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Streptococcus pneumoniae in Nineveh Province: A Comprehensive Infection Survey and Public Health Implications

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Abstract:

Objective: *Streptococcus pneumoniae* causes infections, including pneumonia, meningitis, otitis media, and mortality, particularly in children, the elderly, and immunocompromised patients. Public health is affected by *S. pneumoniae* in Iraq, and the high number of cases results from insufficient health care, mainly in Nineveh Province. The purpose of this study was to perform a wide-ranging survey of infections in Nineveh from 2020 to 2024.

Material and Methods: Patient data were gathered based on clinical symptoms and informed consent. Blood samples were tested for antibodies against *S. pneumoniae*. A statistical analysis was performed using Statistical Package for the Scocial Science (SPSS) to establish incidence rates and prevalence factors.

Results: It was found that pneumonia is common in the area, and the number of cases is predicted to rise noticeably in the years 2023 and 2024. Mosul experienced the highest number of cases. Tal Afar and Hamdaniya were second. The data show that infection affected people more commonly according to their sex and was highly concentrated in teens and young children.

Conclusion: The findings emphasize the importance of increasing therapeutic and preventive measures, improving health infrastructure, and raising community knowledge in order to decrease the spread of disease.

Keywords: infection, Mosul, pneumonia, prevalence, vaccine

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Introduction

Streptococcus pneumonia is an acute infection that causes fever, chills, pleuritic discomfort, dyspnea, productive cough, and leukocytosis. The onset may be less abrupt, particularly in the elderly. In infants and small children, the earliest symptoms may be fever, vomiting, and convulsions[1,2]. Pneumonia is the leading cause of death in newborns and the elderly, and while antimicrobials have reduced the case fatality rate to 5–10%, it still stands at 20–40% among patients with considerable underlying illness. In impoverished nations, the case-fatality rate in children frequently surpasses 10%, reaching 60% in infants under 6 months of age. It is an endemic disease that primarily affects infants, the elderly, and people with underlying medical issues[3,4].

Pneumonia is more frequently found in poor countries and communities. Winter and spring in temperate zones see the most cases of influenza, and the disease can affect people all year round in all other climates. Most centers log illnesses according to what a patient shows, initially as symptoms and signs, because it is difficult to identify specific bacteria. Most patients come in after starting antibiotic treatment; confirmation tools are not readily available[5,6].

S. pneumoniae comprises 83 recognized types and 11 serological patterns, accounting for approximately 75% of global infections. Pneumococci can be detected in the upper respiratory tracts of healthy people from around the world via droplet spread, direct oral contact, or indirect exposure to respiratory secretions-contaminated things. Person-to-person transmission is prevalent, although illness spread between casual contacts and companions is unusual. Presumably, pathogenic pneumococci are no longer present in considerable amounts of oral and nasal secretions. Penicillin kills susceptible strains within 24–48 hours[7,8].

Susceptibility and immunity

Exposure to influenza, pulmonary edema, alcohol, chronic lung disease, and air irritants can all make a person more likely to get symptomatic pneumococcal infection. Older people and those with chronic illnesses, including asplenia, sickle cell disease, chronic heart disease, diabetes, kidney failure, and HIV infection, are more likely to face risks. In most cases, infection develops once a person is no longer immune to the particular serotype, and it can continue for years[9,10].

Incidence of *S. pneumonia* in Iraq

More than 3% of the population in Iraq is aged 65 and older, and about 19% of adults report high blood pressure, 13% report high blood sugar, and 27% are overweight. Moreover, it is thought that up to 31% of Iraqi men and 4% of women smoke tobacco, which raises the likelihood of pneumococcal disease. In 2015, Iraq experienced about 111,636 cases of pneumococcal diseases, the majority being pneumonia. There were 1,954 deaths reported[11,12].

The absence of laboratory facilities and the reliance on clinical diagnosis have resulted in significant difficulties for Iraq in the diagnosis and surveillance of pneumococcal illnesses. The absence of an efficient surveillance system further complicates the estimation of the disease's actual burden. Although the conjugated pneumococcal vaccine (PCV) was added to the national vaccination schedule in March 2017, just 37% of children received the vaccine in 2019, leaving over a million youngsters unprotected[13,14].

One reason immunization is low in Iraq is that people lack access to education, are not informed about vaccines, are concerned about getting side effects, and deal with various difficulties caused by politics, economics, and security. Wars made things worse by forcing people to change their homes and leading to the spread of contagious diseases. Immunization efforts have decreased because

of the COVID-19 pandemic, which raises the possibility of more vaccine-preventable disease outbreaks[15,16].

Disease control

To control disease:

1- It is crucial to report epidemics rather than individual cases.

2- Avoiding congestion in household and public areas.

3- Hospital isolation and the burning of patient waste. Respiratory isolation of patients may be justified, such as in cases of antibiotic-resistant diseases.

4- Specific therapies, such as antibiotics for germs and viruses, and postponing treatment can be lethal, particularly in newborns and young children, depending on the clinical indicators.

5- During outbreaks in institutions or other limited population groupings, inoculation with the 23-valent vaccine should be implemented, unless the type causing the disease is not included in the vaccine[17,18].

This study attempted to assess the frequency of pneumonia in Mosul and Nineveh's suburbs between 2020 and 2024.

Material and Methods

This work was documented in compliance with the consent of the College of Medicine Ethics Committee UOM/COM/MREC/25-08/FEB2. The study cases were first detected by specialized physicians based on a set of clinical symptoms. Patient information was gathered using the consent form found in the appendix file. After verifying the clinical signs, a laboratory investigation was performed on patients' blood samples to detect the presence of antibodies against *S. pneumonia*. The study samples included all clinically and laboratory-verified cases in Nineveh Province from 2020 to 2024.

Gathering information like gender, age, location, symptoms, and lab results for each patient was completed using records at hospitals and clinics. Cases were divided into groups of less than one year, one to 4 years, 5 to 14 years and so on, until more than 45 years of age.

Just like other conditions, clinical diagnosis of symptoms and epidemiology was used to determine how much pneumonia occurred, and not by testing for its causes. Although *S. pneumoniae* can be distinguished from other infections, no specialized tests were done for this purpose. When looking at the findings, remember that pneumonia could be caused by many infectious strains in addition to pneumococcal ones. Further research should add microbiological procedures to improve how cases are diagnosed.

The analysis of the data was done with SPSS version 25. Through the analysis of data with statistical tools, epidemiologists found the way that diseases are transmitted, and tracked any changes in incidence over different periods. ANOVA testing helped calculate the correlation between different variables.

Results

Because of a high number of cases, pneumonia is considered a disease that constantly occurs in Iraq, including Nineveh Province. The number of cases changes in relation to the number of people living in a region. The incidence was evaluated between 2020 and 2024. It was observed that the changes in incidence rates are obvious. In this study, peak cases occurred in 2023 and 2024, with a significant difference in infection rates between males and females.

A small variation was observed in the number of infections among the first 3 age groups of less than 15 years, while the other 2 groups had lower numbers, i.e., among the ages over 15 years, which is consistent with the widely recognized recorded statistics. Table 1 and Figure 1 reveal a significant association between the number of infections and age groups (3 and 4) and gender (p-value<0.01).

Table 1 Pneumonia cases by age group and gender 2020–2024

Year	<1Y		1–4		5–14		15–44		>45Y		Total		Grand total
	M	F	M	F	M	F	M	F	M	F	M	F	
2020	1,142	993	1,243	1,087	1,077	947	267	245	198	174	3,927	3,446	7,373
2021	1,242	1,108	1,275	1,132	897	802	306	270	181	168	3,901	3,480	7,381
2022	673	618	895	761	702	699	220	214	168	98	2,658	2,390	5,048
2023	1,126	936	1,247	1,143	1,030	911	239	168	213	181	3,855	3,339	7,194
2024	1,140	937	1,667	1,433	1,358	1,282	561	573	746	584	5,472	4,809	10,281
Total	5,323	4,592	6,327	5,537	5,064	4,640	1,589	1,470	1,506	1,204	19,813	17,464	37,277

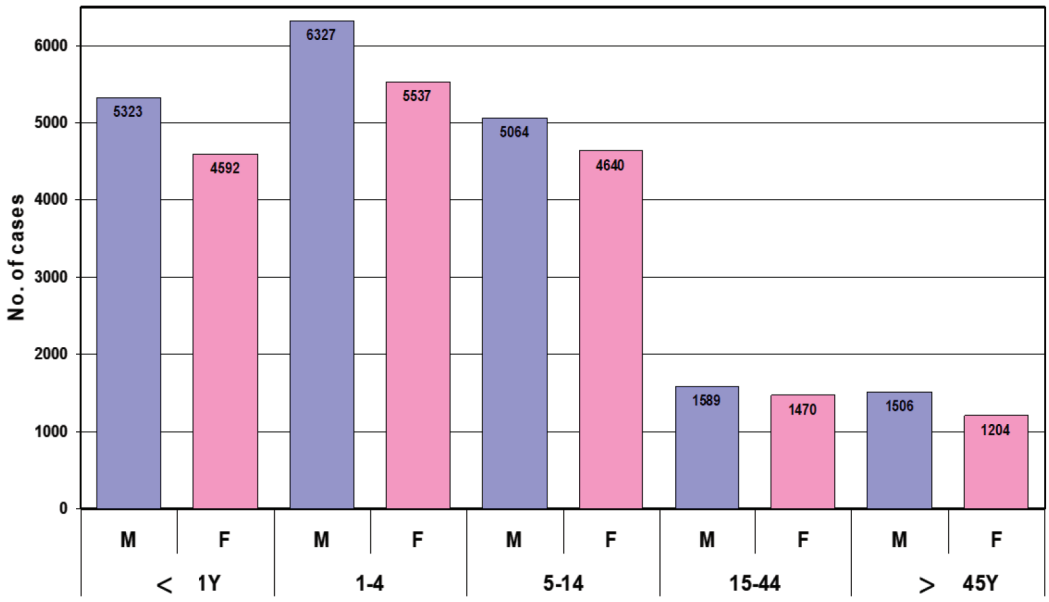

Figure 1 Pneumonia cases by age groups and gender reported in Nineveh Province

According to the findings of the current study, the highest rates of infection were concentrated in Mosul city districts, Ayser followed by Aymen. In Nineveh Province, Tal Afar had the maximum recorded instances, followed by Hamdaniya district and Baaj. The remaining districts recorded smaller numbers, as seen in Table 2 and Figure 2.

Discussion

Pneumonia is a severe respiratory disease that has a considerable impact on public health, particularly in densely populated locations with challenging environmental and socioeconomic factors[19].

Table 2 Pneumonia cases by district 2020–2024, suburban Ninawa

Years	Aymen	Ayser	Talafar	Sinjar	Ba'aj	Talkeif	Sheekhan	Hamdaneya	Qayara	Hadhar	Makhmoor	Other province	Total
2020	2,647	2,658	0	18	1,047	301	125	414	3	117	41	2	7,373
2021	2,600	2,638	353	83	327	418	86	478	17	333	47	1	7,381
2022	1,518	1,278	959	34	88	208	83	631	18	175	56	0	5,048
2023	1,724	1,154	1,933	41	227	306	420	1,249	12	3	76	49	7,194
2024	3,384	2,870	1,317	136	684	303	376	1,034	35	28	100	14	10,281
Total	11,873	10,598	4,562	312	2,373	1,536	1,090	3,806	85	656	320	66	37,277

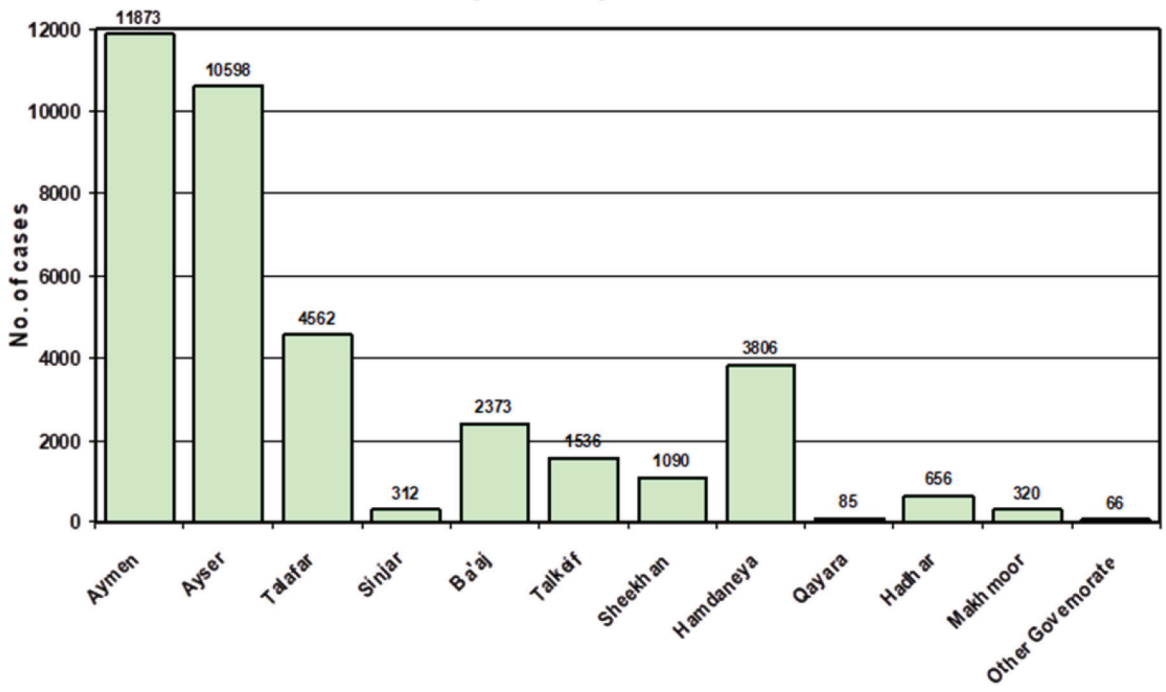

Figure 2 Pneumonia cases by district 2020–2024, suburban Ninawa

There are several agents involved in causing pneumonia, like bacteria, viruses, or fungi. Besides *S. pneumoniae*, *Haemophilus influenzae*, *Mycoplasma pneumoniae*, and respiratory viruses play a big role in causing pneumonia. The study mainly examined pneumococcal pneumonia, yet we accept that there are other agents that can cause pneumonia[20,21]

According to data from Nineveh Province, Iraq, pneumonia is an endemic disease with a considerable number of cases reported each year. Between 2020 and 2024, there was a variation in the number of cases that was exactly related to the size of the population, indicating the importance of population density on disease propagation.

Between 2023 and 2024, infections increased dramatically, and a lot more cases were reported. The rise might have occurred for environmental or social reasons, or it could have been caused by improved case reporting. Studies show that children below 15 years old were the most likely to get infected, and the differences among the other age groups were very small. In comparison, the number of cases among individuals older than 15 years was much lower, which might be because they have acquired some protection from the disease or are less likely to encounter it.

The percentage of people with infections was higher in men than women, which may be connected to the different causes or ways of handling health in each group. Male infection rates were substantially greater than females (p-value<0.01), possibly due to variations in etiological variables or health practices between the sexes. Geographically, the city of Mosul (Ayser) had the most cases, followed by the Tal Afar region, indicating that these places may be more vulnerable to outbreaks, due to high population density or a lack of health services.

The results show that more focus on treating and preventing the disease in at-risk groups like youths is required. Health authorities also need to focus on improving health facilities and informing the public in order to reduce the chance of pneumonia in Nineveh Province and the whole country.

Based on what is known now, preventive measures in crowded areas, centered on young populations, should be improved. Health systems should be augmented in places where infections are the most common, for example, Tal Afar and Hamdaniya. Conversely, further research is needed to determine the particular elements that lead to males' higher infection rates than females. The local government's interest in increasing health awareness programs to enhance preventive habits among the people, particularly in the most impacted areas, is required. The current study results could help with public health decision-makers' direct preventive and therapeutic measures to limit the spread of pneumonia in Nineveh Province and Iraq in general[22-24].

A previous study found that children under the age of 4 had the highest rates of pneumonia, which was attributable to their underdeveloped immune systems. The immunological protection offered by mother's milk, particularly IgA and IgG, has resulted in a decrease in the number of infections among children under the age of one year. Recently, however, infection rates have gone up among children over 4, based on more time spent outdoors at nurseries and schools, and incomplete pneumococcal vaccinations in some cases[25,26].

According to a previous study, the number of children with pneumococcal infection was 23.5%, and the infection was more common in males (16.5%) than females (7%). The current findings are in agreement with what Saleh (2019) observed: about 27% of children experience pneumococcal infections in emergency departments[27,28].

Vaccination is the best way to stop chronic diseases, but in Iraq, chaos and crowded camps mean that people are not vaccinated, which helps diseases to spread. Through enhanced surveillance and the analysis of data, potential groups at risk may be discovered. Furthermore, stronger regulations should be put in place for getting, storing, and distributing vaccines. Raising community awareness and training health workers is required to promote community participation in combating this disease[29-30].

Conclusion

Children under 15 in Nineveh Province are most commonly affected by pneumonia, and males are more often affected than females. Reported infections went up in 2023 and 2024, and there were large differences in the areas affected, with Mosul and Tal Afar recording the most infections. Due to the evidence, effective and precise

clinical tests, as well as strong prevention measures, should be used, mainly in the regions with the highest sickness rates. Based on the evidence, changing and enhancing both healthcare and prevention programs are important, particularly focusing on the areas with the highest rates of infections. Spreading health education and improving disease monitoring helps a lot in stopping diseases from spreading.

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Conflict of interest

The author declares that there is no conflict of interest associated with this research.

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