MODERN MEDICINE AND PRACTICE
https://inovatus.es/index.php/ejmmp

EUROPEAN JOURNAL OF MODERN MEDICINE AND PRACTICE
Vol. 4 No. 12 (Dec - 2024) EJMMP ISSN: 2795-921X

MORBIDITY DUE TO ACUTE RESPIRATORY INFECTIONS IN CHILDREN UNDER 5 YEARS: JORDANIAN ROYAL MEDICAL SERVICES

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Abstract: This descriptive, cross-sectional study assessed morbidity due to acute respiratory infections (ARIs) among 176 children under five years old, admitted to Princess Haya Bint Al-Hussein Military Hospital, Jordan, from May to June 2024. ARIs, a leading cause of childhood morbidity and mortality, disproportionately affect young children due to factors like malnutrition, environmental exposures, and inadequate healthcare access. This study aimed to characterize ARI morbidity, identify common symptoms, and analyze risk factors, including socioeconomic status, nutritional health, and environmental conditions. Data collection included demographic information, clinical presentations, diagnoses, and treatments. Results showed that pneumonia and bronchopneumonia were the most prevalent diagnoses, particularly in children under one year, with male predominance. Risk factors such as exposure to secondhand smoke (75%) and low socioeconomic status (58.3%) were prevalent. The study also highlighted high antibiotic use, with 59.1% of patients receiving ceftriaxone, despite 80–90% of ARIs being viral in origin, which raises concerns about antimicrobial resistance. These findings underscore the urgent need for targeted interventions addressing socioeconomic disparities and improving environmental health. Enhanced preventive measures and responsible antibiotic stewardship are crucial for reducing the burden of ARIs in this vulnerable population.

Key words: acute respiratory infection, morbidity, child health, risk factor, antimicrobial.

Introduction:

Acute respiratory infections (ARIs) pose a significant challenge to public health worldwide, particularly affecting children. These infections are the leading cause of illness and healthcare demands in pediatric patients, especially among those younger than five years (Wang et al., 2022; Zhang et al., 2020). ARIs encompass a wide range of conditions, from minor upper respiratory tract infections (URTIs), such as the common cold, to serious lower respiratory tract infections (LRTIs), including pneumonia and bronchiolitis (Bhutta et al., 2021; Viner et al., 2020). Although these infections occur year-round, their prevalence increases markedly during colder months, aligning with seasonal peaks in viral infections (Azzari et al., 2020; Nascimento et al., 2021). The impact of ARIs is substantial, resulting in increased hospital admissions, school absenteeism, and economic strain due to healthcare expenditures and lost productivity (Liu et al., 2021; Yu et al., 2020).

Globally, ARIs are among the foremost causes of morbidity and mortality in children, with the most severe effects observed in low- and middle-income countries (LMICs) (Ginsburg et al., 2020; Hu et al., 2022). These infections, alongside other preventable health issues such as acute diarrheal diseases and malnutrition,

contribute significantly to childhood mortality rates (World Health Organization [WHO], 2021; Yakoob et al., 2020). Estimates indicate that ARIs are responsible for nearly 20% of all deaths among children under five, translating to approximately 1.9 million deaths each year (Rudan et al., 2021; O'Brien et al., 2020). In Jordan, particularly within the Jordanian Royal Medical Services, ARIs remain a critical concern, representing a leading cause of illness and hospital admissions in young children (Al-Haj et al., 2023; Sawalha et al., 2022).

The historical context of respiratory infections extends back to ancient times. Hippocrates, around 412 B.C., documented respiratory epidemics associated with environmental changes, with cases that progressed to pneumonia (Rindfleisch, 2020). Accounts of influenza-like illnesses can be traced to Europe in the 6th and 9th centuries, with the first officially recorded influenza epidemic noted in 1173 (Gao et al., 2020). Since then, periodic outbreaks have been a common occurrence in medical history, with five major pandemics occurring in the 20th century, the most catastrophic being the 1918 Spanish flu, which resulted in over 20 million deaths worldwide (Paltiel & Zheng, 2020; Morens et al., 2022). More recently, the 2009 H1N1 influenza pandemic highlighted the potential of respiratory viruses to inflict widespread illness and fatalities across all age groups (Bhatia et al., 2021).

Children in LMICs are disproportionately affected by acute respiratory infections due to a combination of risk factors, including malnutrition, inadequate sanitation, overcrowded living conditions, and limited access to healthcare services (Saha et al., 2020; Rakhshani et al., 2021). In these environments, the incidence of pneumonia, a severe form of ARI, is particularly elevated, with an estimated 156 million new cases reported annually among children under five (Perera et al., 2021; Hu et al., 2020). The majority of these cases are found in sub-Saharan Africa and South Asia (Nair et al., 2020; Suliankatchi et al., 2021). The burden of ARIs in Jordan, although less extensively researched, reflects global patterns, with pneumonia and bronchiolitis contributing significantly to pediatric hospital admissions within the Jordanian Royal Medical Services (Al-Shamiri et al., 2023; Suman et al., 2022).

The causes of ARIs are varied, with viral agents such as respiratory syncytial virus (RSV), influenza, parainfluenza, and adenoviruses responsible for 80-90% of infections (Pereira et al., 2022; Ralston et al., 2020). Although bacterial pathogens are less frequently identified, they are linked to more severe clinical outcomes, especially in children with underlying conditions like immunodeficiency or malnutrition (Zhou et al., 2021; McCullers, 2021). In young patients, ARIs are often associated with secondary complications, which may include bacterial superinfections, respiratory failure, and, in some instances, long-term respiratory issues (Reis et al., 2022; Verhoeven et al., 2021). Factors influencing the pathogenesis of ARIs include host characteristics such as age, nutritional status, and immune history, in addition to environmental influences like tobacco smoke exposure, air pollution, and seasonal climate variations (Mehta et al., 2020; Oscherwitz, 2022).

The typical incubation period for ARIs is brief, usually ranging from 1 to 3 days, allowing for rapid transmission, particularly in settings such as daycare centers and schools where close contact is inevitable (Santos et al., 2021; Olcay et al., 2020). The primary transmission mode is through respiratory droplets, although contact with contaminated surfaces (fomites) also contributes to the spread (McKinney et al., 2020; Mena et al., 2021). Once established, the infection can propagate along the respiratory mucosa without requiring systemic spread, which accounts for the localized nature of many ARIs (Mendez et al., 2022; Yoon et al., 2020).

In Jordan, similar to many regions, the high incidence of ARIs in children under five years of age imposes a considerable burden on healthcare systems (Al-Sawaf et al., 2021; Rumman et al., 2022). Data from the Jordanian Royal Medical Services indicate that ARIs are a predominant cause of outpatient visits, hospitalizations, and medication costs (Al-Qudah et al., 2023; Khatib et al., 2020). Moreover, ARIs significantly contribute to the overuse and misuse of antibiotics, exacerbating the growing issue of

antimicrobial resistance (AMR) (Abu-Laban et al., 2020; Zaalouk et al., 2021). In light of the substantial burden posed by ARIs, initiatives have been launched to improve preventive measures, including the promotion of vaccination, public health campaigns aimed at reducing indoor air pollution, and efforts to enhance early diagnosis and appropriate treatment practices (El-Khateeb et al., 2022; El-Saadany et al., 2020).

The current study, undertaken within the Jordanian Royal Medical Services, aims to quantify the impact of ARIs on children under five, identify significant risk factors, and evaluate the effectiveness of existing management strategies. The results of this research are anticipated to guide healthcare policies and resource allocation, with the goal of decreasing ARI-related morbidity and mortality, minimizing unnecessary hospitalizations, and addressing the overprescription of antibiotics in this vulnerable demographic.

Methodology:

This study employed a descriptive, cross-sectional design aimed at assessing morbidity due to acute respiratory infections (ARIs) in children under five years of age. The study was conducted within the framework of the Jordanian Royal Medical Services, specifically at the Princess Haya Bint Al-Hussein Military Hospital, from May to June 2024. A total of 176 pediatric patients, all younger than five years, who were admitted with a confirmed diagnosis of acute respiratory infections, were included in the analysis.

About the population, the study population comprised children aged 0 to 59 months, hospitalized with a clinical diagnosis of ARIs, which included both upper respiratory tract infections (URTIs) and lower respiratory tract infections (LRTIs), such as pneumonia and bronchiolitis. Inclusion criteria encompassed all patients admitted with ARIs during the study period, irrespective of the severity of illness, provided that the diagnosis was corroborated through clinical evaluation and radiological or laboratory findings where appropriate. Exclusion criteria included children with chronic respiratory conditions or immunodeficiencies that might confound the outcomes of ARI morbidity.

In addition, data were systematically extracted from the medical records of each patient. A standardized data collection form was used to gather relevant clinical and demographic information.

Result:

Table 1. Patients by age and gender

Age group (in years)	**Gender**					
	Male		**Female**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**
Under one year	54	55.10%	45	54.90%	99	56.30%
1-2 Years	35	35.70%	30	36.60%	65	36.90%
2-4 Years	9	9.20%	7	8.50%	16	9.10%
Total	98	55.70%	82	44.30%	176	100.00%

This table categorizes 176 patients based on age groups and gender (male and female). It shows the distribution across three age groups: under one year, 1–2 years, and 2–4 years. Each age group displays the number of patients in each gender and their percentage within that age group, giving insights into the age distribution and gender balance among the patients.

- **Meaning**: The table reveals that the majority of patients (56.3%) are under one year old, indicating that younger children might be more susceptible to the condition being studied. There is also a slightly higher prevalence among male patients (55.7%) compared to females (44.3%).

- **Academic Insight**: Such age and gender distributions are valuable in epidemiological studies, as they help identify vulnerable groups. In this case, the data may suggest the importance of focusing healthcare resources on very young children, especially males, for preventive and therapeutic interventions.

Table 2. Patients by associated risk factors

Risk factors	No.	%
Early weaning from breastfeeding	15	8.50
Atopy	17	9.60
Malnutrition	7	3.90
Anemia	19	10.70
Chronic diseases	4	2.20
Exposure to secondhand smoke	135	75.00
Low family socioeconomic status	105	58.30
Overcrowding	86	47.20

This table lists various risk factors associated with the patients, detailing the number and percentage of patients exposed to each factor. The most common risk factors are exposure to secondhand smoke (75%), low socioeconomic status (58.3%), and overcrowding (47.2%).

- **Meaning**: The prevalence rates suggest that environmental and socioeconomic factors may play a significant role in the health conditions affecting these patients. For instance, secondhand smoke exposure and low socioeconomic status are particularly high, which may contribute to the likelihood or severity of respiratory issues.
- **Academic Insight**: Identifying risk factors is essential for preventative healthcare strategies. By highlighting modifiable risks like smoke exposure and socioeconomic conditions, public health initiatives can be tailored to address these factors, potentially reducing the incidence of respiratory diseases in vulnerable populations.

Table 3. Patients by manifestations

Clinical Manifestations at Admission	No.	%
Fever	174	96.7
Cough	150	83.3
Anorexia	135	75
Dyspnea (shortness of breath)	104	57.8
Whining (grunting)	10	5.6

This table records the clinical symptoms that patients presented with upon admission, such as fever, cough, anorexia, and dyspnea (shortness of breath). Fever is the most common symptom (96.7%), followed by cough (83.3%).

- **Meaning**: The table underscores that fever and cough are predominant clinical presentations, which may aid in the preliminary diagnosis of the patients' condition. The lower frequency of symptoms like grunting (5.6%) suggests that these are less common but might indicate more severe cases.
- **Academic Insight**: Clinical symptom analysis assists healthcare providers in prioritizing symptoms for diagnosis. Understanding common symptom presentations helps streamline diagnostic protocols, especially in settings where similar symptoms are shared across respiratory diseases, enhancing early detection and management accuracy.

Table 4. Patients by diagnosis and age groups

Diagnosis	Age group							
	Under 1 year		1-2 Years		2-4 Years		Total	
	No.	%	No.	%	No.	%	No.	%
Pneumonia and Bronchopneumonia	90	88.2	66	97.1	13	92.9	169	96.0
Bronchiolitis	7	6.9					7	4.0
Acute Otitis Media	2	1.9			1	7.1	3	1.7
Pertussis-like Syndrome	2	1.9					2	1.1
Herpangina	1	1					1	0.6
Tracheobronchitis			1	1.5			1	0.6
Total	102	58	68	38.6	14	7.4	176	

This table categorizes diagnoses across different age groups, showing both the number and percentage of diagnoses within each group. Pneumonia and bronchopneumonia are overwhelmingly common across all age groups, representing 96% of cases.

- **Meaning**: The table illustrates that pneumonia and bronchopneumonia are predominant diagnoses, especially in children aged 1–2 years (97.1%). Other diagnoses, like bronchiolitis, pertussis-like syndrome, and tracheobronchitis, are comparatively rare, possibly indicating secondary or less common respiratory conditions in this population.
- **Academic Insight**: Understanding age-specific diagnosis prevalence is crucial for targeted healthcare responses. This data suggests that preventative and treatment efforts for young children should prioritize pneumonia, which is highly prevalent, especially in the youngest age groups.

Table 5. Patients by diagnosis and antimicrobial treatment applied

Antimicrobial Treatment	Diagnosis									
	Pneumonia and Bronchopneumonia		Otitis Media		Pertussis-like Syndrome		Tracheobronchitis		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Ceftriaxone	101	58.3	2	66.7			1	100	104	59.1
Ampicillin	45	25.6							45	25.6
Ampicillin and Gentamicin	24	13.6							24	13.6
Ceftriaxone and Vancomycin	2	1.1							2	1.1
Erythromycin					1	100			1	0.6
Total	172	97.7	2	1.1	1	0.6	1	0.6	176	100

This table details the types of antimicrobial treatments administered to patients based on their diagnoses. Ceftriaxone is the most frequently used treatment (59.1%), particularly in cases of pneumonia and bronchopneumonia.

- Meaning: The table suggests that ceftriaxone is the preferred antimicrobial for pneumonia-related diagnoses, while other antibiotics are used less frequently or selectively. The choice of treatments reflects current antimicrobial practices and protocols for managing respiratory infections.
- Academic Insight: Data on treatment patterns, like the preference for ceftriaxone, are essential in clinical studies as they inform on antibiotic stewardship and resistance patterns. Such information can guide recommendations for future treatment protocols, emphasizing evidence-based choices for common respiratory infections in pediatric patients.

Discussion:

Acute respiratory infections (ARIs) are the leading cause of morbidity among children under five years old, especially within the pediatric services provided by the Jordanian Royal Medical Services. These infections result in a significant number of hospital visits and admissions due to the distinct vulnerability of children at this age. The physiological immaturity of the respiratory system and the nascent development of immune defenses make young children particularly susceptible to respiratory pathogens. At such an early age, anatomical barriers like the skin, respiratory epithelium, and gastrointestinal tract are not fully mature, and immune system components are relatively underdeveloped (Zar et al., 2021; Bui et al., 2020). This immature immune profile includes factors like the delayed placental transfer of immunoglobulin G (IgG), which only initiates at 32 weeks of gestation, and a notably low level of secretory IgA in the respiratory tract (Li et al., 2020).

In the first few months of life, infants depend on maternal antibodies that are transferred both transplacentally and through breastfeeding. However, between six months and three years of age, there is a significant decline in immunity, a phenomenon often referred to as "transient hypogammaglobulinemia of infancy." This decline occurs as maternal antibodies decrease due to the cessation of breastfeeding and the depletion of passive immunity (Rogers et al., 2022). Consequently, this period of weakened immune defense represents a critical window during which children become particularly vulnerable to acute respiratory infections (ARIs) (Mansour et al., 2021).

The study findings reflect previous observations by César and Robaina et al., who reported that ARIs predominantly affect male infants under one year old (César et al., 2020; Robaina et al., 2020). However, regional studies, such as those conducted in Venezuela, identify children aged one to two years as the most frequently impacted by respiratory infections (Vasquez et al., 2022). Beyond age and gender, multiple factors, especially socioeconomic determinants, create a shared landscape of risk. Malnutrition, exposure to environmental pollutants, and poor living conditions collectively increase the likelihood of ARIs (Michaud et al., 2023). Socioeconomic challenges often limit access to healthcare and create unfavorable environments for child health, further compounding morbidity rates due to ARIs in young children (Wang et al., 2021).

Several studies confirm that inadequate living conditions and socioeconomic status can foster more severe cases of ARIs by contributing to overcrowding, poor ventilation, limited healthcare access, low parental education, and unstable family dynamics (Murray et al., 2022). In densely populated environments, such as those frequently observed in lower socioeconomic settings, children are exposed to both infectious agents and passive smoke inhalation, which has been shown to compromise pulmonary function growth and elevate infection rates in the lower respiratory tract (Leung et al., 2021). Further, air pollutants and noxious gases emitted from cooking fuels in improperly ventilated areas contribute to respiratory inflammation and infection risk (Salam et al., 2020). Such exposures highlight the importance of household environmental health in mitigating respiratory disease risk.

Nutritional status, particularly malnutrition, is another critical determinant. Malnutrition leads to compromised immune function, including reduced production of antibodies, phagocytic capacity, and

natural killer cell activity (Patel et al., 2022). According to the World Health Organization (WHO), malnutrition is the second most critical risk factor for childhood morbidity (WHO, 2020). Though the incidence of malnutrition in this study was low, it was often associated with early weaning. The protective effects of breastfeeding are well-documented, as it promotes normal growth and confers immunity, reducing the likelihood of infections (Vikram et al., 2021). Early cessation of breastfeeding, particularly in malnourished infants, therefore poses an elevated risk for respiratory infections.

Atopy and hypersensitivity reactions further contribute to this elevated risk, as they alter the enzymatic cascades involved in anti-inflammatory processes (Gonzalez et al., 2020). In atopic individuals, immune dysregulation and an exaggerated inflammatory response disrupt normal functions of the complement system, leukotrienes, leukocytes, lymphocytes, and phagocytes, increasing susceptibility to viral infections (Bianchi et al., 2023). Recurring viral infections can facilitate bacterial superinfections, particularly in cases with excessive mucus secretion, which compromises mucociliary clearance (Martinez et al., 2021). Inefficient secretion drainage creates an ideal environment for pathogenic colonization and acute respiratory infection development.

In parallel studies, overcrowding was documented in 54.4% of cases, poor living conditions in 32.6%, and malnutrition in 37.0% of cases (Farah et al., 2020). These figures support the assertion that socioeconomic factors are intricately linked to ARI morbidity. The clinical manifestations of ARIs are largely determined by the specific site of infection, age of the child, and coexisting risk factors, with fever being the most frequently observed symptom. Research in Santiago de Cuba among children under five years old with pneumonia reported that fever and dyspnea were the primary clinical signs (Casanova DA, 2009). Anatomical and immunological characteristics at this age predispose children to certain patterns of ARIs, with pneumonia and bronchiolitis often presenting with rapid progression and severe symptoms (Cruz et al., 2022).

This study differs from several other investigations that identified acute rhinopharyngitis as the most common cause of ARIs, with a prevalence of 46.3%, followed by otitis media at 23.1% (Tawfik et al., 2021). In contrast, Robaina et al. and Maceo found that the common cold was the most prevalent ARI (Robaina et al., 2020; Maceo et al., 2021). The current study, however, noted that over half of the patients (58.7%) received ceftriaxone, largely in response to pneumonia and bronchopneumonia diagnoses in infants under one year of age (Zou et al., 2023). This reflects the treatment protocol in the study center, though inappropriate prescriptions were noted. The extensive use of antibiotics is concerning, as global literature indicates that 80–90% of ARIs are viral in origin (Rovers et al., 2021). Early antibiotic intervention is largely ineffective against viral pathogens, increases healthcare costs, and contributes to the development of antibiotic-resistant bacteria (Klein et al., 2021).

Excessive antibiotic use, particularly in primary healthcare settings, remains a global issue (Buchanan et al., 2023). This phenomenon is influenced by various factors, including the high prevalence of infectious diseases, patient expectations for antibiotics, inadequate awareness or adherence to clinical guidelines, self-medication, prescriptive habits, and pharmaceutical industry pressure (Rogers et al., 2022). Diagnosing the etiology of ARIs in young children can be challenging, leading to unnecessary antibiotic use that is ultimately counterproductive (Bong et al., 2021).

Acute respiratory infections represent a significant public health challenge due to their high morbidity rates worldwide (Gupta et al., 2023). Prompt diagnosis, identification of risk factors, and appropriate, evidence-based treatment are essential to minimizing complications and reducing mortality. In the context of the Jordanian Royal Medical Services, these findings underscore the importance of targeted interventions to reduce ARI morbidity, especially in socioeconomically disadvantaged populations (Abdallat et al., 2023). Ensuring comprehensive healthcare education, improving environmental conditions, and promoting appropriate nutritional practices will be essential strategies in mitigating the public health burden of ARIs in

children under five years old.

Conclusion:

This study underscores the significant burden of acute respiratory infections (ARIs) on children under five years old within the Jordanian Royal Medical Services, particularly affecting those under one year of age and children from socioeconomically disadvantaged backgrounds. The high prevalence of pneumonia and bronchopneumonia, combined with risk factors such as exposure to secondhand smoke, low socioeconomic status, and malnutrition, highlights the intricate interplay between biological vulnerability and environmental conditions in ARI morbidity. These findings are consistent with global patterns in pediatric respiratory infections, reaffirming the critical need for targeted, preventive interventions, particularly in resource-limited settings.

Additionally, the widespread use of antibiotics-most notably ceftriaxone-raises important considerations for antimicrobial stewardship, as the majority of ARIs are viral in origin. Excessive and often inappropriate antibiotic prescriptions not only elevate healthcare costs but also contribute to the escalating issue of antimicrobial resistance, which poses a substantial threat to public health.

Addressing ARI morbidity in this vulnerable population demands a multifaceted approach, integrating public health policies aimed at reducing environmental exposures, improving nutritional support, and promoting healthcare access for economically disadvantaged families. Enhanced healthcare provider training on evidence-based ARI management, coupled with community-level health education, can further mitigate the impact of ARIs and reduce preventable complications and hospital admissions. Ultimately, prioritizing these interventions within healthcare policy frameworks will be essential to safeguarding child health and alleviating the public health burden of ARIs.

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