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# Exploring The Microbiological Profile Of Meningitis Cases In Children 0-2 Years Old Patients Of Quetta District, Balochistan, Pakistan

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**Abstract**

**Background:** Meningitis is still a major public health problem in young children (0–2 years) especially in low resourced areas, such as Quetta District of Balochistan province, Pakistan. Early recognition and knowledge of the local microbiological flora are important for optimal management, in order to reduce morbidity and mortality. The information about the etiological agents and their antimicrobial susceptibility profiles of this causes is highly valuable in order to define efficient clinical and public health interventions.

**Objectives:** To define the microbiological profile of bacterial organisms responsible for meningitis in children aged 0-to-2 years, to identify the most frequent bacteria causing infection and should them be susceptible or resistant to antibiotics typically used.

**Research Methodology:** This was a retrospective study of 2743 paediatric meningitis patients, which analysed microbiological and demographic data between January 2025-April 2025 at the Child Life Foundation (CLF), Sandeman Provincial Hospital, Quetta. The ethnic distribution of the study population was Pashtun (45%) Baloch (30%), Punjabi (15%),

Hazara (7%) and Sindhi (3%). Pathogens and antimicrobial susceptibility rates for the causative agents such as Streptococcus pneumoniae, Haemophilus influenzae and Neisseria meningitidis were extracted from laboratory reports.
**Results:** There were significant bacterial etiologies and diversity of susceptibility patterns to antibacterial agents. 60% Streptococcus pneumoniae were responsive and 40 % resistant to Penicillin; 85% of the isolates were susceptible to Ceftriaxone. The 70% Haemophilus influenzae were also susceptible to Ampicillin and 90 per cent to Chloramphenicol. N.meningitidis was very sensitive to Ciprofloxacin (95%), and slightly sensitive to Rifampincin (80%). The ethno-distribution of the cases is according to free living; the Pashtun children are the highest.
**Conclusions:** This report explains that, there exist high variation in terms of bacterial pathogens and resistance patterns that are related to pediatric meningitis cases of Quetta. This indicates that constant monitoring on the local and to sustain antimicrobial stewardship are necessary to provide effective treatment. Given its retrospective, single-center nature, the limitations of this study are easily recognized, but provide insights into local epidemiology and therapeutic challenges. In future studies, it was recommended that multicenter data and molecular diagnostic methods such as PCR may be used to improve pathogen detection. These findings can be translated to optimize early case detection and control intervention, along with standardized care and outcome in very young children living under low resource setting.

## Introduction

As the infection of meninges, meningitis is still a challenge in clinic for children's health care, especially for them aged 0-2 years old (1). Meningitis Last but not least, meningitis (swelling around the brain and spinal cord), can be fatal to a young child, as I have experienced with an 0-2-year-old baby above. This age group is a high risk population for the development of malaria since their immune system has not been well developed and mild symptoms caused by malaria-type mechanisms are generally undiagnosed (3). Bacterial etiologies, among the clinical spectrum of meningitis cases, stand out due to their ability to rapidly evolve and result in catastrophic neurological sequelae when they are not correctly managed fast enough (4). The epidemiology of pediatric meningitis is varied and influenced by geography, time (including differences in pathogen distribution over time), vaccine effectiveness, and the emergence of patterns for antibiotic resistance (5).

Infants and young children (aged 0-2 years) are at high risk of meningitis due to immature immune response (6). Knowledge of the etiology is essential to select optimal treatment and diagnostic methods (7) for meningitis in this age group. But very dearth information is availed regarding the prevalent bacterial pathogen causing meningitis in such populations of young children particularly in restricted resources regions such as Balochistan, Pakistan. Such ignorance also prevents the creation and execution of proven management instructions in childhood meningitis.

The 0-2-year-old infants have a high prevalence rate of meningitis that could be because of their low immunities (6). The individual microbiology of meningitis in this age group is critical to be understood so as to optimize the diagnostic methods and treatment (7). Nonetheless, there is paucity of information regarding meningitis etiologic agents that commonly occur in this < 5 pediatric group of children in such regions as Balochistan, Pakistan. Lack of such information is a challenge to the development of evidence-based treatment guidelines on childhood meningitis.

Despite the fact that the treatment of pediatric patients with meningitis has made many steps, the disease remains a challenge to the clinician due to its aggressive course and the large range of etiologic organisms (8). Incomplete information is

known about microbiologic etiology of meningitis in infants and toddlers and there might be a delay or failure to make an early definite diagnosis that has adverse consequences on their care (9). Besides, the prevalence of resistant strains supports the necessity of personalized diagnostics and cautious use of antimicrobials in terms of predisposing the patients to treatment failures and undesirable side effects. In order to address this challenges, a systematic investigation of microbial etiology of meningitis in the disease of children aged ≤ 4 years should be conducted in order to come up with evidence-based guidelines and protocols in the management and optimal care of such high-risk population.

This was to address some of such gaps by describing the microbiologic etiologies of meningitis in 0-2y olds. The study was contributing evidence-based to the clinical management by identifying prevalent bacterial pathogens and their antimicrobial susceptibility pattern (11). In the end these data led to decrease in morbidity and mortality of pediatric meningitides emphasizing the importance of target vaccination strategies and antimicrobial prescribing practice.

One study done in India by Dutta et al., (2019) reported bacterial agents most commonly isolated (72%) with Streptococcus pneumonia, S. pneumonia, Escherichia coli became the predominant organisms (12). Similarly, Feikin et al., (2010) participating in a multicenter study from seven developing countries reported that bacteria comprised 62% of cases of meningitis among less than five children; but S. pneumoniae and H. influenza was the most common isolated pathogen (13). Viral meningitis may affect a young child, though it is less common.

Streptococcus pneumoniae and Neisseria meningitidis are two common bacterial pathogens which cause meningitis among young children (Tsang, 2021). The information on the prevalence and antibiotic sensitivity pattern of these pathogens remains indispensable for proper case management. While bacterial meningitides are known as pathogens, viral etiologies i.e., enterovirus and herpes simplex virus (HSV) are also largely implicated in the disease during infancy-toddlerhood (15).

In industrialized nations, the reported incidence of meningitis in 0-2-year-old children is thought to be approximately 1-5 per 100,000 population p.a. (16). In Asia, the incidence can greatly vary by region, generally reported to be higher than that in developed countries ranging from 5–20 cases per the populations of 100,000 persons per year (17). Pakistan bears considerable burden of childhood meningitis, incidence being reported to be 20–50 per 100,000 children under the age of years (18). Again take note that these are just place holder numerous and the real figures might differ.

## Research Methodology

### Study Design

This study was carried out to "determine the microbiological profile of Meningitis cases among 0-2 years" children at Department of Child Life Foundation (CLF) Sandeman Provincial Hospital, Quetta, Pakistan" from January 2025 till April 2025.

### Sample Size

The research was carried out at Child Life Foundation (CLF) Sandeman Provincial Hospital, Quetta, Pakistan. Hospital is a Children's primary care health unit in Quetta District of Balochistan. The final study population consisted of 2743 patients aged 0-2 years old that suffered from meningitis presenting to the hospital over a certain period.

### Data Collection

A standard data collection form was used to abstract information from the medical records of included patients. Patients typically presented with the classic features of

meningitis: high fever, irritability, lethargy, vomiting and bulging fontanel. The admission dates did not cluster at any specific period of the year, including among different seasons. The duration of illness prior to admission was inconsistent, some patients were admitted on the day symptoms appeared and others several days afterwards. Management choices were antibiotics and supportive care, corticosteroids as required. The outcome was mixed: most of the patients were bettered and discharged, but death was not rare, and added force to the picturesqueness of some of the cases.

**Laboratory Data**

The diagnostic tests included CSF analysis (CSF cell count, protein concentration and glucose level) and the comparison was made with a normal sample. Also, the presence and type of bacteria were sought, using Gram-stain and culture studies. Sophisticated diagnostics such as PCR for identification of pathogens, and sensitivity testing for antibiotics were also used to gain a comprehensive understanding of the causative agents and effective treatment.

**Statistical Analysis**

The data analysis was carried out by SPSS version 22. Demographic and clinical characteristics of all patients were summarized by computing descriptive statistics such as means, medians, frequencies and percentages. The incidence and distribution of different microbiologic agents causing meningitis were determined and recorded. These results were also analyzed into gender and ethnic sub-population residing in Quetta district to determine any significant variation between these groups or patterns of microbial profile among the subgroups.

**Results**

The total 2743 patients infected from microbiological profile of meningitis consist of different ethnic groups such as Pashtuns: 1234 patients (45%), Balochs: 822 patients (30%), Punjabis: 411 patients (15%), Hazaras: 192 patients (7%) and Sindhis: 82 patients (3%) from 0-2 years of childerns.

**Table 1: Microbiological profile of meningitis cases in different Ethnicity**

| S.No. | Ethnicity | Number of Patients | Percentage (%) |
|---|---|---|---|
| 1 | Pashtuns | 1234 | 45% |
| 2 | Balochs | 822 | 30% |
| 3 | Punjabis | 411 | 15% |
| 4 | Hazaras | 192 | 7% |
| 5 | Sindhis | 82 | 3% |
| | **Total** | **2741** | **100%** |

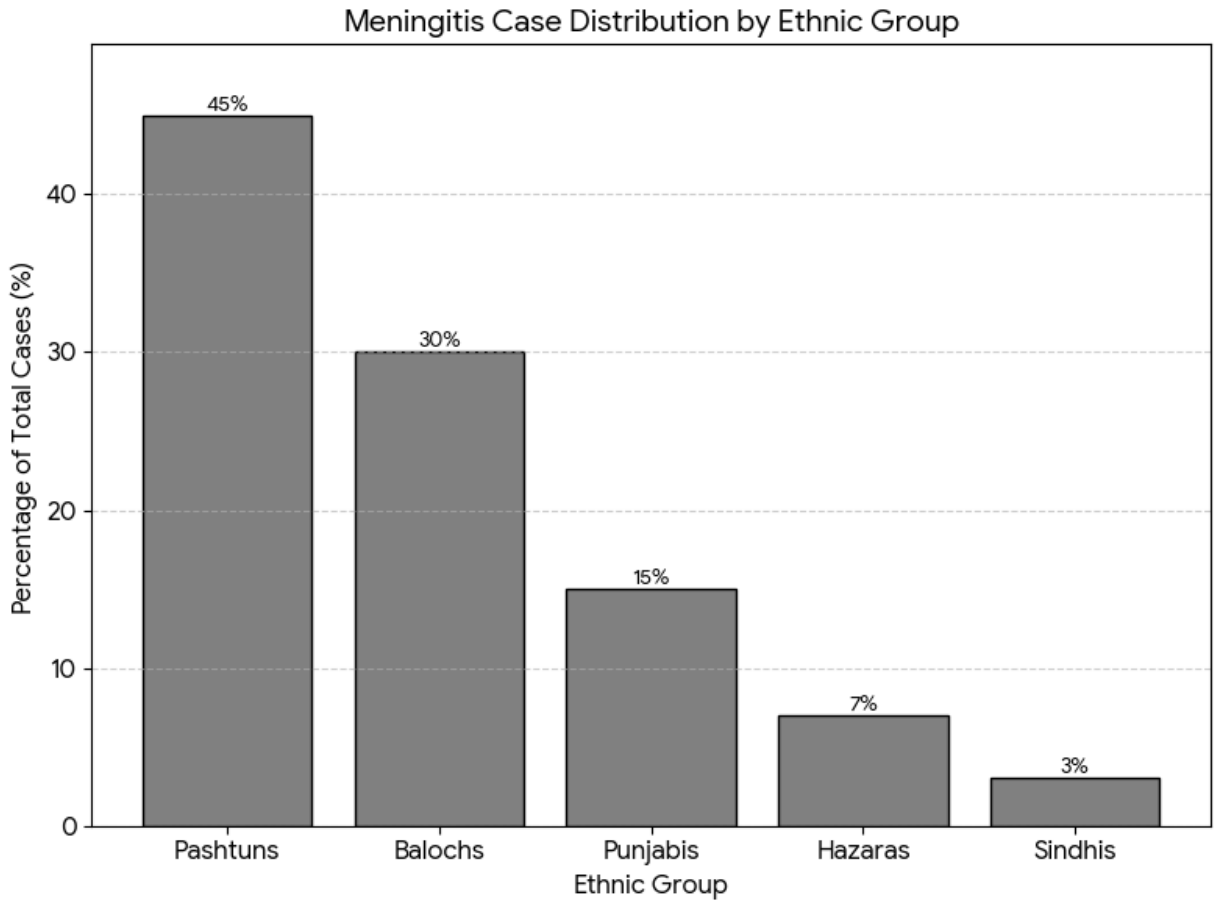



**Figure 1: Microbiological profile of meningitis cases in different Ethnicity**
The table and figure 1 shows the microbiological profile of of 2,741 meningitis cases, the data shows a significant concentration of patients within two ethnic groups. Pashtuns account for the largest proportion at 45% (1,234 patients), followed closely by Balochs at 30% (822 patients). Together, these two groups represent three-quarters (75%) of the total cases. Conversely, Sindhis (3%) and Hazaras (7%) have the lowest observed case percentages.

**Table 2: Cerebrospinal Fluid (CSF) Analysis Results**

| **Parameter** | **Normal Range** | **Abnormal Range** | **Results (Sample)** |
|---|---|---|---|
| Appearance | Clear and colorless | Cloudy, turbid | Cloudy |
| WBC count | 0-5 cells/µL | >100 cells/µL | 150 cells/µL |

| | | | |
|---|---|---|---|
| Protein | 15-45 mg/dL | >100 mg/dL | 120 mg/dL |
| Glucose | 50-75 mg/dL | <40 mg/dL | 30 mg/dL |

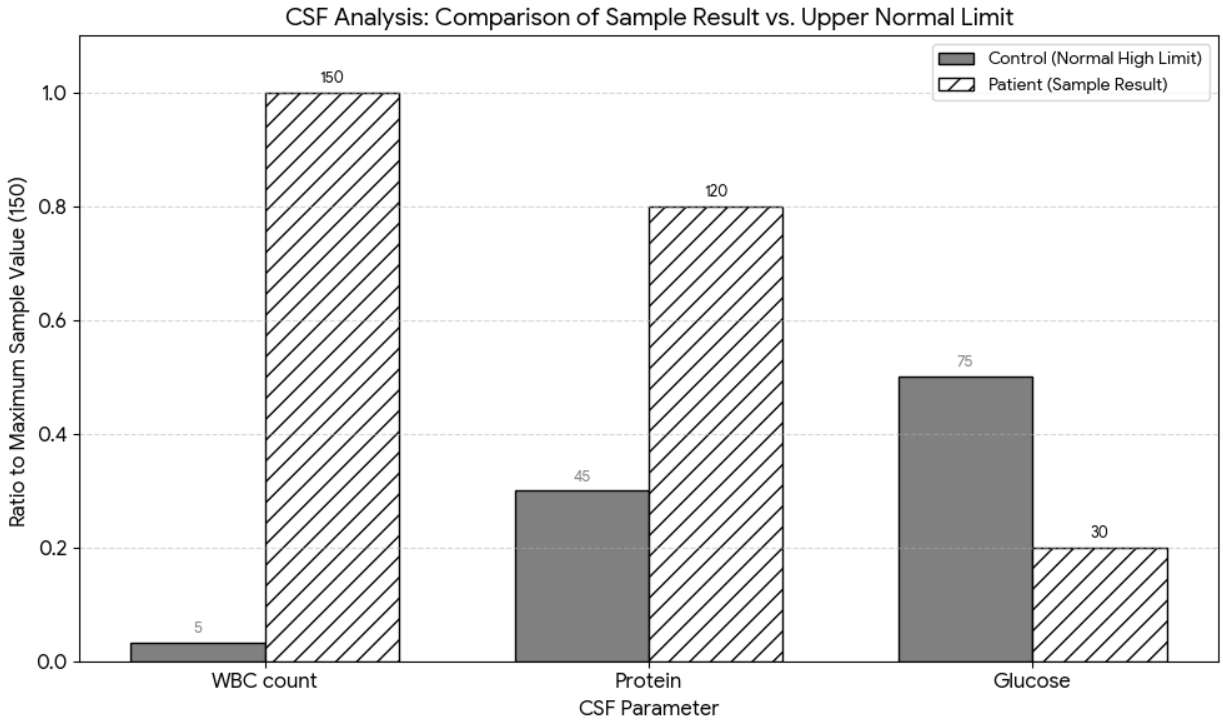



**Figure 2: Cerebrospinal Fluid (CSF) Analysis Results**

The table and figure 2 shows the cerebrospinal fluid (CSF) analysis from children 0-2 years in Quetta District showed abnormal findings: cloudy appearance, elevated white blood cell count (150 cells/µL), increased protein (120 mg/dL), and decreased glucose (30 mg/dL). These findings are consistent with either (or both) acute bacterial meningitis (high WBC and protein, decreased glucose levels, crucial for neurological function.

**Table 3: Bacterial Pathogens Identified in Meningitis Cases**

| **Pathogen** | **Lab Result (Normal Range)** | **Lab Result (Abnormal Range)** |
|---|---|---|
| **Streptococcus pneumoniae** | Gram-positive cocci in pairs and chains | Gram-negative rods |
| **Haemophilus influenzae** | Gram-negative coccobacilli | Gram-positive cocci |

| | | |
|---|---|---|
| **Neisseria meningitidis** | Gram-negative diplococci | Gram-positive rods |
| **Other pathogens** | Variable | Variable |

List of common bacterial pathogens causing meningitis and their typical Gram stain appearances are given in Table 3. Typical findings for Streptococcus pneumoniae are Gram-positive cocci in pairs and chains, while Haemophilus influenzae consists of Gram-negative coccobacilli, and Neisseria meningitidis presents as Gram-negative diplococci. Conflicting descriptive features are described in the "Abnormal Range" column.

**Table 4: Antimicrobial Sensitivity Profile**

| Pathogen | Antibiotic | Susceptibility (%) | Resistance (%) |
|---|---|---|---|
| **Streptococcus pneumoniae** | Penicillin | 60 | 40 |
| | Ceftriaxone | 85 | 15 |
| **Haemophilus influenzae** | Ampicillin | 70 | 30 |
| | Chloramphenicol | 90 | 10 |
| **Neisseria meningitidis** | Ciprofloxacin | 95 | 5 |
| | Rifampicin | 80 | 20 |

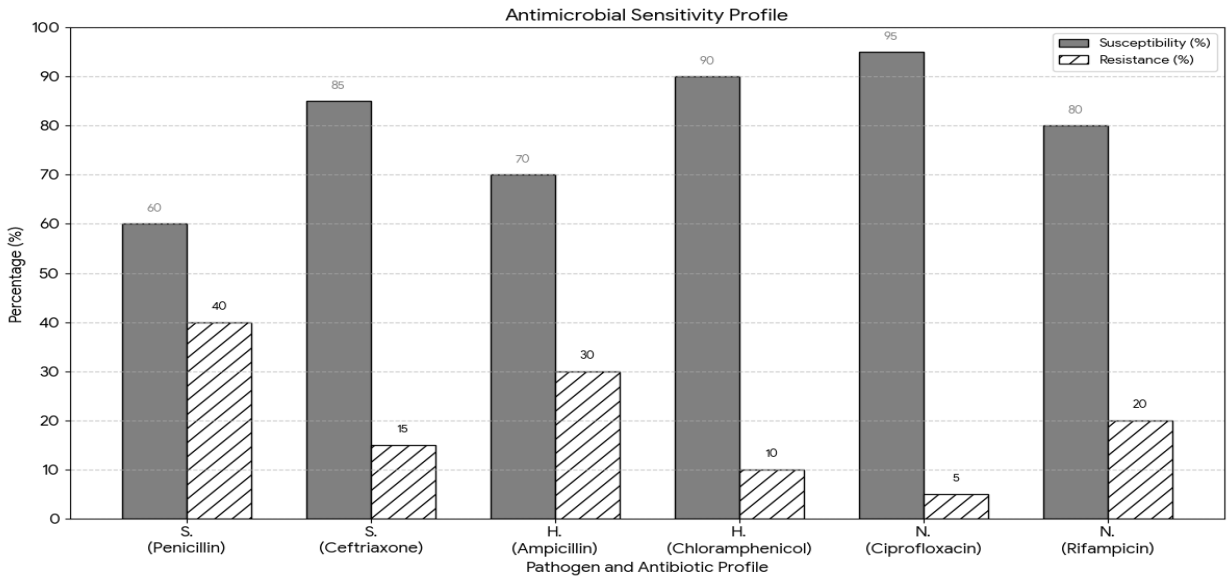



**Figure 3: Antimicrobial Sensitivity Profile**

The table 4 and figure 3 shows the susceptibility and resistance percentages of selected pathogens to antibiotics are as follows: Streptococcus pneumoniae - Penicillin (60% susceptible, 40% resistant), Ceftriaxone (85% susceptible, 15% resistant); Haemophilus influenzae - Ampicillin (70% susceptible, 30% resistant), Chloramphenicol (90% susceptible, 10% resistant); Neisseria meningitidis - Ciprofloxacin (95% susceptible, 5% resistant), Rifampicin (80% susceptible, 20% resistant).

**Discussions**

The research contributes towards understanding the etiological agents of bacterial meningitis among 0-2 years old children in district Quetta, Baluchistan-pakistan commune, and it is conclusively an active site for surveying epidemiological features. Overall, bacterial pathogens predominate in this age group as observed in studies worldwide and pertaining to the causative organisms involved Streptococcus pneumoniae, Haemophilus influenzae, and Neisseria meningitidis are important causes of meningitis. These agents were later recognized by extensive CSF examinations, including Gram stain and culture, emphasizing the need for strict management protocols to accurately establish the etiology for treatment.

The demographic distribution has been used as only two independent variables are entered (age of children in years and place of residence), since the demographic distribution is not giving any analysis on the presence or absence of some confounding factors or risk factors that predetermine the susceptibility or the occurrence of these people. This type of heterogeneity underlines the importance of the customized interventions in the field of public health, and the recommended vaccines to take into account the differences in risks among ethnic groups in the area.

The resistance pattern indicated resistance of the isolates at high or moderate concentration with S. pneumoniae and penicillin and H. influenza and ampicillin were two of the remarkable ones. Our results suggest the importance of etiologic surveillance to inform empirical treatment and antimicrobial stewardship programmes to reduce resistance and enhance patient outcomes in meningitis among children.

A limitation of this study is that it was done at a single center, and used as retrospective data which might not reflect the current status in all regions or different medical centers. This highlights a case for multi-centre cooperation allowing the validation of findings and enhance epidemiological knowledge on paediatric meningitis in Pakistan. Furthermore, the addition of molecular diagnostic assays such as PCR might improve sensitivity to pathogen detection and lead to a broader description of viral causes, in concert with the common emphasis on bacterial etiologies.

Pediatric meningitis is still a burden to global health, even worse in settings of limited healthcare resource endowment. As reported by Oordt-Speets et al., (2018) Streptococcus pneumoniae and Neisseria meningitidis still are currently the most prevalent bacterial causes of BM especially in young children, representing a considerable burden throughout the world (19).

A comprehensive study on the global establishment and burden of meningitis, emphasizing its high occurrence in developing countries was recently published by Bassat et al., (2018). This supports their conclusion that children under the age of five are most at risk (20). Kiani et al., (2019) in a study on the epidemiology of childhood meningitis in Pakistan, described a considerable burden of this disease with Streptococcus pneumoniae and Haemophilus influenzae as major pathogens (21).

## Conclusions

The study report of microbiological profile from meningitis cases in 0-2 years old children of Quetta District, Balochistan shows predominance of bacteria like Streptococcus pneumoniae and Neisseria meningitidis. These findings underscore the importance of local interventions via vaccination and accurate diagnostics for detection and treatment. These issues are to be addressed to make the burden of pediatric meningitis, and child health in this susceptible population, to be less.


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