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Seasonal variations of respiratory viruses detected from children with respiratory tract infections in Riyadh, Saudi Arabia

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ABSTRACT

ARTIs have a huge impact in health systems in which 20–30% of all hospital admissions and 30–60% of practitioner visits are related to respiratory tract infections. The aim of this study is to determine the prevalence, age distribution, and seasonal variation of respiratory viruses. This study was descriptive retrospective study in which all patients 14 years of age and below who presented with signs and symptoms of ARTIs between January 2013 and December 2014 and had respiratory specimen tested by direct immunofluorescence assays for viruses identification were included in the study. During that period, a total of 4611 patients who presented with ARTIs from January 2013 to December 2014 were investigated, viruses were detected in 1115 (24%). RSV was associated with 97.4% of the total viral pathogens. Viruses were detected throughout all the two years with a peak in winter; Dec (*n*: 265), Jan (*n*: 418), Feb (*n*: 218), and Mar (*n*: 109). Viral pathogens are very important cause of ARTIs in our region. RSV was the most common virus detected with the highest detection rate in children who are two years old and below. A multi-center surveillance with more sensitive detection methods like PCR may help to provide a comprehensive understanding of virus distribution in our area, which may contribute implant an effective prevention approach for each virus.

Introduction

Acute respiratory tract infections (ARTIs) are the most common causes of both morbidity and mortality in children worldwide especially in developing countries [1].

ARTIs have a huge impact in health systems of developing countries responsible for 19% of deaths in children younger than five years of age and 8.2% of all disabilities [1].

20–30% of all hospital admissions and 30–60% of practitioner visits are related to respiratory tract infections [2–4]. ARTIs are commonly classified as upper respiratory tract infections (URTIs) and lower respiratory tract infections (LRTIs) according to the site of infection. Annual mortality of LRTIs in children younger than five years of age estimated to be 1.8 million worldwide [5]. In United States (US), pneumonia remains the leading cause of hospitalizations accounting for 70% of admissions in children younger than five years [6]. Bacteria and fungi can cause respiratory infections, however, viruses are responsible for majority of cases ranging from 40% to 50% of infections in infants and children hospitalized with pneumonia in developing countries [7]. Respiratory syncytial virus (RSV) is the most commonly detected virus among children with LRTIs [8,9]. RSV is associated with more than 100 000 pediatric hospitalizations annually in the US [10]. Other important common viruses include influenza A and B, parainfluenza viruses, adenoviruses and metapneumovirus [9].

The distribution of respiratory viruses causing ARTIs varies based on the populations, geographic areas and the socioeconomic status [9]. Identifying the prevalence of the common viruses causing ARTIs and the seasonality for these viruses in our region is essential to avoid antibiotics overuse. In Saudi Arabia, a study showed a significant misuse of antibiotics in which 74.7% of patients presented with viral ARTIs were treated with antibiotics. Therefore, further studies in developing countries including Saudi Arabia are needed to help in prevention, control, and treatment of ARTIs.

The main aim of this study is to determine the prevalence of respiratory viruses, age distribution, and seasonal variations of these viruses in patients who are 14 years of age and below both in emergency room as well as inpatient settings.

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Materials and methods

Setting and subjects

This retrospective data base review study was conducted in King Abdul-Aziz Medical City (KAMC), a tertiary hospital in Riyadh, Kingdom of Saudi Arabia. The data was collected from the microbiology data base record. We included patients who were 14 years of age and below and presented with signs and symptoms of ARTIs from January 2013 to December 2014 and had respiratory specimen tested by direct immunofluorescence assays (DFA) for viruses identification. Patients presented with ARTI more than once in a different visit of at least one month interval were re-included in the study and analyzed as different patients. DFA was performed per the manufacturer's instructions (IMAGEN, Oxoid, Cambridgeshire, United Kingdom) to identify the following viruses: respiratory syncytial virus (RSV), adenovirus (ADV), Influenza-A virus, Influenza-B virus, Parainfluenza 1–3 viruses.

Data collection

Microbiology data base record was reviewed and data were collected in the data sheet. The microbiology data collected in the data sheet included patients' demographics (medical record number, age, and gender), respiratory sample results to demonstrate the type of virus and the date for positive samples. The setting where the patients being treated whether in emergency room or inpatient ward was also recorded.

Statistical analysis

We developed data collection sheet, and data from these forms were entered into Microsoft Excel. Data were analyzed using Statistical Package for Social Science (SPSS) version 23 (SPSS Inc., Chicago, IL, USA). Descriptive data were presented as frequencies and percentages. Continuous data were analyzed using the *t*-test, and categorical data were analyzed using the Chi-square test. A *p*-value <0.05 was considered statistically significant.

Result

A total of 4611 patients who presented with ARTIs from January 2013 to December 2014 were investigated. 1115 of them had a detected virus. The median age of our population was 16 months. The overall detection rate was 24% (2013 and 2014 were 20% and 27% respectively). Of the positive samples, RSV was associated with 1086 cases that accounted for 23.5% of ARTI and 97.4% of the total viral pathogens. Other viruses detected were ADV (0.3%), Influenza-

Table 1
Distribution of virus infections by gender, age, and setting.

		Disease		Setting	
		Negative	Positive	Main hospital	ER
Age groups					
≤3 months	Female	299	139	348	88
	Male	444	178	478	143
3.01–6 months	Female	265	98	244	118
	Male	366	140	328	177
6.01–12 months	Female	336	136	333	139
	Male	430	142	412	160
12.01–24 months	Female	290	78	321	47
	Male	323	90	359	54
24.01–60 months	Female	227	42	251	18
	Male	259	48	295	12
>60 months	Female	125	12	133	4
	Male	132	12	138	6

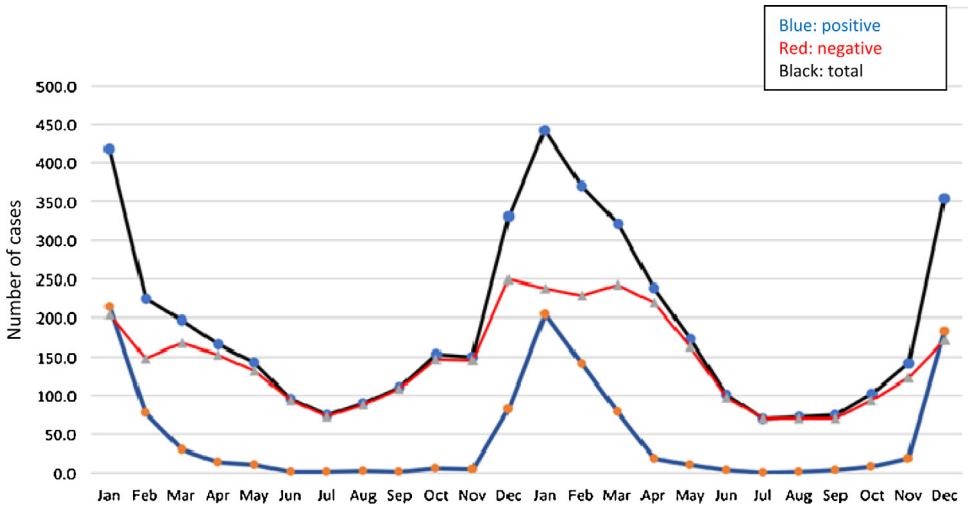

Fig. 1. The monthly distribution and frequency of overall virus detection during 2013–2014.

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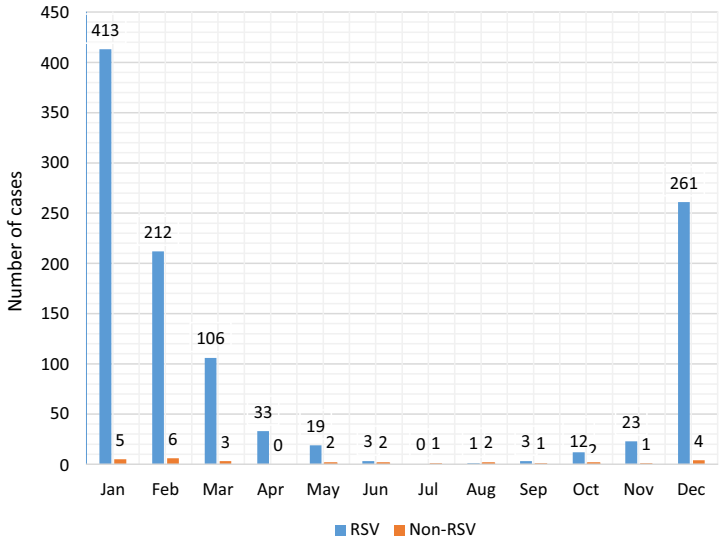

Fig. 2. The monthly distribution of respiratory syncytial virus (RSV) vs. non-RSV.

Table 2
Comparison of RSV versus non-RSV.

		Negative	Positive	
			RSV	Non-RSV
Gender	Female	1542	491	14
Age groups	Male	1954	595	15
	≤3 months	743	310	7
	3.01–6 months	631	233	5
	6.01–12 months	766	271	7
	12.01–24 months	613	164	4
	24.01–60 months	486	86	4
	≥60.01	257	22	2
Settings	Main hospital	2816	802	22
	ER	675	284	7

A (1.2%), Influenza-B (0.2%), Parainfluenza 1–3 (1%). There were 610 male patients; a slightly more than female patients (*n*: 505) with a ratio of 1.2:1. The vast majority of viral respiratory infections were in the first 2 years of life (89.7%). The age distribution of this study was as follow: 317 patients were ≤3 months, 238 patients were between 3.0 and 6 months, 278 patients were between 6.01 and 12 months, 168 patients were between 12.01 and 24 months. 90 patients were between 24.01 and 60 months. 24 patients were >60 months. Most patients were admitted to the main hospital (73.9%) (Table 1). The number of positive samples for respiratory viruses per month for 2013 and 2014 is shown in (Fig. 1). There were detected viruses throughout the two years with a peak in winter months; Dec (*n*: 265), Jan (*n*: 418), Feb (*n*: 218), and Mar (*n*: 109). Furthermore, we analyzed the data and divide patients into RSV vs. non-RSV groups. The monthly distribution of RSV cases vs. non-RSV cases is shown in (Fig. 2). RSV cases vs. non-RSV cases were compared in gender, age and setting as shown in Table 2.

Discussion

Respiratory tract infections are one of the most common diseases among children worldwide. Viruses constitute a high proportion of respiratory tract infections in children. Viral causes of respiratory tract infections in developing countries showed a detection rate of 14–48% [11–13]. It has been observed that the detection rate of viral pathogens varies noticeably based on the method used. When DFA method is used the detection rate usually varies between 10 and 50%. Use of PCR increases the sensitivity of virus detection to 60–80%. However, DFA use has an advantage of being a point of care test as well as being less labor intensive. We utilized DFA that provides alternative a fairly reliable detection rate especially during the early phase of the disease [14]. Using PCR method, Richter et al.; found that 86% of the samples were positive for viruses [15]. Moreover, a study done in KSA showed a detection rate of 63% [16]. In our study, viruses were identified in only 24% of children presented with ARTIs. This difference in detection rates for viral pathogens might be attributed to different detection methods, study design, and geographic areas. In most studies, male patients were more likely to be affected than female patients [12,13,15].

Similarly in our study, male patients were slightly higher than female patients with a ratio of 1.2:1.

RSV is the most common pathogen that has a wide distribution worldwide [12,13,17].

Although most of the respiratory tract infections are diagnosed clinically, those who present with severe diseases or require hospitalizations need a microbiologic diagnosis. Based on DFA we used to identify viral pathogens, we found out that RSV was associated with 23.5% of ARTI and 97.4% of the total viral pathogens. This high rate of RSV was shown also in Bukhari et al. study; 95.5%. It has been observed in this study that rate of RSV decreased after 2 years of age that led to an overall statistically significant reduction in detection rate.

In our study, the detection rate of non-RSV was very low and was similar to other local data as it shown by Bukhari; 2.6% and 4.5% respectively. Nevertheless, a study done in China showed different results in detecting non-RSV; 31.6%. This could be explained because our population lives in an area considered as a tropical region and thus not having an extreme winter. Moreover, the method we used can only identify 6 viruses, it is well known that other viruses like rhinovirus and metapneumovirus have a significant proportion of viral cause of ARTIs in children. Detection rate varies depending on the setting, a statistically significant increased detection rate in ER compared with the main hospital; 30.1% and 22.6%, respectively.

Many studies have shown the association between respiratory viruses and climate. Bukbari et al. study, which was conducted in the same city, demonstrated higher detection rate in winter. Similarly in this study, viruses were detected throughout the

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study period with a peak in winter. As expected, 89.7% of respiratory infections in this study occurred in children younger 2 years and this might be attributed to the underdeveloped immunity.

Our limitation in this study was the diagnostic methods we used. DFA could not detect the new viruses like human metapneumovirus (hMPV), human Bocavirus (hBoV) and human polyomavirus, which encountered in increasing frequency after using PCR as diagnostic tests. In addition, we don't have the time when the DFA was taken in prior to the illness.

In conclusion, this study has shown virus distribution among different age groups, genders, and seasons in Riyadh, Saudi Arabia. Our study found that viral pathogens are very important cause of ARTIs in our region. RSV was the most common virus detected with the highest detection rate in children who are two years old and below. A multi-center surveillance with more sensitive detection methods like PCR may help to provide a comprehensive understanding of virus distribution in our area, which may contribute to reduce the misuse of antibiotics and help to implement an effective prevention approach for each virus, especially during its peak season.

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Competing interests

None declared.

Ethical approval

Not required.

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