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Research Article

# ASSESSMENT OF TREATMENT OUTCOME AND ASSOCIATED FACTORS OF BACTERIAL MENINGITIS AT PEDIATRICS WARD IN MIZAN TEPI UNIVERSITY TEACHING HOSPITAL. SNNPR, SOUTHWEST ETHIOPIA

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**ABSTRACT**

**Objective:** The aim is to assess the treatment outcome and associated factors of bacterial meningitis in the pediatric ward of Mizan Tepi University teaching hospital, southwest Ethiopia.

**Methods:** A retrospective cross-sectional study was conducted among pediatrics between the ages of (0 and 15 years) admitted to the Pediatric ward of MTUTH from January 1, 2015, to December 31, 2017. Data were collected through a Data abstraction checklist from March 10 to 22, 2018. Data were entered using the EPI-INFO (version 3.5.1) and then transferred to SPSS (version 21) for the analysis, and bivariate analysis was performed for all independent variables, and variables with $p<0.25$ were selected to fit multivariate logistic regression. Finally, multivariate logistic regression was performed to determine independent predictors of poor outcomes. An odds ratio and 95% confidence interval were used, and the level of statistical significance was considered at $p<0.05$.

**Results and Discussion:** The results of this study were analyzed for 99 patients treated for acute bacterial meningitis. The most frequently used initial antibiotic regimen in young infants was ampicillin plus gentamycin (87.5%). While most of the older infants and children, 71 (78%) were initially managed with ceftriaxone. Among the treated patients, 76 (76.76%) were improved and 23 (23.23%) of them had poor outcomes (11.1% died, 9.1% Left against medical advice, and 3% were Referred to a Higher facility. The determinant factors of poor outcome of pediatrics treated for bacterial meningitis were duration of illness before hospital admission AOR=11.26, 95% CI (1.8–68), vomiting (AOR=4.9, 95%CI (1.2–19.9) and AB regimen changes (AOR=4.6, 95% CI (1.72–20.43) independent predictors of poor outcomes.

**Conclusion:** To conclude that, this study has shown the initial antimicrobial regimen used was almost in line with the recommendation. At discharge around 25% of the pediatric patients treated for bacterial meningitis, experienced poor outcomes, which implicates the need for more attention during treatment. Duration of illness before hospital admission most independently predicts the incidence of poor outcomes.

**Keywords:** Bacterial meningitis, Antimicrobial therapy, Pediatrics, Ethiopia.

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## INTRODUCTION

Meningitis is one of the most common types of central nervous system infection. It is a medical emergency characterized by inflammation of the meninges, subarachnoid space, and brain vasculature resulting from infection [1]. It is quite severe and may result in brain damage, hearing loss, learning disability, and death if not treated early, its mortality approaches 100%, and even with current antibiotics and advanced pediatric intensive care, the mortality rate of the disease is approximately 5–10% [2,3]. It is usually caused by viral, bacterial, or fungal pathogens.

Bacterial meningitis is a severe and potentially life-threatening infection that is associated with high rates of mortality, morbidity, and significant disability in survivors [4]. Bacterial meningitis affects approximately 1.2 million people each year and causes almost 170,000 deaths globally [5]. It is among the 10 major causes of mortality from infectious diseases worldwide, mainly in the pediatric population [6]. According to the WHO report, BM is one of the five major killer diseases of children under 5 years (acute respiratory infections - mostly pneumonia, diarrhea, measles, malaria, and malnutrition) [7]. The mortality of untreated bacterial meningitis approaches 100% [3]. The incidence of bacterial meningitis in sub-Saharan African children is about 10 times greater than that in well-resourced countries [8]. More than two-thirds of these occur before 5 years of age and most of them in developing countries [2]. Similarly, it accounts for about 6–8% of all causes of hospital admissions in Ethiopia, and the case fatality rate associated with bacterial meningitis is as high as 22–28% [9]. The causes of bacterial meningitis vary with age in pediatrics.

The most common bacterial causes of neonatal meningitis are group B streptococcus, *Escherichia coli*, and *Listeria monocytogenes* [10], mainly acquired from the maternal birth canal during delivery. Whereas, the most common etiologic agents in children beyond the neonatal period are: *Haemophilus influenzae* Type b (HIb), *Neisseria meningitidis*, and *Streptococcus pneumoniae* [11]. However, these organisms are not limited to pediatrics; alterations of host defense due to anatomic defects or immune deficits also increase the risk of meningitis from less common pathogens such as *Pseudomonas aeruginosa* and *Staphylococcus aureus* [10]. The clinical features are almost similar regardless of etiologic agents in both age groups, including fever or hypothermia, failure to feed, vomiting, and later lethargy, seizure, and full fontanel, but meningeal signs are generally rare [10]. However, in older children, headache and focal neurologic signs like sixth nerve palsy or signs of meningeal irritation (such as nuchal rigidity, kerning's sign, or Brudziniski sign) are usually present [11]. However, the definitive diagnosis of meningitis requires the analysis of spinal fluid chemistry and the identification of specific pathogens from the culture of the CSF [12].

The treatment approach to the patient with suspected acute bacterial meningitis depends on early recognition of the meningitis syndrome,

rapid diagnostic evaluation, and emergent antimicrobials should be considered to reduce the risk of mortality and complications due to delay in treatment [13]. The choice of empiric antibiotics should take into consideration the blood-brain barrier penetration, local epidemiology, early versus late disease, resistance patterns, and availability within resource constraints [14]. In resource-limited settings, the treatment of pediatric bacterial meningitis generally has two protocols based on age under 2 months and above 2 months of age [11,14]. In neonates, ampicillin (400 mg/kg/day in 4-divided doses) and gentamycin (7.5 mg/kg/day) are commonly used, whereas Pediatric beyond neonatal periods are commonly treated with ceftriaxone 100 mg/kg/day q12 h and adding vancomycin 60 mg/kg/day in four divided doses in case of MRSA suspect and considering other antibiotics depending on suspected bacterial pathogens [15]. Empirical use of adjuvant dexamethasone (0.15 mg/kg/dose, four times a day) given before or up to a maximum of 12 h after the first dose of antibiotics and continued for 2–4 days is currently recommended. To improve neurological outcomes, particularly in hearing impairment, in children who had *H. influenzae* meningitis Recent studies have suggested that, unlike adults with bacterial meningitis, steroids do not improve mortality in children, and, hence, with the decline in the incidence of HIb meningitis, the use of steroids in children with bacterial meningitis has increasingly been questioned [12].

The treatment outcomes of pediatric hospitalized with acute BM. In Canada, among 101 infants admitted with definitive BM, 13 died and 17 had a moderate or severe disability at 1 year of age [9]. In Africa, mortality due to meningitis is much higher, the reports of Angola, with a mortality rate of 33% among 403 children [16]. However, more adverse outcomes were reported from pediatric wards of Uganda 28 (36.8%) patients died, and 22 (28.9%) survived with sequelae mainly, spasticity and hydrocephalus) and 15 (19.7%) improved without sequelae [17]. Similarly, in Ethiopia, from 425 patients treated with BM, shows 156 (36.7%) were discharged with the unfavorable outcome (GCS=1–4), and 86 patients (20.2%) died in the hospital [18].

The risk factors for the poor outcome are associated with the clinical presentation at admission, comorbid condition, delayed presentation to the hospital, impaired consciousness, seizures and underweight, high CSF protein, positive blood culture, and absence of petechial on admission, and initial treatment are absolute risk of sequelae [19]. In Canada, among 101 infants admitted with definitive bacterial meningitis, the presence of seizure duration of >72 h, presence of coma, and leukopenia (sensitivity: 88%; specificity: 99%) [20]. In Brazil reported, out of 35 patients who had followed up, Behavioural change (22.9%), Seizures at admission (OR=5.6, CI 1.2–25.9), cerebrospinal fluid protein concentration >200 mg/dL ($p<0.01$), and cerebrospinal fluid glucose concentration/glycemia ratio ($p<0.01$) were identified as risk variables for sequelae [21]. In Africa, Angola reported that fatal outcome was associated with impaired consciousness, severe dyspnea, and seizures, and severe neurological sequelae (found in 25% of our patients) were associated with a delayed presentation to the hospital, impaired consciousness, and seizures and underweight [20]. In Ethiopia, a retrospective study in Jimma, Hawassa, Gondar, and Arba Minch University hospitals and a prospective study in Jimma University Specialized Hospital in 2016 shown patients present with pneumonia were associated with 3 times more likely to die in hospital than patients without pneumonia (AOR=2.97; 95% CI=1.38–6.41). Moreover, the presence of cranial nerve deficits (III, VI, and VII) at admission was associated with a nearly five times increment of mortality (AOR=4.73; 95% CI=1.45–15.50). In addition, treatment with dexamethasone was associated with over three times increments of mortality (AOR=3.38; 95% CI=1.87–6.12). Focal neurologic deficits (AOR=3.33; 95% CI 1.31–8.50), seizures (AOR=2.20; 95% CI 1.03–4.67), and a low level of consciousness (AOR=2.65; 95% 1.21–5.81) at admission were associated with the occurrence of neurologic sequelae at discharge [22]. Therefore this retrospective study is providing significant information about treatment outcomes and factors associated with poor outcomes of pediatrics treated for bacterial meningitis. Despite the fact that majority of the burden in the developing world but most of the literature originates from developed countries. In our country, a limited number of studies have been done regarding ethology and Treatment strategy, but those studies lack treatment outcomes and factors associated with poor treatment outcomes. Therefore, further study in our setup was necessary to assess treatment outcomes and factors associated with treatment outcomes of pediatric BM.

**Objective**

*General objective*

1. To assess treatment outcome and associated factors of bacterial meningitis in the pediatric ward of Mizan Tepi University teaching hospital, southwest Ethiopia.

*Specific objectives*

1. To identify commonly prescribed antimicrobial agents to pediatrics with bacterial meningitis in Mizan Tepi University teaching hospital
2. To determine treatment outcome at discharge
3. To identify factors associated with poor treatment outcomes.

**METHODS**

**Study area**

This study was conducted at the pediatric ward of MTUTH. MTUTH is found in Bench Maji Zone, Mizan Amman Town, SNNPR; which is located 563 Km Southwest of Addis Ababa, the capital of Ethiopia, and it is 830KM away from Hawassa, the capital city of SNNPR. It is the only teaching hospital for Bench Maji Zone, and it has four major wards, namely medical, surgical, pediatrics, and Gynecology/Obstetrics. It gives both inpatient and outpatient services for people coming from the catchment areas and has 268 healthcare professionals in different disciplines. From these 38 are physicians and 202 are a nurse in the hospital. The pediatric ward has 24 beds with a perceived more than 100% occupancy rate and has two units; a neonatal intensive care unit and general pediatrics. Currently, nine physicians and 13 nurses run the ward**.** A retrospective cross-sectional study design was conducted from January 1; 2015, to December 31; 2017, and data were collected from March 10 to March 22; 2018. All pediatrics admitted to the pediatric ward of MTUTH with a diagnosis of BM during the study period and fulfilled eligibility criteria. All pediatric cases that were clinically or bacteriologically confirmed diagnoses of acute BM and treated for BM during the study period were included in the study. However, Pediatrics with treatment outcomes not stated, Pediatrics with TB meningitis, age >15 years, and medical records with incomplete information were excluded from the study.

**Study variables**

*Independent variables*

Patient-related factors

1. Age
2. Sex
3. Weight.

Drug related factors

1. Adjuvant dexamethasone use
2. Hx of antibiotic exposure
3. Time of change of antibiotics
4. Antimicrobial regimens.

Disease related factors

1. Duration of illness before admission.
2. Clinical features at presentation
3. Presence of comorbidities (like as severe dyspnea, pneumonia, malaria, DM, and HIV/AIDS)
4. Severe acute malnutrition
5. Clinically or bacteriological diagnosis
6. Laboratory investigations.

*Dependent variables*

1. Treatment outcomes.

**Data collection and analysis**

*Instrument*

The data were collected through data abstraction checklist, which is prepared by the principal investigator by reviewing different literature [9,22], and data were abstracted from the patient profile by the investigator. The instrument contains socio-demographic, clinical, and treatment-related information.

*Data analysis*

After data collection, data were checked for completeness and consistency, then data was entered by using the EPI-INFO software version 3.5.1, and then transferred to SPSS software version 21 for analysis and bivariate analysis was done for all independent variables, and variables with $p<0.25$ were selected to fit multivariate logistic regression. Finally, multivariate logistic regression was performed to determine independent predictors of poor outcomes. An odds ratio and 95% confidence interval were used and the level of statistical significance was considered at $p<0.05$.

*Data quality control*

Before starting the data collection, the designed data abstraction checklist was pre-tested in the hospital by cross-matching with the patient profile chart, and then the data abstraction checklist were rearranged as necessary. The data collector makes frequent checks on the data collection process to ensure data quality.

**Ethical consideration**

Ethical approval letters were obtained from the Ethical Review Board of the School of Pharmacy, Faculty of Medicine and Health Sciences, Mizan Tepi University, the Medical Director of Mizan Aman General Hospital. Before data collection, permission was obtained from the general hospital and data set owner to access health-care records of pediatrics admitted to the ward during the study period. The data abstraction templates were coded rather than named to ensure confidentiality. The data collected were kept under key and lock and accessed by the research team only. Soft data were kept in a computer with a password known only by the research team.

**RESULTS**

A total of 140 patients were admitted with the diagnosis of bacterial meningitis within the study period, but only 99 pediatric patients were included in the study (8 young infants and 91 older infants and children) are diagnosed with BM during the study period and started treatment for BM. Others were excluded from the study due (33- loss of patient medical records, 6- Poor documentation, 2-changes of initial diagnosis). Therefore, the analysis was limited to 99 patients that completed the whole course of treatment for BM and died within the ward after initiation of treatments for meningitis.

**Demographic and baseline characteristics of the patient**

The median age of pediatrics admitted with acute bacterial meningitis was 72 months. Eight (8.1%) of them are under 2 months and 91.9% were above 2 months. The proportions of males were higher than females in both age groups, 62.5% (young infants) and 65.9% (older infants and children). The median duration of illness before hospital admission of pediatrics with BM was 2 days (range of 1–20). The median body weight was 15.5 kg for overall patients; likewise, the median body weight of young infants was 5.5 kg, whereas 15.75 kg for older infants and children. The mean body temperature for both groups was almost in the febrile region, 38.20°C±0.66 for young infants and 37.670°C with SD=1.4 for those older infants and children (Table 1).

The number of admission increase from year to year in Pediatrics with bacterial meningitis, which linearly increased over years Fig. 1.

**Presenting clinical symptoms**

The common clinical features of pediatrics hospitalized with bacterial meningitis are fever (89.9%), neck rigidity (71.7%), vomiting (63.3%), and seizure (20.2%). The two most common clinical features at presentation for young infants were: fever 7 (87.5%) and neck pain 5 (62.5%) (Fig. 1). Whereas the most common features for older infants and children were fever 60 (65.93%), vomiting 60 (65.9%), and 26 (28.57%) neck rigidity (Fig. 2). The median duration of illness before hospitalization was 2 days (ranged 1–20).

**Drug-related factors**

Most of the pediatrics were initially treated with ceftriaxone (72.6%), but the remaining pediatrics were treated with chloramphenicol plus crystalline penicillin and 9.1% were treated with ampicillin and gentamycin. Young infants (87.5%) were initially treated with empiric Ampicillin plus gentamycin regimen. On the other hand, in a majority of the older infants and children, the initial AB regimen was ceftriaxone (75.8%). The median duration of treatment was 8 days for younger infants and 7 days for older infants and children.

**Treatment outcomes of childhood BM**

Among 99 pediatrics treated for BM (76.77%) was improved and (23.23%) had poor outcomes. Of which 11 (11.1%) died, 9 (9.1%) left with medical advice and 3 (3%) and referred to a higher facility for further treatment. From a total of young infant patients, 6 (62.5%) improved, 1 (12.5%) died, 1 (12.5%) was referred to a higher facility, whereas, of older infants and children, 71 (78%), are improved and 10 (11%) of them are died. The median duration of improvement after treatment of pediatrics treated for BM is 7 days (Table 3).

**Risk factors of poor outcomes**

Risk factors of poor outcomes for infants under 2 months and older infants (>2 months) and children might be different. This might be

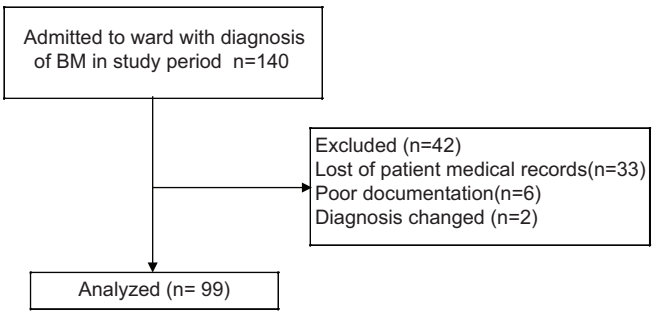


**Fig. 1: Enrollment of children treated for bacterial meningitis in Mizan Tepi University teaching hospital from January1; 2015 to December 31; 2017**

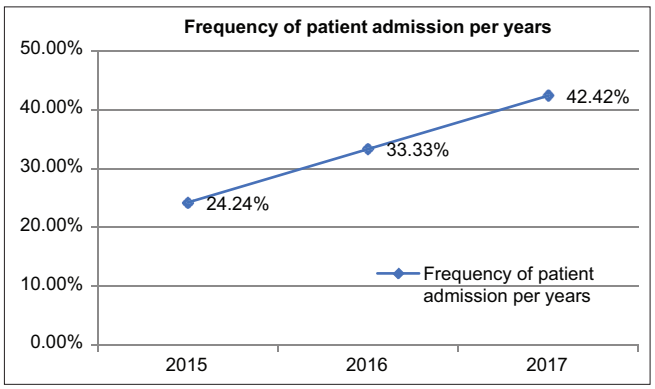


**Fig. 2: Frequency of pediatrics admitted to MTUTH and treated for BM from January1; 2015 to December 31; 2017**

**Table 1: Demographic and baseline characteristics of pediatrics treated for bacterial meningitis in Mizan Tepi University teaching hospital from January, 2015 to December 31, 2017**

| Characteristics | ≤2 months (n=8), n (%) | >2 months (n=91), n (%) | Total (n=99), n (%) |
|---|---|---|---|
| Gender | | | |
| Male | 5 (62.5) | 60 (65.9) | 65 (65.6) |
| Female | 3 (37.5) | 31 (34.1) | 34 (34.3) |
| Duration of illness prior to hospital presentation (h) | | | |
| <72 | 5 (62.5) | 30 (32.9) | 35 (35.4) |
| ≥72 | 3 (37.5) | 61 (67.1) | 64 (64.6) |
| Median body weight (kg) | 5.5 | 15.75 | 15.5 |
| Mean body temperature (°C) at admission | 38.2 | 37.67 | 38.0 |
| Clinical presentation of pediatrics admitted for BM | | | |
| Fever | 7 (87.5) | 82 (90.1) | 89 (89.9) |
| Vomiting | 2 (25) | 61 (67) | 63 (63.6) |
| Neck rigidity | 4 (50) | 67 (73.6) | 71 (71.7) |
| Seizure | 2 (25) | 20 (22) | 22 (22.2) |
| Presence of co-morbidities | | | |
| Yes | 6 (75) | 51 (56) | 57 (57.6) |
| No | 2 (25) | 40 (44) | 42 (42.4) |
| Types of co-morbidities | | | |
| Malaria | 2 (33.3) | 28 (54.9) | 30 (52.6) |
| LLONS | 5 (83.3) | 1 (1.96) | 6 (10.5) |
| Pneumonia | - | 4 (7.84) | 4 (7) |
| Anemia | - | 4 (7.84) | 4 (7) |
| AGE | - | 4 (7.84) | 4 (7) |
| Tetanus | - | 3 (5.9) | 3 (5.3) |
| Others* | 1 (16.6) | 15 (29.4) | 16 (31.4) |

*AOM, epilepsy, hypovolumia, CHF, sepsis, pyelonephrites, hypoglycemia, T1DM, SAM, oral candidiasis scabies umbilical hernia. AGE: Acute gastroenteritis, LLONS: Let let onset neonatal sepsis, SAM: Sever acute malnutrition, BM: Bacterial meningitis, T1DM: Type 1 diabetes mellitus, CHF: Congestive heart failure

**Table 2: Drug regimen used in pediatrics treated for bacterial meningitis in Mizan Tepi University teaching hospital from January 01 to December 31, 2015–2017**

| Regimens | Under 2 months (n=8), n (%) | Above 2 months (n=91), n (%) |
|---|---|---|
| Initial regimen | | |
| Ampicillin plus gentamycin | 7 (87.5) | 2 (2.2) |
| Crystalline penicillin plus chloramphenicol | - | 17 (18.7) |
| Cotrimoxazole | - | 1 (1.1) |
| Ceftriaxone alone | 1 (12.5) | 71 (78) |
| Regimen changed to | | |
| Ceftazidime plus vancomycin | 1 (12.5) | 5 (5.5) |
| Others changed regimen* | - | 4 (4.4) |
| Adjuvant therapy | | |
| Dexamethasone use | - | 60 (65.9) |
| Duration to dexamethasone use (days) | - | 3 |

*Ceftriaxone plus gentamycin, ceftriaxone alone, crystalline penicillin plus ceftriaxone, crystalline penicillin plus chloramphenicol

associated with exposed to different treatment regimens, but in order to done separate analysis for two age groups is difficult because of the small sample size under 2 months. Bivariate logistic regression was done for all independent variables to select possible candidates for multivariate logistic regression. In order to determine their association with the incidence of poor outcomes, potentially relevant predictors were chosen for multivariate analysis based on their significance from the bivariate analysis with $p<0.25$. Three variables were selected that significantly affect the dependent variable from multivariate logistic regression; these include Duration of illness before hospital admission, clinical presentation, AB regimen change during the treatment period.

## DISCUSSION

Among 99 pediatrics treated for BM, The median age of pediatrics at admission was 72 months (range of 1–168). The median duration of illness before hospital admission for pediatrics with BM was 2 days (1–20). At admission, pediatrics presents with chief compliance of fever (89.9%), neck rigidity (71.7), vomiting (63.6), seizure (22.2%), and meningeal sign positive (30.3%), and CBC was done only for (37.4%), but others diagnosed by clinically. Pediatrics admitted with BM were initially treated with ceftriaxone alone (72.6%). and combined regimen (crystalline penicillin plus chloramphenicol [17.2%], ampicillin plus gentamycin [9.1%]). The median duration of the regimen change was 3 days (1–6).

Early initiation of optimal antibiotic therapy for confirmed or suspected BM has been one of the most important factors to reduce morbidity and lethality. In the current study as illustrated in Table 2, most of the young infants 87.5% were initially treated with empiric ampicillin plus gentamycin regimen. On the other hand, in older infants and children, the most commonly used empiric AB regimen was 78% ceftriaxone. The selection of ABs was nearly in line with the current recommendation for developing countries [15]. Eleven percent of patients' ABs changes were considered due to poor response to the empiric regimen. Among young infants for whom ABs change was considered, in only one of the cases the empiric ampicillin plus gentamycin was to ceftazidime plus vancomycin. The change was not lined with a current recommendation as almost all the changes were made within the first 3 days and the first-line alternative was not considered according to the current recommendation for resource-limited countries of the WHO [4]. Nearly 50.5% of patients treated for BM improved within a median time of 5 days.

In all young infants, combinations of two ABs were considered empiric therapy for BM. Most of the patients (87.5%) were given a combination of Ampicillin and Gentamycin and the remaining 12.5% were put on ceftriaxone for initial management. Among patients initially put on ampicillin plus gentamycin, almost 71.4% improved without complications and 28.57% had poor outcomes, while only one case was initially treated with ceftriaxone and improved without acute complication. Whereas 78% of older infants and children were initially treated with ceftriaxone and almost 80.3% improved and 20.7% had poor outcomes (9.7% died, 8.3% left with medical advice and 2.7% referred to a higher facility) whereas 22% of patients treated with (16.5% patient 24 treated with crystalline

**Table 3: Treatment outcomes of pediatrics treated for bacterial meningitis in Mizan Tepi University teaching hospital from January 1 to December 31, 2015–2017**

| Patients outcomes | ≤2 months (n=8), n (%) | >2 months (n=91), n (%) | General (n=99), n (%) |
|---|---|---|---|
| Good outcomes | | | |
| Improved | 5 (62.5) | 71 (78) | 76 (76.76) |
| Poor outcome | | | |
| Death | 1 (12.5) | 10 (11) | 11 (11.1) |
| Refer to higher facility | 1 (12.5) | 2 (2.19) | 3 (3) |
| Left against medical advice | 1 (12.5) | 8 (8.8) | 9 (9.1) |
| Median time to improvement (days) | 8 | 7 | 7 |

**Table 4: Bivariate and multivariate logistic regression for risk factors for poor outcomes pediatrics (0–15 years) treated for bacterial meningitis in Mizan Tepi University teaching hospital from January 1 to December 31, 2015–2017**

| Variables | Outcomes | | Bivariate logistic regression results | | Multivariate logistic regression results | |
|---|---|---|---|---|---|---|
| | Good (n=76) | Poor (n=23) | p | COR (95% CI) | AOR (95% CI) | p |
| Age (months) | | | | | | |
| ≤2 | 4 | 3 | 0.217 | 2.7 (0.558–13.066) | 1.9 (0.05–786) | 0.831 |
| >2 | 72 | 20 | | | | |
| Sex | | | | | | |
| Male | 48 | 17 | 0.344 | 1.653 (0.584–4.680) | | |
| Female | 28 | 6 | | | | |
| Duration of illness before hospital admission (h) | | | | | | |
| ≤72 | 33 | 2 | 0.006 | 3.9 (1.472–10.332) | 11.26 (1.8–68) | 0.008 |
| >72 | 43 | 21 | | | | |
| Presence of co-morbidity | | | | | | |
| Yes | 42 | 15 | 0.399 | 1.518 (0.575–4.004) | | |
| No | 34 | 8 | | | | |
| Clinical features at admission | | | | | | |
| Fever | | | | | | |
| Yes | 67 | 22 | 0.317 | 2.955 (0.354–24.654) | | |
| No | 9 | 1 | | | | |
| Vomiting | | | | | | |
| Yes | 46 | 17 | 0.246 | 1.848 (0.654–5.218) | 4.9 (1.2–19.9) | 0.026 |
| No | 30 | 6 | | | | |
| Neck rigidity | | | | | | |
| Yes | 55 | 16 | 0.794 | 1.146 (0.413–3.180) | | |
| No | 21 | 7 | | | | |
| Seizure | | | | | | |
| Yes | 14 | 8 | 0.104 | 2.362 (0.838–6.654) | 2.042 (0.534–7.802) | 0.297 |
| No | 62 | 15 | | | | |
| Meningeal sign | | | | | | |
| Positive | 25 | 5 | 0.405 | 2.6 (0.274–24.648) | | |
| Negative | 13 | 1 | | | | |
| Initial AB regimen | | | | | | |
| Ceftriaxone alone | 57 | 15 | 0.327 | 4 (0.250–63.950 | | |
| CAF and crystalline penicillin | 11 | 4 | 0.470 | 0.400 (0.033–4.806) | | |
| Ampicilline and gentamycine | 6 | 3 | 0.713 | 0.600 (0.039–9.156) | | |
| Other initial regimen* | 2 | 1 | 0.783 | 0.667 (0.037–11.936) | | |
| Changes AB regimen | | | | | | |
| Yes | 5 | 6 | 0.015 | 5.012 (1.367–18.380) | 4.679 (1.72–20.426) | 0.040 |
| No | 71 | 17 | | | | |
| Dexamethasone use | | | | | | |
| Yes | 46 | 14 | 0.976 | 1.014 (0.390–2.637) | | |
| No | 30 | 9 | | | | |

*Cotrimoxazole, ceftriaxone and vancomycine, ceftriaxone plus crystalline penicillin. AOR: Adjusted odds ratio, COR: Crude odds ratio, CAF: Chloranphenicol, CI: Confidence interval

penicillin plus chloramphenicol, 2.2% ampicillin plus gentamycin, 1.1 cotrimoxazole) from those cases 4.4% died and 2.2% left against medical advice. In this study from a total of pediatrics treatment for BM, 76.8% was improved, and 23.2% had a poor outcome. The average length of hospital stay for discharged patients was 8 days. The average time from hospital admission to death was 4 days. Those who left against medical advice had an average length of hospital stay of 4 days. Almost similar results were reported from retrospective cohort studies conducted in Canada [20].

**Risk factors of poor outcomes**

In this study, the gender distribution of pediatrics treated for BM was predominated by males (65.6%), and had contributed to a higher percentage (17.2%) of the poor outcomes of BM; this gender difference was not statistically significant. Delayed presentation to the hospital (after 72 h of illness) was higher in males (45.6%) and determinant factor for poor treatment outcomes as shown in Table 4. Similarly, a retrospective study conducted in Angola shows that delayed presentation affects treatment outcomes [16]. Dexamethasone use in this study for the treatment of

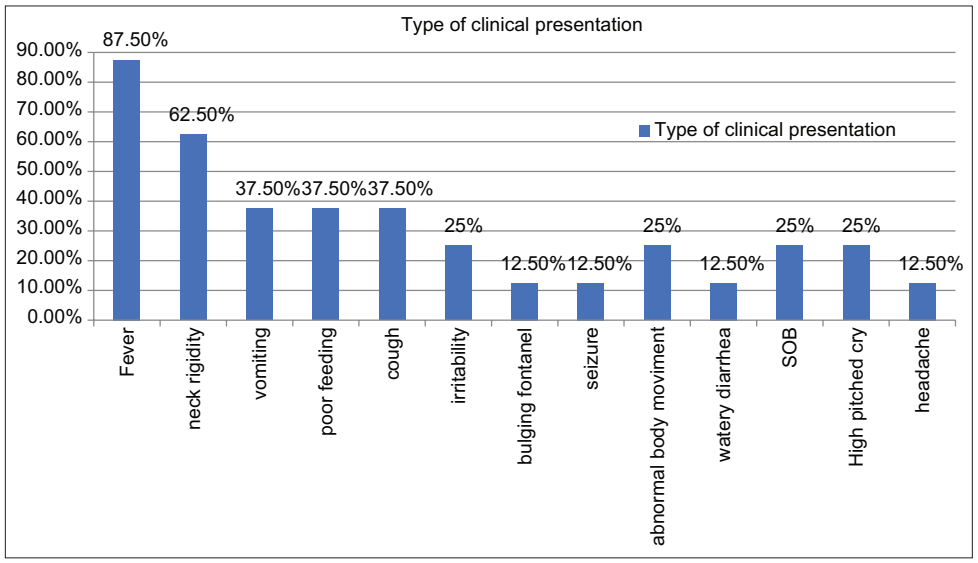


**Fig. 3: Clinical presentations at admission of younger infants treated for bacterial meningitis in Mizan Tepi university teaching hospital from January1; 2015 to December 31; 2017**

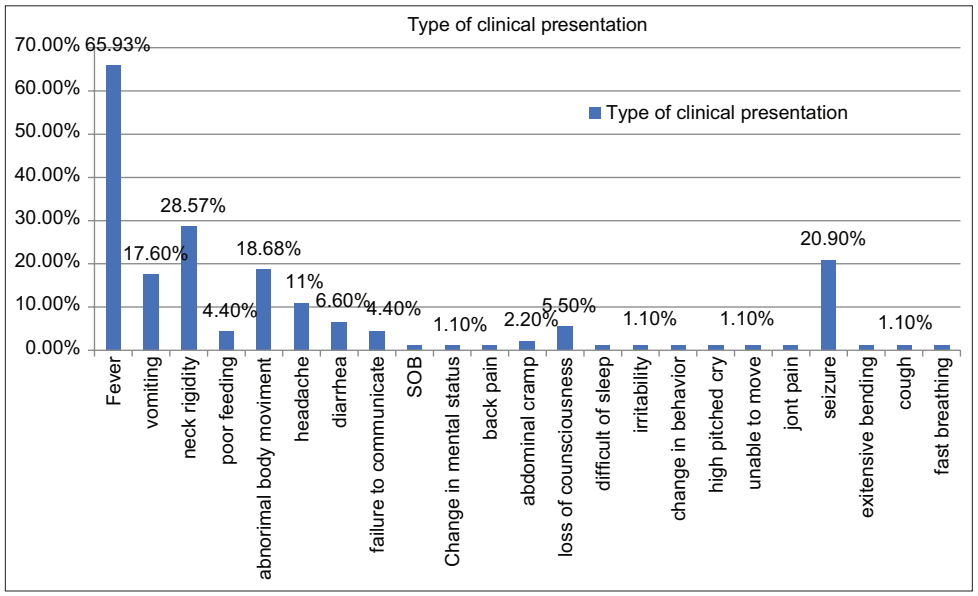


**Fig. 4: Clinical presentations at admission of older infants and children treated for bacterial meningitis in Mizan Tepi University teaching hospital from January 1 to December 31; 2015–2017**

pediatrics with bacterial meningitis is not significantly associated, but a retrospective study conducted in Jimma, Hawassa, Gondar, and Arba Minch Hospital treated with dexamethasone associated with over three times increment of mortality (AOR=3.38; 95% CI=1.87–6.12) [22].

Many clinical features as described in Figs 3 and 4 before or at hospital admission are associated with the outcome of bacterial meningitis (5, 27 and 28). In this study, patients presenting with vomiting 5 times increase the incidence of poor outcomes (AOI=4.9 95%CI (1.2–19.9) and determinant factor for poor outcome. Similarly, the presence of seizures at or prior to admission increased 2 times the incidence of poor outcomes but statically not significant and this is not in line with a retrospective study conducted in Brazil [21]. In the current study, another factor related to ABs found to have a statistically significant association with poor outcomes was a change of initial regimen. In general (11.1%) of pediatrics treated for BM, the initial regimen was changed. From this, only 5% improved and 7.1% had poor outcomes [21].

**Limitations of the study**

My study was not free of limitations. To mention some: the data collection period was too short, which could not allow the collection of enough samples. As could be seen from the result part, some of the ranges of confidence intervals were wider due to the small sample size. Poor documentation and lost medical records were limitations during the study. Absence of diagnostic tests to confirm BM.

## CONCLUSION

In this study, the selection of empiric therapy in children treated for BM was close to recommendations, but empiric regimen change was not recommended in low-resource settings; however, it needs for revising management protocol regarding the timing of empiric ABs regimen for children with BM in this ward. Most bacterial meningitis in children is treated with ceftriaxone.

At discharge, about a quarter of patients treated for BM were poor. This means that special care is required when treating these patients. Some independent predictors of poor outcomes were established. Duration of illness before admission, AB regimen during the duration of treatment and the patient's presence of vomiting are independent predict the occurrence of negative consequences. These factors indicate a need for antimicrobial susceptibility testing and critical patient evaluation hospitalized with BM.

## RECOMMENDATIONS

### To the hospital (MTUTH)

To create awareness on alarming clinical future and timely admission of pediatrics with bacterial meningitis by working cooperatively with health extensions workers in the community because of long duration of illness during admission significantly affect treatment outcome.

To create awareness on the health-care team to give due attention to patients presented with severe clinical features such as seizure, vomiting, and irritability as these were the alarming signs of poor outcomes.

To revise management protocol regarding the timing of empiric ABs regimen for children with BM.

### For further researchers

Focused on antimicrobial sensitivity, and study with large sample size and longer study periods are required.

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## AUTHOR CONTRIBUTION

Tsegaye Nigussie: tsega1994et24@gmail.com. Is first author of this research work; Belete Birhanu: beletebirhanu65@gmail. Is corresponding author and also participated without any limitation throughout the work. This research is non funded research work.

## CONFLICT OF INTEREST

There is no conflict of interest were encountered between authors throughout in this research work.

## REFERENCES

1. Barichello T, Glauco D, Jaqueline S, Samuel G, Lutiana R, Antonio L. Pathophysiology of neonatal acute bacterial meningitis. J Med Microbiol 2013;62:1781-9.
2. Mulu A, Kassu A, Tessema B. Bacterial isolates from cerebrospinal fluids and their antibiotic susceptibility patterns in Gondar University. Ethiop J Health Dev 2005;19:160-4.
3. Tacon CL, Flower O. Diagnosis and management of bacterial meningitis in the paediatric population: A review. Emerg Med Int 2012;2012:320309.
4. Tebruegge M, Curtis N. Epidemiology, etiology, pathogenesis, and diagnosis of recurrent bacterial meningitis. Clin Microbiol Rev 2008;21:519-37.
5. World Health Organization (WHO). Weekly Epidemiological Record. vol. 80. Geneva: World Health Organization; 2015. p. 313-20.
6. Fauci AS. Infectious diseases: Considerations for the 21st Century. Clin Infect Dis 2001;32:675-85.
7. World Health Organization. Antimicrobial and Support Therapy for Bacterial Meningitis in Children: Report. Geneva, Switzerland: World Health Organization; 1997.
8. Molyneux EM, Walsh AL, Forsyth H, Tembo M, Mwenechanya J, Kayira K, *et al*. Causes and outcome of bacterial meningitis in Malawian children. Malawi Med J 2003;15:43-6.
9. Ahmed A. Etiology of Bacterial Meningitis in Ethiopia: A Retrospective Study. Institute of General Practice and Community Medicine Section for International Health; 2012.
10. Kliegman RM, Behrman RE, Jenson HB. Nelson Textbook of Pediatrics. 18th ed., Ch. 602. Netherlands: Elsevier Health Sciences; 2008.
11. Ethiopia FMHACA. Standard Treatment Guidelines for General Hospitals. 3rd ed. Ethiopia: FMHACA; 2014. p. 248-52.
12. Saez-Llorens XM, GH XM. Acute bacterial meningitis beyond the neonatal period. In: Long S, editor. Principles and Practice of Pediatric Infectious Diseases. 3rd ed. Philadelphia, PA: Churchill Livingstone; 2008. p. 284-91.
13. Tunkel AR, Hartman BJ, Kaplan SL, Kaufman BA, Roos KL, Scheld WM, *et al*. Practice guidelines for the management of bacterial meningitis. Clinical infectious diseases. 2004;39:1267-84
14. Furyk JS, Swann O, Molyneux E. Systematic review: Neonatal meningitis in the developing world. Trop Med Int Health 2011;16:672-90.
15. Tunkel AR, Hartman BJ, Kaplan SL, Kaufman BA, Roos KL, Scheld WM, *et al*. Practice guidelines for the management of bacterial meningitis. Clin Infect Dis 2004;39:1267-84.
16. Pelkonen T, Monteiro L, Correia M, Bernardino P, Peltola H. Risk factors for death and severe neurological sequelae in childhood bacterial meningitis in sub-Saharan Africa. Clin Infect Dis 2009;48:1107-10.
17. Kiwanuka JP, Mwanga J. Childhood bacterial meningitis in Mbarara hospital, Uganda: Antimicrobial susceptibility and outcome of treatment. Afr Health Soc 2001;1:9-11.
18. Gudina EK. Assessment of Treatment Strategies in Acute Bacterial Meningitis in Ethiopia. Dissertation, LMU München: Faculty of Medicine; 2016.
19. Vasilopoulou VA, Karanika M, Theodoridou K, Katsioulis AT, Theodoridou MN, Hadjichristodoulou CS. Prognostic factors related to sequelae in childhood bacterial meningitis: Data from a Greek meningitis registry. BMC Infect Dis 2011;11:214.
20. Klinger G, Choy-Nyok C, Beyene J, Perlman M. Predicting the outcome of neonatal bacterial meningitis. Pediatrics 2000;106:477-82.
21. Antoniuk SA, Hamdar F, Ducci RD, Kira AT, Cat MN, Cruz CR. Childhood acute bacterial meningitis: Risk factors for acute neurological complications and neurological sequelae. J Pediatr (Rio J) 2011;87:535-40.
22. Gudina EK, Tesfaye M, Adane A, Lemma K, Shibiru T, Wieser A, *et al*. Adjunctive dexamethasone therapy in unconfirmed bacterial meningitis in resource limited settings. BMC Neurol 2016;16:153.