Burden of Acute Respiratory Infections among Refugees 5 years and older in Dadaab, Kenya

By

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ABSRACT

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Background

Acute Respiratory Infections (ARIs) are a leading cause of morbidity and mortality worldwide with people in developing countries having the highest burden. Refugees and other displaced populations are even at a higher risk of contracting infections. There are no reliable estimates of burden and etiology of ARIs among children and adults 5 years and older in refugees camps.

Objective

To determine the burden of Lower Respiratory Tract Infections (LRTI) and the etiology of viral ARIs among children and adults 5 years and older in Hagadera Refugee Camp in Dadaab, Kenya

Methods

Data from the Hagadera Mortality Register, the United Nations High Commissioner for Refugees (UNHCR) Health Information Systems (HIS) database and the ARI Surveillance were used to determine the burden and etiology of ARI in the camp. Cause of death in the mortality register for 2012 was compared with the deaths captured in the UNHCR HIS. The burden of LRTI was estimated from those captured in the HIS database. All the cases fulfilling the World Health Organization (WHO) case definition for Influenza-like illnesses (ILI) and Severe Acute Respiratory Infections (SARI) between 2010 and 2011 were analyzed to determine etiology, seasonality, demographic characteristics and common presenting complaints. To calculate the rates, population estimates was obtained from the HIS and from the CIA World Factbook. Data analysis was done using Epi-Info 7 from the Centers for Disease Control and Prevention.

Results

The overall mortality attributed to LRTI was 21.3%. Among children and adults aged 5 years and older, 12.4% of deaths and 11% of hospital admissions were attributable to LRTI. In the ARI surveillance data for 2010 and 2011, 410 patients aged 5 years and older met the case definition of ILI and SARI. Among the 361 samples tested, 158 (43.8%) tested positive for at least one virus. Of those tested positive, 58 patients (37.4%) had Influenza A, 45 (29.2%) Adenovirus (AdV), 34 (21.9%) Influenza B, 16 (10.0%) Respiratory syncytial virus (RSV), 4 (5.0%) parainfluenza 1 (PIV1), 3 (1.9%) parainfluenza 2 (PIV2), 16 (10.3%) parainfluenza 3 (PIV3) and 9 (5.8%) human metapneumovirus (hMPV); 27 (17%) patients had more than one virus isolated. Persons between the ages of 5-14 years were 6.5 times more likely to be hospitalized as a result of SARI than those above the age of 24 years (P-value <0.001). Headache, lethargy, nausea and muscle/joint pains were all significantly higher in patients with SARI compared with those with a diagnosis of ILI. Muscle/joint pains was associated with Influenza A isolation (P-value 0.002).

Conclusion

Respiratory tract infections are a substantial burden in refugee camps among children and adults 5 years and older, with the younger age groups affected significantly more. Influenza A and B as well as Adenovirus are the leading viral causes of ARI in the refugee camps among older children and adults.

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INTRODUCTION

Introduction and rationale

The four Dadaab Refugee Camps are located in Garissa County, in the former North-Eastern Province of Kenya, about 100 kilometers from the Kenyan-Somali border. As of December 2012, Dadaab hosted 468,770 refugees, 98% of them from Somalia. Hagadera Camp of Dadaab is one of the highly populated camps with 139,415 people as of December 2012. Refugee camps hosting large number of people in a confined area, are especially prone to infectious diseases, and are at a higher risk of Acute Respiratory Infections (ARI) due to overcrowding, suboptimal living conditions and malnutrition [1].Few comprehensive data exist on etiologies of ARIs in older children and adults in Africa [2].The World Health Organization (WHO) recommends presumptive diagnosis and treatment of these illnesses based on clinical symptoms. However, recent studies raise concerns over the frequency of treatment failure in Africa [3]. This raises the question of whether these infections might be of viral etiology and therefore not treatable with anti-bacterial agents.

Problem Statement

The burden and etiologies of ARIs in older children and adults in most developing countries is unknown. The situation is even worse in refugee camps, where residents are at a higher risk of these infections and few tests are performed. Determining the burden and the etiology of ARIs is an important step in designing specific interventions measures.

Study Objectives

1. What is the proportion of hospital admissions and mortality that are attributable to Lower Respiratory Tract Infections (LRTIs) among those <5 years and ≥ 5 years in Hagadera Camp, Dadaab?
2. What are the viral pathogens responsible for ARIs in children and adults ≥ 5 years in Hagadera Camp, Dadaab?
3. What are the common symptoms associated with Influenza-Like Illnesses (ILI) and Severe Acute Respiratory Illness (SARI) beyond the case definition?
4. Is there a seasonal pattern of the viral ARIs in Hagadera Camp, Dadaab?
5. What are the crude and age-specific SARI hospitalization rates in Hagadera, Dadaab?

Significance Statement

Identifying the burden and viral etiology of ARIs among refugees will add to the existing knowledge about ARIs in refugee camps. In the world of increasing drug resistance, it is important to have an understanding of the proportion of ARIs that are attributable to viral etiologies. The information generated will also help agencies involved in provision of health services to prioritize and advocate for preventive measures.

LITERATURE REVIEW

Introduction

Acute respiratory infections (ARIs) are a leading cause of morbidity and mortality worldwide [7] with the highest burden faced by people in developing countries [4, 5]. Refugees and other displaced groups may be at an even higher risk of contracting respiratory infections [1]. Estimation of the burden of ARIs is unreliable [13] due to association of ARIs, especially pneumonia, with diseases like measles, malnutrition and malaria [1] as well as poor sensitivity and specificity of diagnostic tests used for detecting ARIs [13]. The etiology of ARIs in older children and adults in developing countries in general and crisis areas in particular is uncertain [13]. Although simple and cost-effective measures exist that can avert deaths due to ARI [4], determining the etiology and burden of these infections is key to designing specific intervention measures.

Classification

ARIs are classified as upper respiratory tract infections (URTIs) and lower respiratory tract infections (LRTIs) depending on the anatomical site of the respiratory tract that is infected [6, 7]. However, ARIs may extend to surrounding organs like the ears and the sinuses and may have systemic effects [8]. URTIs are the most common infectious diseases of the ARIs and the majority of them have a viral etiology [6, 8]. Acute viral infections may predispose one to secondary bacterial infections and exacerbate chronic or recurring respiratory conditions [1]. Pneumonia is the most common LRTI and presents with cough and rapid breathing [6]. Influenza-like illness (ILI) or clinically suspected influenza illness is a non-specific ARI. Its case definition is fever and cough and/or sore throat. Diagnosis of Severe Acute Respiratory Illness

(SARI) is made if a case meets the ILI case definition but in addition has shortness of breath or difficulty breathing and requires hospital admission. There is a considerable overlap between the different case definitions and one may progress to the other [9].

Burden

ARI remains the leading cause of mortality and is the second most common cause of illness worldwide being responsible for 3.9 million deaths annually in all age groups [7, 10]. Pneumonia is the leading killer of children aged under 5 years globally causing about 18 percent of all under 5 years deaths, or 1.3 million deaths annually [5].

Among the under 5 years age group, there is a wide variation of the burden of ARI between countries based on income [5]. An overwhelming 99 percent of pneumonia deaths in this age group occur in developing countries, and three-quarters of these take place in only 15 countries [4, 5, 7]. In the industrialized countries, only 4 percent of all deaths are attributable to pneumonia [7]. The incidence of pneumonia and its rate of mortality among children is 10 times higher in developing countries compared with the corresponding group in industrialized countries [11]. In Kenya, which is one of the 15 countries with the highest pneumonia mortality rate, pneumonia is the leading childhood killer, responsible for 16 percent of all under 5 years deaths [4, 7].

ILI is a major cause of illness worldwide [12]. However, little is known about the burden in Sub-Saharan Africa [2, 12]. A few population-based studies have shown substantial burden in young children [1, 2, 12, 13]. This contrasts with data from industrialized countries where the elderly have the highest burden and severity of ILI. This may be due to lack of access of health care for the elderly in Sub-Saharan Africa and the lack of disease data among this older population and thus the reported low disease burden [13].

Different studies have demonstrated pneumococcus as the most common etiology among inpatients and is associated with influenza virus infections among the outpatients with ARI symptoms [2, 14, 15]. Although ARI-attributable mortality is known to decline with age after the first 5 years, again the burden in older children and adults is uncertain [16].

Crises areas

The Inter-Agency Standing Committee (IASC) recognizes humanitarian crisis in a country, region or a society when there is a total or considerable breakdown of authority resulting from internal or external conflict and which requires an international response that goes beyond the mandate or capacity of any single agency and/or the ongoing United Nations country program [17].

Complex emergency is a term used for a man-made crisis in an area that is faced with extensive violence, loss of lives, population displacements, widespread damage to economy, increased disease burden, and deterioration of security [17]. Areas that are affected by crises are typically areas with pre-existing weak health systems and high burden of infectious diseases, like diarrheal diseases and ARIs [17].

The existing large burden of ARI in pre-crises time worsens during a crisis [18]. In a study conducted by Hershey and colleagues, pneumonia was attributed to 20 percent of deaths among children under the age of 5 years, making it the second commonest cause of death after malaria in United Nations High Commissioner for Refugees (UNHCR) administered refugee camps in Africa [18]. Overall, pneumonia is among the leading cause of mortality in all age groups in crisis and ARI, in general, is the largest baseline contributor to disability-adjusted life-years

(DALYs) [18]. Even with this huge burden, humanitarian responses do not prioritize interventions directly targeting pneumonia [6].

The association of pneumonia with diseases such as measles, malaria and malnutrition in most crises areas complicates the estimation of the burden of ARI [6]. Malnutrition may be a cause or consequence of pneumonia while pneumonia is a severe complication of measles [18]. Respiratory complications of severe malaria also mimic pneumonia [18]. The existing overlap between these diseases and the poor sensitivity and specificity of the existing diagnostic criteria leads to unreliable estimates of the ARI burden [16]. Also, the use of verbal autopsies in community studies can be unreliable and introduces uncertainty in the determination of cause of death [16].

In a study done in two long-term refugee camps in Kenya, 50 percent of children under 5 years old with ILI and SARI symptoms were found to be positive for at least one viral pathogen, with Adenovirus (AdV) contributing 21.7%, Respiratory Syncytial Virus (RSV) 12.5%, Influenza A 9.7%, Parainfluenza 9.4%, human metapneumovirus (hMPV) 5.7%, and Influenza B 2.6%[1].

Risks factors

ARI incidence and mortality is inherently associated with poverty [4, 5]. Factors found in low resource settings, such as under nutrition, micronutrient deficiency, such as zinc and vitamin A, sub-optimal breastfeeding practices, lack of access to vaccinations, indoor air pollution, inadequate hygiene practices and sanitation, and other comorbidities, such as HIV and malaria, have all been implicated in the high burden of ARI [5]. Under nutrition alone is responsible for up to a third of child deaths [5, 19]. These children are at a particularly greater risk of pneumonia deaths due to weakening of the immune system and respiratory muscles that are needed to protection and clear secretions in the respiratory tracts [5].

Humanitarian crises frequently occur in areas with weak healthcare systems. The burden of ARI depends on the phase of the emergency [6]. In the stable long-term refugee camps, mortality rates rarely exceed emergency thresholds and are often lower than the surrounding host populations due to better access to water, sanitation and primary health care in the camps [6]. However, the high levels of malnutrition, inadequate water and sanitation, and overcrowding that are usually seen during the acute phase of emergencies lead to considerable infectious diseases burden and high mortality rates [6, 18].

Surveillance systems in crisis areas focus on diseases with epidemic potentials giving little attention to ARI. Furthermore, there is almost always an absence of diagnostics to confirm their existence. This is further compounded by the lack of acceptable indicators like Case Fatality Ratio (CFR) to assess quality of care for ARI [6].

Etiology

Differentiating the etiology of ARIs and particularly pneumonia is difficult [6]. Viruses are an important cause of pneumonia in children aged less than 5 year [1]. Some studies have found RSV to be the most common cause of LRTI among children, responsible for more than 65% of hospitalized cases in which a virus was found [20, 21] and the third most common cause of LRTI death after *Streptococcal pneumoniae* and *Haemophilus influenzae* type b. AdV, influenza virus, parainfluenza virus and hMPV are also associated with a substantial burden of ARI in this age group [1]. The routine diagnostic tests used in the diagnosis of LRTIs lack sensitivity and specificity and therefore the exact burden by etiology is difficult to determine [16]. Although oropharyngeal and nasopharyngeal specimens may show a pathogen, it is not possible to differentiate the pathogenic organisms from the normal flora. The gold standard, culture of lung aspirate, is too invasive and low resource areas lack the high skilled human resource that is needed to implement it [16].

In all age groups, fifty or more percent of the ARI cases are due to bacterial causes and a further 25%-50% due to a viral etiology [6]. *Streptococcus pneumoniae* and *Haemophilus influenzae* type b are the leading bacterial causes of pneumonia [8]. Pathogens causing atypical pneumonias, such as *Mycoplasma pneumonia* and *Chlamydia pneumoniae,* are also recognized as important causes in older children and adults [8]. Bacterial culture of lung aspirates in children hospitalized for pneumonia in developing countries revealed more than 30 percent with *Streptococcus pneumoniae,* 11%-50% with *Haemophilus influenzae* type b and less than 30 percent with *Staphylococcus aureus* [22].

There are a considerable number of mixed viral and bacterial infections causing pneumonia. In a study done in Pakistan, 26 percent of children with RSV had a bacterial pneumonia due to *H. influenzae* type b or *S. pneumoniae* while 54 percent of pneumonia due to *H. influenzae* type b infection and 47 percent of *S. pneumoniae* infections were associated with viral infections [22].

Interventions

Although the majority of childhood pneumonias are preventable and treatable through cost-effective interventions, death attributable to pneumonia has remained unacceptably high in the developing world [4, 5]. Delayed recognition of pneumonia symptoms by caregivers, poor health seeking behaviors, and inappropriate treatment of patients with symptoms contribute to the high mortality associated with pneumonia, especially among children under the age of 5 years [5].

The Global Action Plan for Prevention and Control of Pneumonia (GAPP) identifies case management, vaccination, prevention of HIV infection, improvement of nutrition, reduction of low birth weight, and control of indoor air pollution as the key strategies for treating, preventing and protecting against pneumonia [23].

The 2006 WHO recommendation to add *Haemophilus influenzae* type b vaccine into the national routine immunization schedule of low income countries has partly led to the success observed in lowering child mortality in developing countries [5]. However, coverage in these countries is far from being universal [4]. Pneumococcal conjugate vaccines (PCV) introduction into national immunization programs has created new hope in the reduction of child mortality in the same low income countries. Thirteen of the fifty low income countries with data introduced PCV by the end of 2011 [5]. So far, a significant decrease in invasive pneumonia cases and hospitalization of children has been observed in areas where PCV have been introduced [24-26].

Both measles and pertussis present with a severe form of pneumonia. Increased coverage of measles and pertussis vaccines has been shown to substantially reduce pneumonia morbidity and mortality [5]. Although the uptake of measles and pertussis vaccine is high globally, the world's poorest children are often left unvaccinated [5]. In addition, in these poor settings and especially in crowded settings of rapidly expanded refugee camps, measles cases are often seen in older children and young adults [27] making them also vulnerable to increased morbidity and mortality from ARI, especially pneumonia. Promotion of exclusive breastfeeding, adequate nutrition, and reduction of indoor air pollution have also been shown to reduce the impact of pneumonia [4, 5, 23].

Scaling up of these vaccines and promotion of breastfeeding in the world's poorest countries would avert 67 percent of pneumonia deaths by the year 2015 [4]. However, older children and adults should not be neglected. Without knowing the burden and etiology of ARI among this older age population, the interventions of vaccination and other preventive measures, and most appropriate treatment regiments cannot be determined. This study will examine the burden and etiologies of ARI among older children and adults and make recommendations for treatment and other interventions.

METHODS

Three databases were used for the study:

Acute Respiratory Infection Surveillance System

Data from the Acute Respiratory Infection (ARI) Surveillance System on facility-based patients from one of the five health posts and the main hospital in Hagadera refugee camp were used. Patients presenting who matched the case definition of influenza-like illnesses (ILI) for the health post or severe acute respiratory infection (SARI) for the hospital as defined by the World Health Organization (WHO) were eligible. All cases fulfilling the SARI criteria and the first three ILI cases were enrolled on a daily basis.

Specific symptoms and characteristics of each category captured by the case definition of ARI are as follows:

ILI included children and adults ≥ 5 years of age and the following:

1. Temperature of ≥38°C,
2. Cough or sore throat, and
3. Does not meet criteria for SARI

SARI included children and adults ≥ 5 years of age and the following:

1. Temperature ≥ 38°C
2. Cough and or sore throat, and
3. Shortness of breath or difficulty in breathing

For each patient enrolled in the ARI surveillance, nasopharyngeal and oropharyngeal swabs were obtained and tested using real time reverse transcriptase polymerase chain reaction (RT-PCR) for influenza A and B viruses, respiratory syncytial virus (RSV), adenovirus (AdV), parainfluenza serotypes 1-3 and human metapneumovirus (hMPV). Staff within each health facility (i.e., Hagadera main hospital and the camp health post) completed a brief standardized questionnaire, including age, sex, address, signs and symptoms (to verify if match case definition). Details of the case definitions, specimen collection and processing are described in a previously published paper [1].

Daily data from the ARI surveillance in Hagadera camp from 2010-12 were obtained from CDC Kenya without personal identifiers.

UNHCR Health Information Morbidity/Mortality System

These data were collected from all five health posts and one hospital at Hagadera and obtained from the Health Information department of the Hagadera Camp. The Health Information System (HIS) is a standardized tool used by United Nations High Commissioner of Refugees (UNHCR) to design, monitor and evaluate refugee public health and HIV programs with the aim of improving the health status of people of concern to UNHCR [28]. Age categories (less than 5 years and 5 years and older) and specific morbidity and mortality data due to lower respiratory tract infections (LRTI) and all other causes for all outpatients and inpatients presenting to health posts and the main hospital in Hagadera were collected.

LRTI included children and adults ≥ 5 years of age and the following:

1. Temperature ≥ 38°C or subjective fever, and
2. Cough or sore throat; and
3. Shortness of breath or difficulty in breathing

Monthly Morbidity and Mortality LRTI data from HIS from 2011-2012 were used. The monthly population figures for Hagadera camp were also collected for age categories <5 and ≥5 years of age. These data were entered into Microsoft Excel 2010.

HIS Mortality Registry, Hagadera Main Hospital

HIS includes registers to be used for aggregating morbidity and mortality data. One such register is the HIS mortality registry with collected all deaths at the Hagadera hospital. This register contains name, age, sex, address, nationality, date of death, and free text for direct and underlining cause of death.

Using a standardized collection form, all deaths from the HIS mortality registry that occurred at the Hagadera Hospital from January through December 2012 were collected giving each a unique serial numbers. Patient characteristics (i.e., sex; age in years or months, if less than 1 year old; camp residence; date of death; and cause of death as free text by attending clinician) were collected and entered into a Microsoft Excel 2010. No names were collected. The LRTI and pneumonia free text terms were collapsed to just LRTI.

Assumptions

The CIA World Factbook population profile for Somalia and the HIS database population figures for the camp were used to estimate the age groups and camp populations. An average of 2011 and 2012 was used as the annual estimate of the population. For 2012, the age profile data on Somalia was 44.3% were less than 15 years. Among those 15 years and older, 18.8% were 15-24 and 36.8% were 25 and older [29]. The HIS database provides camp estimates as <5 years and ≥5 years of age. The population of those < 5 years was obtained from the HIS database. The remaining age categories used The World Factbook proportions [29].

Data analysis

Verification

Collected age (categorized as <5 and ≥5 years of age for HIS database comparison), sex, date (month for HIS comparison) of death, and cause specific mortality (LRTI or other) from the mortality registry were used to compare the deceased cases to the HIS Morbidity and Mortality database (LRTI vs. other).The mortality register was considered the "Gold Standard" as far as capturing the total number of hospital deaths; however, the case definition may not have been as stringent as SARI. For 2012, the age category (<5 and ≥5 years) and quarterly-specific numbers of LRTI vs. other deaths in the Mortality Registry were compared with the number of LRTI vs. other deaths per all hospitalized patients in the HIS system. The percent differences of these numbers were compared by age and quarterly time period. The HIS mortality database was considered acceptable for use in determining the health burden of LRTI, if it matched the collected mortality register data within 10 per cent. If acceptable for 2012, then HIS mortality would be used for that year and 2011.

For 2011 and 2012, attributed burden of hospitalization for LRTI was calculated among all those hospitalized and among the population by age category.

Rate and frequency determinations

The rates of SARI hospitalization per 10,000 persons (aged 5-14, 15-24, 25-54, and 55 years and above) were done by dividing the number of SARI cases by the age specific population obtained from the HIS and World Factbook for 2010-2012.

The viral etiology of ILI and SARI among children above 4 years and adults for 2010 and 2011 were determined. The seasonal patterns and distribution of the different viruses were also determined on a quarterly basis.

For each etiology, the frequency of those presenting with cough and sore throat were made. In addition, a frequency distribution of the other common presenting complaints per syndrome was determined for the 3 year period. In univariate analysis these other common complaints were used as variables for the outcome of any or specific viral etiologies present or not.

Ethical Considerations

A Non-Research Determination was granted by Emory University and the U.S. Centers for Disease Control and Prevention (CDC). Permission to use data from the three sources was obtained from both CDC Kenya and UNHCR. To conduct this study, no personal identifiers were collected.

The initial surveillance activity was waived for institutional review by Kenya Medical Research Institute Ethical Review Committee and CDC because the surveillance was considered as non-research public health activity.

RESULTS

Comparison of Mortality Register and HIS Database

Deaths captured in the 2012 mortality registry were compared with the corresponding age category, cause and period captured by the HIS mortality database. There was a large discrepancy of deaths captured in these two systems with the HIS database capturing a total of 163 deaths compared with 88 by the mortality register, translating to a difference of 46% in the whole year (Table 1). Since this exceeded more than 10 % difference that was set at the start of the analysis, only the HIS database was used to determine the proportion of LRTI deaths in the year 2011 and 2012. The morality register was no longer considered the 'gold standard'.

Table 1: *Comparison of age specific deaths due to LRTI and other Diseases captured by the mortality register and the HIS system* by quarter (Q), 2012

Mortality Register							**HIS Electronic database**					**Absolute difference**	**% Difference**
		Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total		
LRTI	<5 years	3	7	3	6	19	7	4	8	6	25	-6	
	≥5 years	2	5	3	5	14	3	1	3	0	7	7	
Other	< 5 years	2	1	3	2	8	15	11	17	12	55	-47	
	≥5 years	21	9	9	8	47	26	14	16	20	76	-29	
Total		**28**	**22**	**18**	**21**	**88**	**51**	**30**	**44**	**38**	**163**	**-75**	**46%**

From the HIS data, a total of 432 patients died in Hagadera Hospital in 2011 and 2012. These two years, 92 (21.3%) were attributed to LRTI. The majority of the LRTI deaths were among children (77.2%) aged less than 5 years; therefore, the mortality attributed to LRTI among the older children and adults was 12.4%. The crude mortality rate for 2012 was 11.7 per 10,000 per year for a total population of an average of 2011 and 2012 of 110377. The crude mortality rate for 2011 was 21.5 per 10,000.

The proportion of admissions attributable to LRTI was 25.2% in 2011 and 19.7% in 2012. Among children under the age of 5 years, 41% of the hospitalization was due to LRTI in 2011 and 37% in 2012. In those aged 5 years and older, 11% of hospitalization was due to LRTI in both 2011 and 2012. (Table 2)

Table 2: *Total number of hospital admissions in Hagadera Hospital in 2011 and 2012 from HIS database*

Disease		2011	2012	Total
LRTI	<5 years	2497	1177	**3674**
	≥5 years	741	726	**1467**
Other	<5 years	3620	2037	**5657**
	≥5 years	6010	5699	**11709**
Total		**12868**	**9639**	**22507**

ARI Surveillance

ARI cases

Between January 2010 and December 2011, 410 patients aged 5 years and older (range 5-70 years, mean 12.8 years, median 8.0 years) met the case definition of ILI and SARI, which combined is considered ARI. Of these, 213 (52%) had ILI, while 197 (48%) had SARI. Age categories consisted of 308 patients (75.1%) between 5 and 14 years, 47 (11.5%) 15-24 years, 51 (12.4%) 25-54 years and only 4 (1.0%) were 55 years or older. These comprised of 229 males (55.9%) and 181 females (44.1%). Cough was present in 401 (97.8%) of patients with ARI and 258 (63.39%) had a sore throat. Cough and sore throat were both present in 249 (62.6%) of the ARI cases. Additional common symptoms were headache 191 (46.8%), lethargy 145 (35.4%), nausea 100 (24.6%), muscle/joint pains in 66 (16.2%) and 37 (9.1%) had diarrhea (Table 4). Muscle/joint ache was associated with Influenza A (p-value = 0.002) (Table 5) while lethargy was associated with isolation of any virus from a specimen (Table 6). None of the other symptoms were significantly associated with any of the isolated viruses. Of the 410 patients, 361 had samples tested. Because of variation in testing, only seasonality was only examined by quarterly intervals. Among the 361 samples tested, 158 (43.8%) tested positive for at least one virus. This included 58 patients (37.4%) who tested positive for Influenza A, 45 (29.2%) for Adenovirus, 34 (21.9%) for Influenza B, 16 (10.0%) for RSV, 4 (5.0%) for PIV1, 3 (1.9%) for PIV2, 16 (10.3%) for PIV3 and 9 (5.8%) for hMPV. Seventeen percent (27) of patients had more than one virus isolated. (Table 3).

SARI cases

Among the 197 patients who met the case definition of SARI, the age ranged between 5 and 55 years (mean 13.1 and median 9.0). Of these patients, 148 (75.1%) were aged between 5-14 years, 19 (9.6%) were 15-24 years, 29 (14.7%) were 25-54 years and (0.6%) were 55 years or older. Males comprised 112 (56.9%) compared with 85 (43.1%) females. Of these 197 cases, 185 (95.4 %) had presented with cough and 73 (37.6%) had sore throat. Both cough and sore throat were present in 64 (34.6%). Other symptoms that patients had were headache 63.3%, lethargy 62.4%, nausea 48.7%, muscle/joins pains 31.8%, diarrhea 16.2%, and convulsions 13.3% (Table 4). At least one virus was detected in 45.5% of the 165 SARI patients tested. The viruses detected were Influenza A 46%, Adenovirus 26%, Influenza B 17.6%, PIV1 7.1%, PIV2 2.7%, 6.8% PIV3, hMPV 6.9% and RSV 6.8%.

ILI cases

The age range of the 211 patients meeting the ILI criteria was 5-70 years (mean 12.3 years and median 8.0); 75.1% were in the 5-14 years age group, 13.2% were 15-24, 10.3% were aged 25-54 years while less than 1.4% were aged 55 years and above. Males comprised 117 (55.0%) compared with 96 (45.0%) females. All the patients who met the case definition of ILI had cough. Sore throat was present in 81.6% of ILI patients. Headache was also a common presenting symptom (38.3 %), followed by lethargy (10.3%) and nausea 2.4%. At least one virus was detected in 42.4% of the 158 patients tested, with Adenovirus (31.3%), Influenza A (28.9%), Influenza B (25.3%), Parainfluenza 3 (13.6) and RSV (13.3%) contributing the majority of the cases.

Table 3: *Demographic and etiological distribution of ILI and SARI cases tested between January 2010 and December 2011 in Hagadera Refugee Camp, Dadaab (N=410) from ARI surveillance*

	ARI		ILI		SARI		P-Value
	n=410	%	n=213	%	n=197	%	
Age Group(Years)							
5-14 years	308	75.1%	160	75.1%	148	75.1%	0.38
15-24 Years	47	11.5%	28	13.2%	19	9.6%	0.16
25-54 Years	51	12.40%	22	10.3%	29	14.7%	NA*
>54 Years	4	1.0%	3	1.4%	1	0.6%	NA
>24 Years	55	13.4%	25	11.7%	30	15.3%	REF†
Gender							
Males	229	55.9%	117	55.0%	112	56.9%	
Females	181	44.1%	96	45.0%	85	43.1%	0.696
Virus Isolated (samples positive / samples tested for each virus)							
At least one virus	158/361	43.8%	83/196	42.4%	75/165	45.5%	REF
Adenovirus	45/156	29.0%	26/83	31.3%	19/73	26.0%	0.534
Influenza A	58/157	37.4%	24/83	28.9%	34/74	46.0%	0.147
Influenza B	34/157	21.9%	21/83	25.3%	13/74	17.6%	0.328
Parainfluenza 1	4/121	5.0%	2/65	3.1%	4/56	7.1%	0.357
Parainfluenza 2	3/157	1.9%	1/83	1.2%	2/74	2.7%	0.939
Parainfluenza 3	16/155	10.3%	11/81	13.6%	5/74	6.8%	0.216
hMPV	9/156	5.8%	4/83	4.8%	5/73	6.9%	0.638
RSV	16/157	10.0%	11/83	13.3%	5/74	6.8%	0.216

*NA, not applied
† REF, reference group

Table 4: *Frequency distribution of common presenting symptoms of ILI and SARI among the enrolled 410 cases seen between January 2010 to December 2011 (N=410)*

	ARI		**ILI**		**SARI**		P-Value
Symptoms	n=410	100%	n=213	52%	n=197	48%	NA
Cough	401	97.8%	213	100%	188	95.4%	NA
Sore Throat	258	63.4%	185	81.6%	73	37.6%	NA
Headache	191	46.8%	67	38.3%	124	63.3%	<0.001
Lethargy	145	35.4%	22	10.3%	123	62.4%	<0.001
Nausea	100	24.6%	5	2.4%	95	48.7%	<0.001
Muscle/Joint Pain	66	16.2%	4	1.9%	62	31.8%	<0.001
Diarrhea	37	9.1%	5	2.4%	32	16.2%	<0.001
Convulsion	27	6.6%	1	0.5%	26	13.3%	<0.001

Table 5: *Association between of muscle/joint pains and type of viruses isolated*

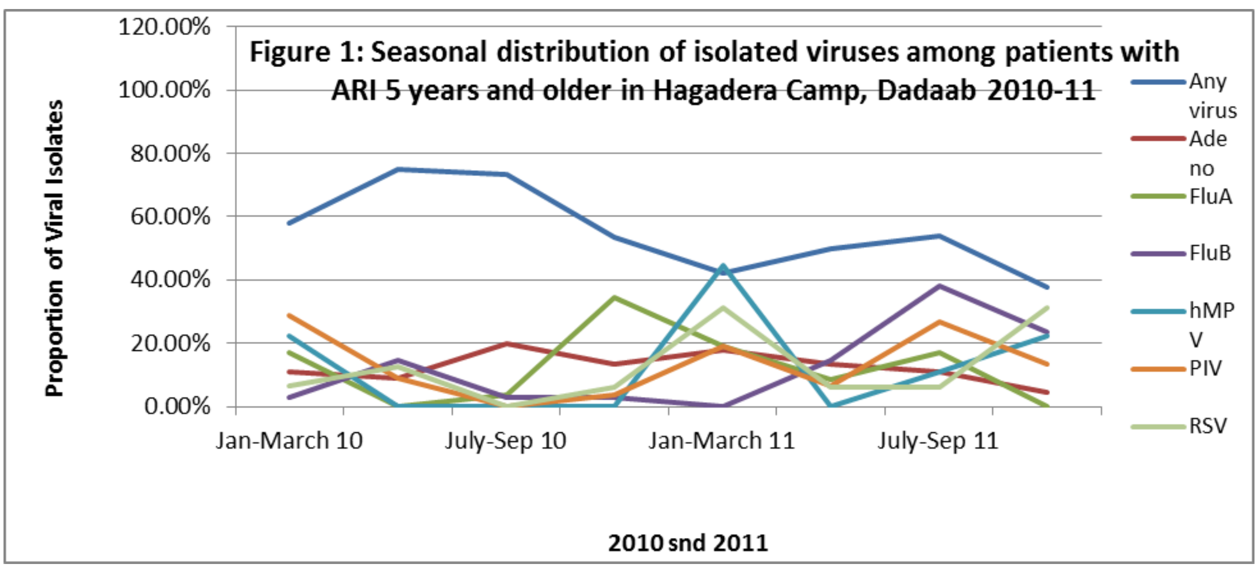
Virus isolated	Muscle/joint pains	Total cases	Prevalence Ratio	P-value
Any virus		158	1.0	1.000
Adenovirus	4	44	0.7	0.437
Influenza A	14	57	2.2	0.002
Influenza B	2	34	0.4	0.248
HMPV	0	9	0	0.606
RSV	3	16	1.5	0.437
Parainfluenza	2	24	0.6	0.742

Table 6: *Association between lethargy and type of virus isolated*

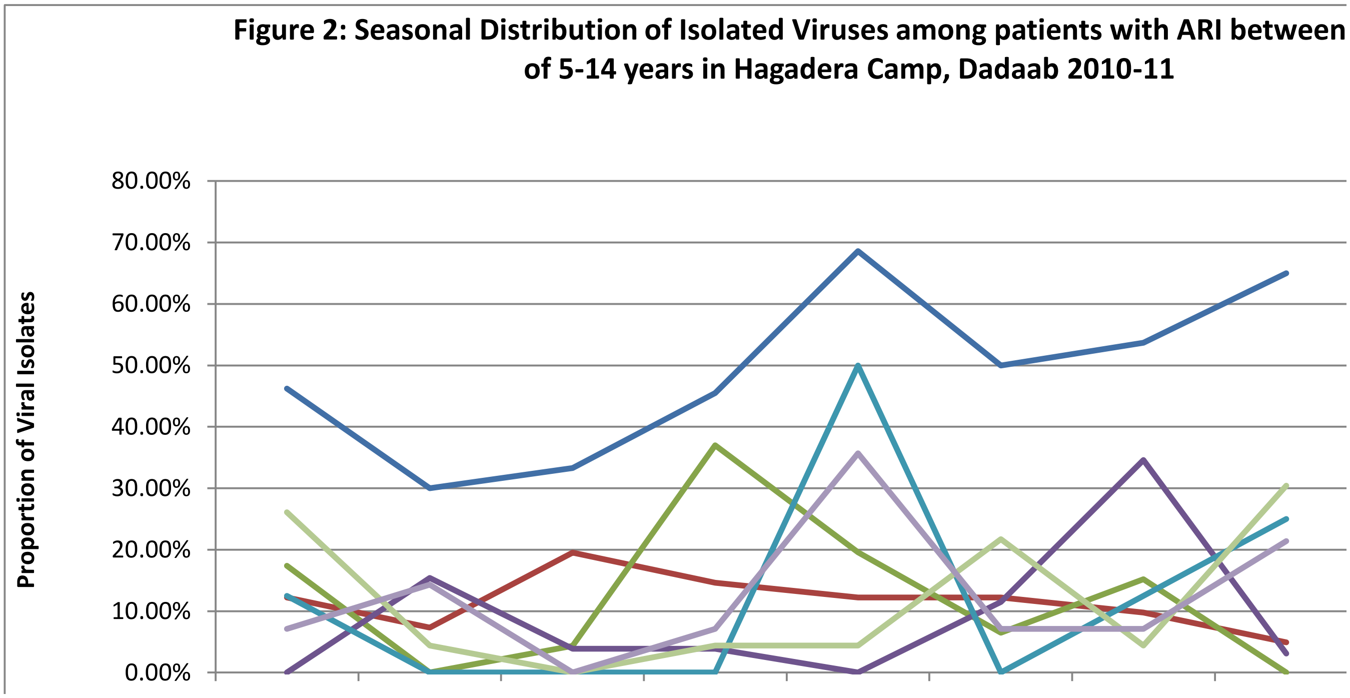
Virus isolated	Lethargy	Total cases	Prevalence Ratio	P-value
Any virus	66	158	1.4	0.026
Adenovirus	21	45	1.2	0.475
Influenza A	29	58	1.3	0.134
Influenza B	13	34	0.9	0.696
HMPV	4	9	1.1	1.000
RSV	4	16	0.6	0.186
Parainfluenza	9	24	0.9	0.661

Seasonal Patterns

There was no any distinct variation observed in the overall viral cases. The hMPV and parainfluenza viruses were highest between January and March. There were no observed seasonal patterns for the other viruses (Figure 1).



Among the 5-14 years age group, a slight increase in the overall viral cases was noted in the period between January and March. Influenza B peaked in April-June. There was no distinct seasonality observed in the other viral cases (Figure 2).



SARI Hospitalization Rates

Calculated population figures assuming an estimated population of 110377 from HIS for those aged 5 years and older showed that 36,576 people were 5-14 years, 25,042 were 15-24 years and 48759 were above 24 years of age. The crude annual SARI hospitalization rate was 9.0 per 10,000 people. The highest rates were seen among those between the ages of 5-14 years (20.2 per 10,000). The rate of hospitalization for those in the age category 15-24 years was 4.0 per 10,000. The lowest rates, 3.1 per 10,000, were in the >24 years category. Those in the 5-14 years age category were 6.5 times more likely to be hospitalized as a result of SARI than those above the age of 24 years (P-value <0.001). There was no statistically significant difference between those in the age category 15-24 and those above 24 years old. (Table 7)

Table 7: *SARI hospitalization rates (per 10,000 persons)*

Age Group	2010	2011	Total cases	Cases per year	Population	SARI Rate	Rate Ratio	P-Value
5-14 Years	73	76	149	74	36576	20.2	6.6	<0.001
15-24 Years	3	16	19	10	25042	4.0	1.10.8	0.655
>24 year	10	20	30	15	48759	3.1	REF	REF
Total	86	112	198	99	110377	9.0	NA	NA

Comparison of LRTI and SARI rates

When the SARI in ARI surveillance and LRTI hospitalization in HIS rates were compared for 2011, LRTI rates were found to almost 7 fold greater than the SARI cases (P-value <0.001) (Table 8).

Table 8: *Comparison of SARI and LRTI hospitalization rates, 2011*

Age Group	LRTI cases	SARI cases	Population	LRTI rate	SARI rate	Rate Difference	P-value
≥5 years	726	112	110377	65.8	10.1	55.7%	<0.001

DISCUSSION

LRTI Burden

Although our study determined the mortality register as the “Gold Standard” at the start of the project, the HIS database captured many more deaths than the mortality register. Since multiple death registers were used to extract this information, it is possible than not all the registers were actually availed. HIS reports are submitted at the end of every week in an electronic form, therefore, we thought the data storage was more reliable, although it is still open to missing data as reported by Hershey et al [18] or to duplication of data. Therefore, we used it to determine the burden of LRTI in the refugee camp.

The proportion of hospital admissions attributable to LRTI as well as LRTI cause specific mortality was found to be high, suggesting a high burden of LRTIs in the refugee camp. Even though higher burden was seen among children less than 5 years old, among children aged 5 years and older and adults, the proportion of deaths attributable to LRTI was still important at 12%.

Our finding of 21% proportion of deaths among the under 5 years age group attributable to LRTI is comparable to other studies in the same age category in other UNHCR operated refugee camps in 16 other countries in Africa and Asia [18] and a systematic review of 36 studies in crisis-affected areas by Bellos and colleagues [6].

In 2011 and 2012, between 20%-25% of all hospital admissions were attributable to LRTI. Among those in the under 5 years age group, this ranged from 37%-40%. Similar studies and results were reported in other crisis areas [1, 6, 18].

ARI Surveillance

In the ARI surveillance, at least one virus was isolated in more than 43% of the specimens tested for at least one virus. This further suggests the importance of viral etiologies in both ILI and SARI. The majority of these were Influenza A virus, Influenza B virus and AdV. Studies in western Kenya among children aged 5 years and older and adults also revealed 23% of specimens had at least one virus isolated and that Influenza A, Influenza B virus, RSV and hMPV were the most prevalent among the tested specimens. This suggests a higher burden of viral ARIs in refugee camp settings than in other parts of the country, but whether this remains with further testing or additional years remains to be determined [14].If remains true, this could be due to the living conditions in the camps [6, 18]. The type of virus isolated among those with ILI and SARI were not found to be statistically different, suggesting similar causation between the two or even progression of one to the other [9]. To our knowledge, our study is the first to demonstrate viral etiology among children 5 years and older and adults in a refugee camp setting.

A previous study from the same surveillance project revealed AdV and RSV as the leading cause of viral etiologies in children less than 5 years of age with more than 50 percent of specimens positive for at least one virus [1].

More patients with either SARI or ILI presented with cough than sore throat. Either of these is required for each diagnosis. This is comparable to another study done in Angola [30]. All other common symptoms were all significantly higher in patients with SARI compared with those with a diagnosis of ILI, showing the severity of this syndrome. Muscle/joint pains were significantly associated with Influenza A. None of the other symptoms were associated with any specific isolated viruses. We have found no studies comparing common symptoms of ILI and SARI apart from those in the case definition.

Although no distinct seasonal variability was noted when all age groups were combined, a slight increase in the viral cases was noted among children in the 5-14 years category in January-March. The hMPV and parainfluenza peaked between January and March in all age groups, while Influenza B slightly peaked during the period between April-June among children in the 5-14 years category. Another study that looked at children under the age of 5 years at the same surveillance site between the years 2007-2010, showed a peak of overall viral activity between November and February. Influenza A and hMPV peaked in November and December while Parainfluenza peaked in January and February. Although this partly overlaps with our peak period, the viruses that peaked at this time are different except parainfluenza [1]. This might be because of our ability to only look at two years.

The age-specific SARI hospitalization rate was highest in the 5-14 years age category, suggesting more disease burden and severity in this age group. The rates were more than 5.5 times higher compared to those above the age of 24 years. Among children less than 5 years, the rates are even higher at a rate of 57 per 1000 [1]. This clearly demonstrates the highest burden of SARI faces the younger age groups but that those 5-14 years of age are also vulnerable to infection.

When rates of LRTI hospitalization (from the HIS database) and SARI hospitalizations (from the ARI surveillance data) were compared, there was a marked difference between the two. Although the case definitions for the two are different, a rate difference of more than 50% between the two was not expected. Nevertheless, LRTI hospitalization rate of 65.8 per 10,000 further attests to the high burden of respiratory tract infections in the refugee camps. This high burden of LRTIs in refugee camps is similar to other studies in similar settings [6, 18].

There is a likely association of malnutrition, overcrowding, inadequate water and sanitation and outbreaks of measles with the high burden of LRTI and SARI. Cases of both were highest in 2011 when the camp had the highest population growth and malnutrition rates, overcrowding, and outbreaks of measles [31, 32].

General measures to reduce overcrowding at the refugees camps, improve the nutrition status of the population and stepping up of measles vaccinations have all been shown to reduce the burden of LRTI in refugee camps [4, 5, 23].

Limitations

Our findings are subject to some limitations. Mortality data at the facility level were tabulated from several books. There is a possibility that not all the books were availed. There was no evidence that a central mortality register existed. Secondly, LRTI and SARI have different case definitions and therefore any comparison between the two is only for purposes of demonstrating the overall burden of respiratory infections. Thirdly, not all the SARI and ILI cases were tested for viruses (361 out of 410). There was also a slight variation between the number of the eight viruses tested for each specimen (238-359) out of 361 specimens). Rejection of specimen and inadequate samples were the main reasons for these variations. Fourthly, variations in the samples tested per month may have affected the seasonal patterns of the viruses, especially given the lack of testing that took place in November and December, a time of viral peak among those younger than 5 years in the prior study. Fifthly, only the first 3 patients with ILI were sampled. This may have opened the study to a selection bias because those who arrived at the health posts early were more likely to be selected. Lastly, there are no data to show how many of the LRTI and SARI patients who needed hospitalization were actually hospitalized.

PUBLIC HEALTH IMPLICATION

We have demonstrated in our study that respiratory tract infections are a leading cause of morbidity and mortality in the refugee camp studied among older children and adults. We now also have a better understanding of the viral causes of these infections among older children and adults in refugee camp settings. There is a need to include ARI preventive measures in crises areas. Reduction of overcrowding, indoor air pollution, and malnutrition rates, and scaling up of measles vaccination coverage in older children should be prioritized.

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