of allergen pollens from the flora such as Cynodon dactylon, Zea Mayus, Morus alba, Robinia pseudoacacia, Populus alba and Platanusntalis etc. which were found predominant in large no. in the study area. The incidence of respiratory infections such as wheezing associated with LRTI and Bronchi pneumonia were found higher in the lower age groups between >6 years while as cases of bronchiolitis were mainly found in the age group >2 years and shows no such signs in the above age groups. The study also shows that there is strong association of respiratory infections with different socio-economic variables such as residence, sex, parental education, parental occupation, income, housing type, family size, breastfeeding and behavioural attitude such as smoking around the family, approach adopted during sneezing, washing hands etc. in the study it was found that high cases of incidence were diagnosed from rural areas with more or less low standards of living, traditional values, lack of perception related to various life issues. Similarly, cases were higher in lower income groups, unlettered respondents (lacking education, kachha houses, and joint family) shows higher cases of respiratory infections among their offsprings. Besides this behavioural attitude such as insane smoking habits and open sneezing around family members including children's, unhygienic approaches show higher incidence. The study also revealed that mothers who were adopting breastfeeding to their young ones show fewer signs of infectious diseases as compared to non-lactating mothers whose children's were more susceptible to respiratory illnesses.

As it is not possible to change the natural phenomena such as seasonal dynamics but with rational approaches as viewed by neo deterministic approach we can cope up with many natural challenges

provided how rational we go. Children's must be avoided as much as possible to the infectious environment. Maintaining better hygiene both inside and outside can eradicate the burden of respiratory infections. The study also recommended the rational behavioural attitude such as skip smoking as much as possible mainly around the family, cover mouth during sneezing and washing hands of their young ones and habit of breastfeeding albeit with some limitations. The government should make necessary programs to make aware illiterate parents, raise their standards by providing suitable jobs so they will generate more income and vice verily spend more on their family benefits.

Abbreviations:
SPSS: Statistical Package for the Social Sciences
ARI: Acute Respiratory Infections
LRTI: Lower Respiratory Tract Infections
URTI: Upper Respiratory Tract Infections

Conflict of Interest: None

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How to cite this article: Wani MA, Mayer IA, Naik S et.al. Seasonal epidemiology of acute respiratory infection among the children in Kashmir Himalayan region-India. Int J Health Sci Res. 2019; 9(2):203-210.

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