

Prevalence of *Klebsiella pneumoniae* Infection in Adults Attending National Hospital, Abuja, Nigeria

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Abstract

Original Research Article

This study was aimed at determining the prevalence of *Klebsiella pneumoniae* infection in adults attending National Hospital, Abuja. A semi structured questionnaire for socio-demographic information was administered after obtaining patients' informed consent. A prevalence rate of 21.0% was recorded for this study, with the highest prevalence of 30.9% recorded among the female group, while the male group recorded the prevalence of 8.9%, ($P>0.05$). In terms of age, prevalence rates, increased with increase in age of adults ($P<0.05$). Prevalence of the *Klebsiella pneumoniae* infection varied with educational qualification of adults, with those who had no formal education recording the highest prevalence of infection (42.9%). There was also a significant association between educational qualification and prevalence of infection ($P<0.05$). Those who had knowledge of respiratory tract infections recorded lower prevalence of infection (14.0%) and this was significant ($P<0.05$). Those who had a form of respiratory infection however, recorded higher prevalence of the infection (25.9%) and risk factors of living in crowded areas were statistically not significant in this study ($P>0.05$). Those who had a history of Pneumonia had a higher prevalence of infection, but this was not significant ($P>0.05$). There was also a significant difference between prevalence of *Klebsiella pneumoniae* infection and exposure to cold ($P<0.05$). A relatively high prevalence of the infection was recorded in this study, which justifies the need for more awareness of *klebsiella pneumoniae* infection.

Keywords: Respiratory tract infection, Klebsiella, Prevalence, Pneumonia.

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STUDY BACKGROUND

Klebsiella pneumoniae accounts for a significant portion of hospital acquired infections. The principal pathogenic reservoirs for transmission of *Klebsiella* are the gastrointestinal tract and the hands of hospital personnel, because of their ability to spread rapidly in hospital environments, these bacteria tend to cause nosocomial outbreaks. It is well known to most clinicians as a cause of community acquired bacterial pneumonia, occurring particularly in chronic alcoholics [1]. Although found in the normal flora of the mouth, skin, and intestines [2] it can cause destructive changes to human and animal lungs if aspirated, specifically to the alveoli resulting in bloody sputum. In the clinical setting, it is the most significant member of the *Klebsiella* genus of the Enterobacteriaceae. *Klebsiella oxytoca* and *Klebsiella rhinoscleromatis* have also been demonstrated in human clinical specimens. In recent years, *Klebsiella* species have become important pathogens in nosocomial infection [3]. It naturally occurs in the soil, and about 30% of strains can fix

nitrogen in anaerobic conditions [4]. As a free-living diazotroph, its nitrogen-fixation system has been much-studied, and is of agricultural interest, as *Klebsiella pneumoniae* has been demonstrated to increase crop yields in agricultural conditions [5]. It is closely related to *Klebsiella oxytoca* from which it could be distinguished by being indole-negative and by its ability to grow on Melezitose but not 3-hydroxybutyrate. Illness affects middle-aged and older people with debilitating diseases. This patient population is believed to have impaired respiratory host defenses, including persons with diabetes, alcoholism, malignancy, liver disease, chronic obstructive pulmonary diseases, glucocorticoid therapy, renal failure, and certain occupational exposures (such as paper-mill workers). Many of these infections are obtained when a person is in the hospital for some other reason (a nosocomial infection) [6]. In addition to pneumonia, *Klebsiella* can also cause infections in the urinary tract, lower biliary tract, and surgical wound sites. The range of clinical diseases includes pneumonia, thrombophlebitis, urinary

tract infection, cholecystitis, diarrhea, upper respiratory tract infection, wound infection, osteomyelitis, meningitis, and bacteremia and sepsis. For patients with an invasive device in their bodies, contamination of the device becomes a risk factor; for example, neonatal ward devices, respiratory support equipment, and urinary catheters put patients at increased risk. Also, the use of antibiotics can be a factor that increases the risk of nosocomial infection with *Klebsiella* bacteria. Sepsis and septic shock can follow entry of the bacteria into the blood [7]. *Klebsiella* ranks second to *Escherichia coli* for urinary tract infections in older people. It is also an opportunistic pathogen for patients with chronic pulmonary disease. New antibiotic-resistant strains of *Klebsiella pneumoniae* are appearing [8]. *Klebsiella pneumoniae* was first described by Carl in 1882 as a bacterium isolated from the lungs of patients who have died from pneumonia [2], is an important opportunistic pathogen and a frequent cause of nosocomial infections. Infection can occur at nearly any body site, however urinary and respiratory tract infections predominate infections that are frequently preceded by gastrointestinal colonization, and gastro intestinal tract is believed to be the most important reservoir for transmission of the bacteria. *Klebsiella pneumoniae* is a Gram-negative, non-motile, facultative anaerobe belonging to the Enterobacteriaceae family of the γ -Proteobacteria class in the phylum Proteobacteria. *Klebsiella pneumoniae* consists of straight rods 1 to 2 μm in length with a thick, surrounding capsule, it is ubiquitous in nature. When cultured, this species produces a distinctive yeasty odor and bacterial colonies have a viscous/mucoid appearance it is commonly found in the human digestive tract as part of the natural microflora, and is often the cause of hospital acquired, or nosocomial infections involving the urinary and pulmonary systems, especially since it is able to adapt to an existence in an oxygenated or deoxygenated environment. Immunocompromised individuals (people with AIDS or cancer) infected with *Klebsiella pneumoniae* usually develop respiratory tract infections such as pneumonia, but blood infections (septicemia), wound or surgical site infections, and meningitis are also possible [9]. This pathogen possesses many virulence factors that allow it to go undetected by the host's immune system and cause infection in a variety of ways. Firstly, this species uses ferric-siderophore receptors of the host to activate their enterobactin-mediated iron-sequestering system, allowing bacterial

growth. Their thick polysaccharide capsule prevents ingestion by phagocytes and their somatic antigens from being detected by the host's antibodies.

HYPOTHESIS

Ho: The Prevalence of *Klebsiella pneumoniae* infection in adults attending National Hospital Abuja is not significant.

Ha: The Prevalence of *Klebsiella pneumoniae* infection in adults attending National Hospital Abuja is significant.

METHOD

The study of the population consist of adults within the age range of 18 years and above attending National Hospital, Abuja. Approximated sample size for this research is 100 samples.

Laboratory data, clinical data and samples from adult patients was obtained for this study. Sputum sample was produced by a deep cough in an open space and was collected in a well labeled sterile sputum collection cup, samples collected were then transferred to the laboratory for further processing. Socio-demographic data was obtained through questionnaires which was given to the patients. All the equipment used in the laboratory for sample processing were first sterilized. The media used (Nutrient agar, blood agar and MacConkey agar) were prepared according to manufacturers instruction. The sputum sample were first inoculated on well labeled media (MacConkey agar and Chocolate agar) using a sterilized wire loop, it was incubated for 24 hours, at 36 C, the culture results were read, followed by gram staining of the organism. After gram staining of the organism an antibiotic susceptibility test was carried out using Nutrient agar media on cultures that yielded growth of organism, the colonies were collected using a sterilized wire loop and were streaked across a nutrient media and the antibiotic disk was carefully picked using a picker and placed on the media , it was incubated for 24 hours, results were recorded accurately. Results obtained from this study has been represented graphically using tables and bar charts, results were then analyzed statistically using chi square.

RESULTS

Table-1: Prevalence of *Klebsiella Pneumoniae* infection in relation to Gender, in adults attending National Hospital, Abuja

Gender	Number examined	Number positive	Prevalence (%)
Male	45	4	8.9
Female	55	17	30.9
TOTAL	100	21	21.0

$$\chi^2=7.23, df=1; P=0.007$$

Table-2: Prevalence of *Klebsiella pneumoniae* infection in relation to Age, in adults attending National Hospital, Abuja

Age	Number examined	Number positive	Prevalence (%)
18-28	27	3	11.1
29-38	25	1	4.0
39-48	10	3	30.0
49-58	20	6	30.0
59-68	5	2	40.0
69-78	13	6	46.2
TOTAL	100	21	21.0

$$\chi^2=13.45, df=5; P=0.019$$

Table-3: Prevalence of *Klebsiella pneumoniae* infection in relation to Education, in adults attending National Hospital, Abuja

Education	Number examined	Number positive	Prevalence (%)
No formal Education	21	9	42.9
Primary	32	2	6.3
Secondary	29	5	17.2
Tertiary	18	5	27.8
TOTAL	100	21	21.0

$$\chi^2=10.99, df=3; P=0.012$$

Table-4: Prevalence of *Klebsiella pneumoniae* infection in relation to Knowledge and Presence of Respiratory Tract Infection, in adults attending National Hospital, Abuja

Knowledge	Number examined	Number positive	Prevalence (%)	P-value
Yes	57	8	14.0	0.04
No	43	13	30.2	
Have Respiratory Tract Infection				
Yes	27	7	25.9	0.46
No	73	14	19.2	
TOTAL	100	21	21.0	

Table-5: Prevalence of *Klebsiella pneumoniae* infection in relation Risk factors, in adults attending National Hospital, Abuja

Risk factor	Number examined	Number positive	Prevalence (%)	P-value
Living In Crowded Areas				
Yes	61	12	19.7	0.68
No	39	9	23.1	
Frequent Exposure to cold				
Yes	46	14	30.4	0.03
No	54	7	13.0	
History of Pneumonia				
Yes	10	3	30.0	0.46
No	90	18	20.0	
TOTAL	100	21	21.0	

Table-6: Prevalence of *Klebsiella pneumoniae* infection in relation to Location, in adults attending National Hospital, Abuja

Location	Number examined	Number positive	Prevalence (%)
Garki	27	8	29.6
Lugbe	18	1	5.6
Gwarimpa	29	8	27.6
Jabi	11	0	0.0
Lokogoma	15	4	26.7
TOTAL	100	21	21.0

$$\chi^2=7.77, df=4; P=0.10$$

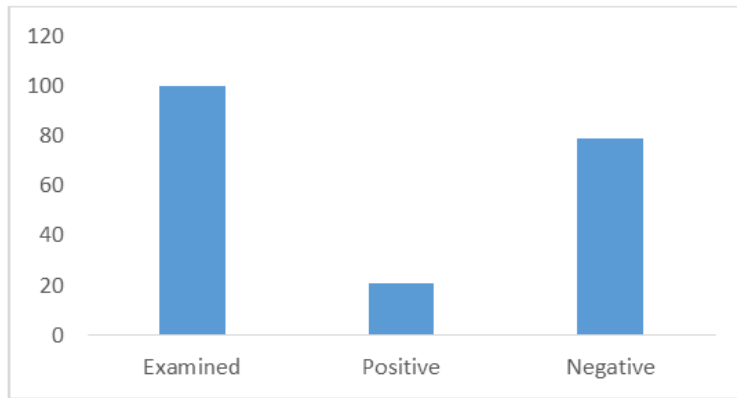


Fig-1: Overall prevalence of *Klebsiella pneumoniae* Infection in adults attending National Hospital, Abuja

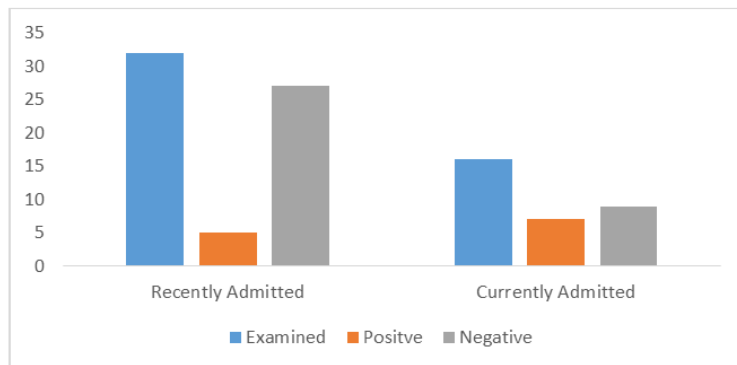


Fig-2: Prevalence of *Klebsiella pneumoniae* infection in relation to admission status

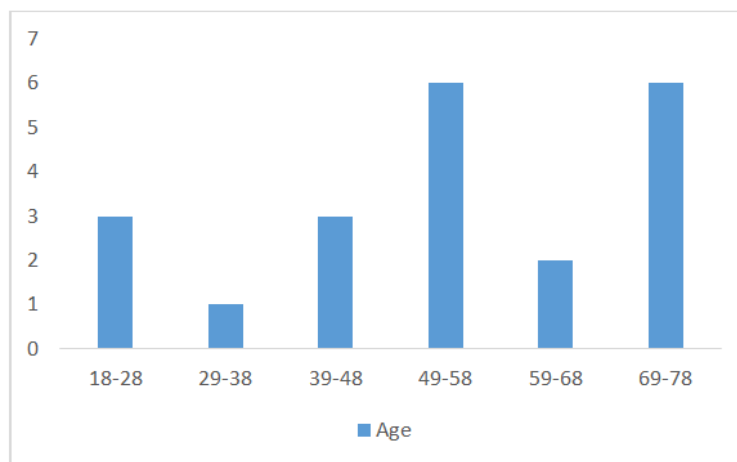


Fig-3: Prevalence of *Klebsiella Pneumoniae* infection in relation to age

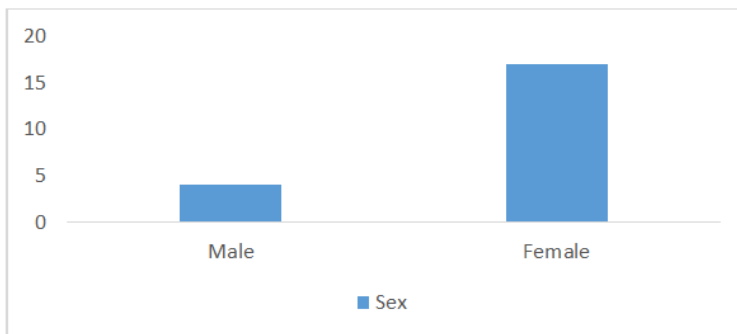


Fig-4: Prevalence of *Klebsiella pneumoniae* infection in relation to sex

DISCUSSION

This study revealed an overall prevalence of 21.0% with 21 of the total number of patients examined positive for the bacterial infection. A prevalence rate of 21.0% is lower than what has been reported in the past. It is lower than a prevalence rate of 98.61% reported by Langarizadeh *et al.*, [10] in their study on prevalence of multi-drug resistant *Klebsiella pneumoniae* among children and adults referred to Tabriz Teaching Hospital in Iran. A prevalence rate of 21.0% is lower than 61% prevalence and 16% prevalence recorded for two serotypes of *Klebsiella pneumoniae* in the study of Chang-Phone *et al.*, [1]. However, a prevalence of 21.0% as characteristic of this study is higher than that of Hamza and Abdulhadi [11], who reported a prevalence of 7.0% for *Klebsiella pneumoniae* in their study conducted in Kano State, Nigeria and also that of Ragasa *et al.*, [12] who reported a prevalence of 5.3% in their study conducted in Jimma University Specialized Hospital, Jimma, Ethiopia. Variations in prevalence rates of infection as observed between the findings of this study and retrospective studies might be as a result of prevailing environmental and risk factors which predisposes inhabitants of the various regions where the different researches were conducted to infection with *Klebsiella pneumoniae*. This study revealed that females have a higher prevalence of the infection (30.9%) than males (8.9%). This high prevalence among females may be attributed in part to the domesticated nature of most females who are often exposed to dust in the course of carrying out their feminine duties in the home as opposed to males who rarely engage themselves in activities that such as cooking and sweeping. Also females are known to be burden bearers in most homes, waking up very early in the morning to ensure that foods in the home are ready for the family. These early functions of theirs might expose them to cold which is usually more pronounced at the early hours of the morning than other periods. Highest prevalence of *Klebsiella pneumoniae* infection in females as recorded in this study is similar to that of Hamza and Abdulhadi [11], who reported a higher prevalence in females (62.5%) than males (37.5%). A higher prevalence of infection with *Klebsiella pneumoniae* as recorded in this study is however in disagreement with the report of Chang-Phone *et al.*, [1] who reported a higher prevalence of the infection amongst males (57.6%). Statistical analysis showed that there was a significant difference in prevalence rates between the ages $P < 0.05$. Prevalence rates increase in patients between the ages of 39-48 (30.0%) up to 69-78years (46.2%). This finding is similar to the report of Hooi *et al.*, [4] who reported an increasing prevalence of infection with increasing age group from 30-39years (10.2%) to 60-69years (20.4%). This implies that as one's age increases, his/her tendency to become infected with *Klebsiella pneumoniae* increases. This finding might be as a result of the weakened immunological capacity of the human body with aging which makes them more susceptible to opportunistic

infections. This is also a possible reason for the lowest prevalence of infection recorded for by age group of 29-38years. The findings of this study is however in disagreement with the report of Hamza and Abdulhadi [11] who recorded highest prevalence of the infection amongst age group 21-30years. Highest prevalence of infection was observed amongst adults who have no formal education (42.9%). A significant difference in terms of education of adults attending National Hospital, Abuja implies that the level of education of people determines their level of information and as such their ability to prevent themselves from acquiring bacterial infections such as the one under consideration. Therefore, people who are educated formally stand a better chance of being free from the infection since they are well guarded on the basic knowledge available on Pneumonia and its causal organisms. Knowledge of respiratory tract infection such as *Klebsiella pneumoniae* as it affects the prevalence of infection in this study was also significant ($P < 0.05$). This was observed in the high prevalence of the infection amongst adults who had no knowledge about the presence of respiratory tract infection (30.2%) when compared to those who have knowledge (14.0%). The occurrence of any form of respiratory tract infection also affected the prevalence of infection as those who had some form of respiratory tract infection recorded highest prevalence of infection (25.9%) when compared to those who don't (19.2%). This was however not statistically significant ($P > 0.05$). This study shows that those who live in crowded areas recorded a lower prevalence of infection (19.7%) than those who live in areas not crowded (23.1%) but this was not significant ($P > 0.05$). Those who had history of Pneumonia however recorded a higher prevalence of infection (30.0%) than those who had never been infected with Pneumonia in the past (20.0%). However, those who were frequently exposed to cold recorded a higher prevalence of infection (30.4%) than those who don't (13.0%) and this was significant. It therefore follows that exposure of oneself to cold can increase the probability of becoming infected with *Klebsiella pneumoniae* and vice versa. Prevalence of infection differed with locations with those from Jabi area of Abuja recording a lower prevalence of infection than those from Garki, Lugbe, Gwarimpa and Lokogoma; which was not significant ($P > 0.05$). This implies that location is not a significant factor affecting the prevalence of infection amongst adults attending National Hospital, Abuja.

CONCLUSION

The prevalence of *Klebsiella pneumoniae* infection amongst adults at National Hospital Abuja is dependent on age, sex, level of education, knowledge of respiratory tract infections and exposure to cold. Location and living in crowded area however poses no significant effect on the prevalence of infection on the selected study population.

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