



Original Research

Prevalence of Respiratory Syncytial Virus Among Children in Dhamar Governorate, Yemen

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Abstract

Background: Respiratory syncytial virus (RSV) is a significant cause of respiratory illness in pediatric populations worldwide.

Aim: This study aims to determine the prevalence of RSV among children under two years of age with respiratory tract infection in Dhamar Governorate and evaluate related risk factors.

Methods: The study, conducted at various hospitals and centers in Dhamar Governorate, enrolled 130 children under two years of age with signs and symptoms of respiratory tract infection from January 2020 to December 2020. A pre-designed questionnaire was used to collect data on Sociodemographic information, symptoms, and risk factors such as age, sex, birth weight, breastfeeding, and presence of other medical conditions.

Results: showed that RSV was detected in 36.9% of the patients, with females being more affected than males. Most RSV-infected children were in their first eight months of life, and an association was found between the presence of smokers among family members, birth weight, breastfeeding, number of siblings, lung disorder, and family medical history, and RSV infection. Further analysis revealed significant associations between RSV infection and risk factors such as lung disorders and family medical history. Symptoms commonly exhibited by RSV-infected patients included cough, fever, wheezing, difficulty breathing, sore throat, runny nose, and blue lips. Environmental factors such as passive smoking, number of siblings, and family medical history of respiratory infections were identified as potential risk factors for RSV infection. Seasonal variations in RSV prevalence were also observed, with higher rates during certain months.

Conclusion: the prevalence of RSV among children with respiratory tract infection in Dhamar Governorate is relatively high, with several risk factors influencing infection rates.

Keywords: Respiratory Syncytial Virus, Children, Respiratory tract Infection, Dhamar Governorate, Yemen.

1. Introduction

Respiratory syncytial virus (RSV) is a significant cause of respiratory illness worldwide in pediatric populations (1). The virus was first isolated from chimpanzees with coryza in 1955 and later from infants and children during a bronchiolitis epidemic in the early 1960s Humans are the only host for RSV (2). It is generally believed that most children will have experienced at least one RSV infection by the age of 2 years. During their first year of life, 68 % of

the infants experienced a RSV infection; by the end of the second year, almost all children had been infected with RSV at least once (3, 4). Respiratory syncytial virus belongs to the Pneumovirus family and Orthopneumovirus genus (5). There are two antigenic subtypes, A and B (6). It is a non-segmented negative-sense single-stranded enveloped Ribonucleic Acid (RNA) virus, its 10 genes encode 11 proteins (7). While there are animal RSV strains, humans are the only reservoir for human RSV infection. Transmission of the virus occurs commonly through direct

or close exposure to infected secretions (8).

The virus can survive six hours or longer on hard surfaces and 20 min on skin (9, 10). Respiratory syncytial virus infection is a seasonal illness with onset and offset, duration, and peak varying annually. The season further varies by geographic region; in the northern hemisphere, it usually lasts from November to April (11). Currently, palivizumab is the only immunoprophylaxis (IP) available to prevent severe RSV in specific high-risk pediatric populations (8). This study aimed to determine the prevalence of RSV infection in children and evaluate the application of prevention measures and some risk factors associated with respiratory syncytial virus infection to avoid infection among families in the Dhamar governorate.

2. Subjects and Methods

Study Design, population and Area

The study was a cross-sectional descriptive prospective study conducted in various hospitals in Dhamar, Yemen, from January to December 2020. A total of 130 children under 2 years of age with Acute Respiratory Infections (ARI) General Dhamar hospital, Al-wehdah hospital, Dr. Mohammed almosaly hospital, Taiba consultative hospital, Dr. Mohammed Khalid hospital, Dr. Nabil almwald specialized Center, Alshefa Sari Medicine Center and Dr. Mohammed Maias Center, Dhamar governorate were included in the study. Acute respiratory infections are highly prevalent in Dhamar during this period of the year, which correspond to the winter and the spring. The rainy season in Dhamar is mainly during the summer with scattered rainy days during the winter.

Sample size

The sample size was calculated assuming that the expected prevalence of RSV in children with respiratory symptoms is 70% accordingly, the sample size required is 130 children (12).

Data Collection

Data collection included information on the children's demographics, feeding, residence, medical history, and presence of smokers in the family.

Source of participants

Participants were recruited from the emergency and accident unit (E/A), the pediatrics outpatients' clinic (OPD), the pediatric medical ward (PMW) and the private PMW (PPMW) in the above-mentioned hospitals.

Criteria for inclusion of patients

Patients aged from 1 to 24 months with a clinical diagnosis of acute lower respiratory tract infections (ALRTI) or mild upper respiratory tract infections (MURTI) were selected.

Specimen's collection

Nasopharyngeal swabs and blood samples were collected from the participants for laboratory analysis.

Specimens must be tested as soon as they are collected. If necessary, they may be stored at (2-8°C for up to 24 hours. The serum or plasma samples could be stored refrigerated (2-8°C) for up to 7 days. For a longer storage they should be kept at -20°C. The samples should not be frozen and thawed repeatedly.

Laboratory analysis

Rapid and qualitative detection of Respiratory Syncytial Virus Antigen (RSV, Ag) infection Nasopharyngeal swabs (Asan Easy Test®, Korea) Antigen (Rapid Test)and, Enzyme-linked immunosorbent assay (ELISA) The RSV IgM Antibody ELISA Test Kit (IFU DERSV03) has been were used for the detection and the quantitative determination of specific IgM antibodies against Respiratory syncytial virus in serum and plasma.

Statistical analysis

All of the statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS; version 23). Categorical variables were compared using chi-square test (χ^2) = 3.8 or more is significant. Multivariate analysis was performed using logistic regression to determine the Probability value ($P \leq 0.05$) was considered statistically significant odds ratios (OR) Risk occurred if relative risk is more than 1

Ethical Consideration

Approval for this study was obtained from the studies Center Committee that belong to the Faculty of Medicine, Dhamar University. In addition, agreement was made with the owner of one of these hospitals, as it is a private hospital.

3. Results

As shown in Table 1, shows the prevalence of Respiratory Syncytial Virus among children in which specimens of 130 children under two years with lower respiratory tract infection in Dhamar Governorate were examined by rapid test Ag and ELISA kit IgM Ab were forty-eight (36.9%) children were positive and eighty-two (63.1%)were negative.

Table 1: Prevalence of Respiratory Syncytial Virus among Children under two years with Lower Respiratory tract Infection in Dhamar Governorate by Rapid test Ag and Elisa kit IgM Ab

		Type of test / Results	Percent (%)	Frequency (No)
Rapid test (Ag)	Positive		36.9	48
	Negative		63.1	82
	TOTAL		100.0	130
Elisa Kit (IgM)Ab	Positive		36.9	48
	Negative		63.1	82
	TOTAL		100.0	130

Table 2 shows the sex, Age(month), Weight (Kg) and Lactation distribution of children under two year old suffering from respiratory tract infection in Dhamar Governorate. in which 28 (35.90%) were males and 20 (38.50%) were females, were in the age group 1-4 months of whom 12 (36.40%) While, in the age group 5-8 months there were a total of 19 (48.70%) positive cases but children in the age group 9-12 months, there were 15 (31.90%) whereas out of 0 (0.0%) in the age group 13-16 and 17- 20 months In the last age group 21-24 there were

2 (28.60%) children. in which out there were of 8 (50.00%) were in the weight group 2.0-4.0 Kg of whom 15 (41.70%) While in the weight group 5.0-7.0 Kg, there were a total of 22 (44.00%) but children in the age group 8.0-10 Kg, there were 3(13.00%) whereas out of 11-13 Kg, in the weight group 14-16 kg 0 (0.00%) children. there were 16 (27.10%) with natural lactation, but there were 15 (60.00%) with artificial lactation, while there where 17 (37.00%) children with both natural and artificial lactation (P = 0.02).

Table 2: The Host Factors distribution of children under two year old suffering from Respiratory Tract Infection in Dhamar Governorate.

Variable Types			Rapid test (Ag) and Elisa kit (Ab)		Total	χ^2	df	P
			Positive	Negative				
Sex	Male	N	28	50	78	0.088	1	0.76
		%	35.90	64.10	100.00			
	Female	N	20	32	52			
		%	38.50	61.50	100.00			
	TOTAL	N	48	82	130			
%	36.90	63.10	100.00					
Age (month)	1-4 Months		12	21	33	5.39	5	0.37
			36.40%	63.60%	100.00%			
	5-8 Months		19	20	39			
			48.70%	51.30%	100.00%			
	9-12 Month		15	32	47			
			31.90%	68.10%	100.00%			
	13-16 Month		0	1	1			
			0.00%	100.00%	100.00%			
	17-20 Month		0	3	3			
		0.00%	100.00%	100.00%				
21-24 Month		2	5	7				
		28.60%	71.40%	100.00%				
TOTAL		48	82	130				
		36.90%	63.10%	100.00%				
Birth Weight (Kg)	2_4		8	8	16	11.16	4	0.03
			50.00%	50.00%	100.00%			
	5_7		15	21	36			
			41.70%	58.30%	100.00%			
	8_10		22	28	50			
			44.00%	56.00%	100.00%			
	11_13		3	20	23			
		13.00%	87.00%	100.00%				
14_16		0	5	5				
		0.00%	100.00%	100.00%				
TOTAL		48	82	130				
		36.90%	63.10%	100.00%				
Lactation	breastfeeding		16	43	59	8.15	2	0.02
			27.10%	72.90%	100.00%			
	Artificial		15	10	25			
			60.00%	40.00%	100.00%			
	Both		17	29	46			
		37.00%	63.00%	100.00%				
TOTAL		48	82	130				
		36.90%	63.10%	100.00%				

χ^2 : Chi-square = 3.8 or more is significant

P : Probability value \leq 0.05 is significant

Table 3: Some potential risk factors for Respiratory syncytial virus infection among children under two year old

suffering from Respiratory Tract Infection in Dhamar Governorate.

Variable Types	Rapid test (Ag) and Elisa kit (Ab)		Total	χ^2	df	P	
	Positive	Negative					
Heart Disorders	Yes	2 28.60%	5 71.40%	7 100.00%	0.22	1	0.63
	No	46 37.40%	77 62.60%	123 100.00%			
	Total	48 36.90%	82 63.10%	130 100.00%			
Lung Disorder	Yes	7 100.00%	0 0.00%	7 100.00%	12.6	1	Less than 0.001
	No	41 33.30%	82 66.70%	123 100.00%			
	TOTAL	48 36.90%	82 63.10%	130 100.00%			
Premature Children	Yes	2 66.70%	1 33.30%	3 100.00%	1.16	1	0.28
	No	46 36.20%	81 63.80%	127 100.00%			
	TOTAL	48 36.90%	82 63.10%	130 100.00%			

χ^2 : Chi-square = 3.8 or more is significant

P : Probability value ≤ 0.05 is significant

Table 3: shows some risk factors that increase the likelihood of being RSV positive. Out of 3 premature children, 2 (66.70%) were positive for RSV. and 7 (100.00%) out of 7 children with lung disorder was positive for RSV (P = 0.001). Out of 7 children suffering from heart disorders, 2 (28.60%) were positive for RSV.

There were no statistically significant associations between these risk factors (premature and heart disorders) and the RSV infections, but There were statistically significant associations between lung disorder and RSV infections (P= 0.001).

Table 4. Some potential symptoms for Respiratory syncytial virus infection among children under two year old in Dhamar Governorate.

Variable Type	Rapid test (Ag) and Elisa kit (Ab)		Total	χ^2	df	P	
	Positive	Negative					
Cough	Yes	48 36.90%	82 63.10%	130 100.00%	0	1	Less than 0.001
	No	0 0.00%	0 0.00%	0 0.00%			
	Total	48 36.90%	82 63.10%	130 100.00%			
Fever	Yes	48 37.20%	81 62.80%	129 100.00%	0.59	1	0.44
	No	0 0.00%	1 100.00%	1 100.00%			
	Total	48 36.90%	82 63.10%	130 100.00%			
Runny nose	Yes	42 37.80%	69 62.20%	111 100.00%	0.27	1	0.6
	No	6 31.60%	13 68.40%	19 100.00%			
	Total	48 36.90%	82 63.10%	130 100.00%			
Sore throat	Yes	44 37.60%	73 62.40%	117 100.00%	0.23	1	0.62
	No	4 30.80%	9 69.20%	13 100.00%			
	Total	48 36.90%	82 63.10%	130 100.00%			
Blue lips	Yes	21 45.70%	25 54.30%	46 100.00%	2.32	1	0.12
	No	27 32.10%	57 67.90%	84 100.00%			
	Total	48 36.90%	82 63.10%	130 100.00%			

	TOTAL	36.90%	63.10%	100.00%			
Wheezing	Yes	32	43	75			
		42.70%	57.30%	100.00%			
	No	16	39	55	2.51	1	0.11
	Total	48	82	130			
		36.90%	63.10%	100.00%			
Difficulty Breathing	Yes	43	70	113			
		38.10%	61.90%	100.00%			
	No	5	12	17	0.47	1	0.49
	Total	48	82	130			
		36.90%	63.10%	100.00%			

χ^2 : Chi-square = 3.8 or more is significant

P : Probability value \leq 0.05 is significant

Table 4: shows some potential symptoms for Respiratory syncytial virus infection among children under two year old in Dhamar Governorate. The most frequent clinical signs/symptoms were fever 48(37.20%), cough 48(36.90%), wheezing 32(42.70%), difficulty breathing

43(38.10%), sore throat 44(37.60%), and blue lips 21(45.70%). There was no significant difference between the symptoms and infection with RSV.

Table 5: Environmental factors as potential risk factors that increase the likelihood of being RSV positive among children under two year old in Dhamar Governorat

Variable Types	Rapid test (Ag) and Elisa kit (Ab)		Total	χ^2	df	P
	Positive	Negative				
Passive Smoking	Yes	29	22	51		
		56.90%	43.10%	100.00%		
	No	19	60	79	14.3	1
	Total	48	82	130		
		36.90%	63.10%	100.00%		
No. of sibling	1-2 Child	0	30	30		
		0.00%	100.00%	100.00%		
	3-4 Child	3	28	31		
		9.70%	90.30%	100.00%		
	5-6 Child	31	16	47		
		66.00%	34.00%	100.00%	51.4	4
	7-8 Child	11	7	18		
		61.10%	38.90%	100.00%		
	9-10 Child	3	1	4		
		75.00%	25.00%	100.00%		
	TOTAL	48	82	130		
		36.90%	63.10%	100.00%		
Family Medical History	Yes	33	30	63		
		52.40%	47.60%	100.00%		
	No	15	52	67	12.5	1
	Total	48	82	130		
		36.90%	63.10%	100.00%		

χ^2 : Chi-square = 3.8 or more is significant

P : Probability value \leq 0.05 is significant

Table 5. Environmental risk factors which increase the likelihood for being RSV positive among enrolled children are shown in Table (5). Among 51 child live with a smoker family member, 29 (56.90%) were positive(P = 0.001),33 (52.40%) of those who are RSV positive had family medical

history. In addition, No. of Children in the same room in group 1-2 child were with negative results for RSV infection 30(100.00%). However, the following groups of 3-4 child were 3(9.70%) , 5-6 child were 31(66.00%) , 7-8 child were 11(61.10%) and 9-10 child were 3(75.00%)

were positive for RSV infection with ($P = 0.001$).

Table 6. Prevalence of Respiratory syncytial virus in Season from 1st January to 31st December 2020 among children under two year old in Dhamar Governorat

Date	Rapid test (Ag) and Elisa kit (Ab)		Total	χ^2	df	P
	Positive	Negative				
1-31 January	13 48.10%	14 51.90%	27 100.00%			
1-29 February	2 20.00%	8 80.00%	10 100.00%			
1-31 March	1 14.30%	6 85.70%	7 100.00%			
1-30 April	0 0.00%	0 0.00%	0 0.00%			
1-31 May	0 0.00%	0 0.00%	0 0.00%			
1-30 June	0 0.00%	0 0.00%	0 0.00%			
1-31 July	0 0.00%	2 0.00%	2 100.00%	13.3	8	0.09
1-31 August	1 14.30%	6 85.70%	7 100.00%			
1-30 September	7 70.00%	3 30.00%	10 100.00%			
1-31 October	7 46.70%	8 53.30%	15 100.00%			
1-30 November	9 39.10%	14 60.90%	23 100.00%			
1-31 December	8 27.60%	21 72.40%	29 100.00%			
Total	48 36.90%	82 63.10%	130 100.00%			

χ^2 : Chi-square = 3.8 or more is significant

P: Probability value ≤ 0.05 is significant

Table (6):Shows the prevalence of Respiratory syncytial virus in Season from 1st January to 31st December 2020, in which out there were of 13 (48.10%) were in the group 1st -31st January, of whom 2 (20.00%) While, in group 1-29th February ,there were a total of 1 (14.30%), in group 1st-31st March, but was in group 1st-30th April, 1st-31st May, 1st-30th June and 1st-31st July 0(0.00%), While in

group 1st-31st August was 1(14.30%), and 7(70.00%) in 1-30 September, but in 1st-31st October group 7(46.70%), while in group 1st-30th November was 9(39.10%), and were 8(27.60%) in 1st-31st December group. It was shown RSV infection increases in cold season and decreases or disappeared in hot season.

4. Discussion

One of the main causes of morbidity and mortality in young children, particularly in the early childhood worldwide is acute lower respiratory tract infection. Many viruses are responsible for the majority of these infections in infants and children. Respiratory Syncytial Virus is the most common causative agent associated with viral respiratory tract infections especially among children (1).

In this study, the RSV infection was detected in 36.9% of children, This prevalence was lower than that reported in previous study carried out in Yemen (40%) (12), and study

in Sana'a-Yemen (44%) (13). It is recognized as an important contributor to hospitalization. Despite its importance, there is no more information on the prevalence of RSV in Yemen. Our findings thus confirm that RSV is the most frequent pathogen causing ARI in Yemen (12). The Respiratory syncytial virus was detected in (36.9%) of children. This prevalence was lower than that reported in previous study carried out in Yemen (40%) (12) and study in Sana'a-Yemen (44%) (13), and (41.0%) (14), and the highest annual prevalence of RSV was reported in Jordan (64%) followed by Pakistan (52.6%), Qatar (48.5%), Algeria (47.8%), Egypt (46.6%), and Iran

(46.1%). Among the studied countries, the highest prevalence of RSV was reported from Tunisia (87.6%), Iraq (82.5%), and Saudi Arabia (79.9%) (15). On the other hand this prevalence was higher to those found in other countries In United Arab Emirates (28.5%) (12) Mozambique (9%), Gambia (19%) and Germany (12.1%) (13) and Cameroon(33%)(16).The lowest annual prevalence of RSV was reported from Oman (1.8%) (15).

In the Table 2. there was no significant difference in the affected sex, males seemed to be less affected than females (35.90% and 38.50%) respectively. Several studies reported the sex distribution of the patients and the male predominance; on average 60% of infected children were male (range 43–88%) (10, 13, 17, 18). But, in this study results showed that RSV infection was more prevalent in female than in male. Respiratory syncytial virus infection was identified more frequently in children under 8 months of age (48.70%) and its prevalence decreased after this age. This age prevalence is similar to that reported in other studies reported by (10, 12, 16, 18, 20). In this study showed that the most likely cause for ARI in children less than 8Kg is an RSV infection was significantly higher in low weight children (16). Breast feeding (Lactation) appeared to be protective against RSV ALRI. However, the multivariate analysis found that breast feeding was not an independent protective factor. In infants <3 months of age, the absence of breast feeding in combination with crowding, smoking, and low maternal education were significant risk factor for development of RSV ALRI ($P<0.001$), the results of the following studies (8, 12, 16), were increased from this study that show significant ($P<0.02$).

In this study there was significant in children with chronic lung disease (100.0%). There is general agreement that prematurity, multiple births, Presence of chronic lung disease and congenital heart disease disorders represents major risks for RSV infection reported by these studies (20-24).The presence of smokers among the family members is found to be a risk factor for RSV infection and this is in agreement with a case control study that examined this association and reported that presence of smokers among family members increased the risk of being RSV positive 26(56.90%) (13, 25, 26).

Table 5. show significantly in number of persons sleeping in the same room(sibling) ($P< 0.001$), In a case control studies from Atlanta examining the effects of day care on ALRI hospitalization, a multivariate analysis of variables not related to care outside of the home showed that the number of persons sleeping in the same room with the child was significantly associated with ALRI hospitalization ($P< 0.001$) (12, 21, 26). Moreover, The family medical history of the children was shown in (table-5) A family medical history of other members with ARI in the time of enrolment of the child in the study were recorded more in children with RSV ($P<0.001$)that agreed by several studies (8, 16, 26). Cough and fever were common symptoms exhibited by the patients with RSV in our study, followed by blue lips, runny nose, and breathing difficulty, which is consistent with the findings of another

study (10).

Respiratory syncytial virus infection has shown to have seasonal outbreaks in many countries around the world, in countries with Mediterranean and temperate climate, RSV occurs during the relatively cold seasons, and in countries with tropical climates it occurs during the wet rainy season (10, 17,19). Respiratory syncytial virus infection positive samples in this study were unevenly distributed throughout the year between the two seasons found in Kinshasa which are the dry season that goes from June to September and the rainy season that goes from October to May, with six RSV positive samples found respectively, followed by the months of April and May which have had two RSV positive samples and lastly the month of August where only one RSV positive sample was found. During the dry season which is considered the cold season in DR Congo meaning June to September there were little to no positive sample (19, 27).

5. Conclusion

A significant number of children under the age of two with respiratory tract infections in Dhamar Governorate tested positive for Respiratory Syncytial Virus. The majority of RSV -infected children were less than eight months old. Factors such as exposure to smokers, low birth weight, breastfeeding, number of siblings, lung disorders, and family medical history were linked to an increased risk of RSV infection, while other factors did not show a significant association with RSV positivity.

6. Recommendations

The following could be recommended from this study: Considering RSV in diagnosis and treating respiratory illnesses in children under two-year age, planning of prevention and control programs for RSV infections. Distinguishing RSV infections depending on the clinical picture, especially because RSV detection is not routine in Yemen and, mothers should be received health education about the RSV transmission and the prevention of its infection.

Competing interests

The authors declare that they have no competing interests.

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