



Prevalence and Risk Factors Associated with Otitis Media amongst Children Aged 0–48 Months in Yola, Adamawa State, Nigeria

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ABSTRACT: Acute Otitis media (AOM), an inflammation of the middle ear, is a common infection in children worldwide. It poses significant health challenges as it is the leading cause of hearing loss. This paper therefore investigate the prevalence and risk factors associated with Otitis media amongst 120 children aged 0–48 months attending hospital in Yola, Adamawa State, Nigeria. Ear swab specimens were collected using sterile swab sticks for bacterial isolation and identification. Information on sociodemographic and potential risk factors associated with otitis media was obtained from parents of the children via questionnaire. *Streptococcus pneumoniae* (20%) and *Staphylococcus aureus* (18.3%) were the major causative agents of AOM. The prevalence of AOM was found to be higher among male children (54.2%) than females (45.8%) in the age group 0-12 months. The highest rate of occurrence was found among children whose mothers had low socioeconomic status (61.7%), low educational level (45.8%), unemployed (71.7%), use bottle-feeding method (52.5%), procumbent position during feeding (81.7%), use cotton buds for ear cleaning (80%), poor feeding hygiene (56.7%) as well as children who have not taken pneumococcal vaccine (68.3%), and those with symptoms related to respiratory tract infections (78.3%). In conclusion, AOM is highly prevalent in Adamawa majorly affecting children less than one year. The main predisposing factors are bottle feeding, procumbent feeding position, poor hygiene, not vaccinating, use of cotton bud and upper respiratory tract infections. There is a need to inform mothers about the risk factors associated with AOM.

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Around the world, children frequently suffer from otitis media (OM), an inflammation of the middle ear caused by common bacterial infection. This is a serious health risk, especially in underdeveloped countries. The condition is well known for its high rate of recurrence and for being the primary cause of hearing loss in children, which can cause delays in their behaviour, linguistic, and educational development (Mohamed *et al.*, 2023). Roughly 141 million individuals worldwide suffer from ear infections, which severely affect their hearing. According to the World Health Organization (WHO),

if nothing is done, by 2050, there will be over 2.5 billion individuals worldwide who will suffer from some form of otitis media, and not fewer than 700 million individuals will have hearing loss (WHO, 2021). Previous research in Nigeria has shown that otitis media is quite prevalent, with rates varying by geographic area from 14.7% to 54% (Atta and Umar, 2021). According to Jamal *et al.* (2022), large burden is found in low- and middle-income nations because of factors such as recurring upper respiratory tract infections, poor hygiene, overcrowding, low socioeconomic level, and inadequate health treatment

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(Jamal *et al.*, 2022). Yosunkaya and Tarhun (2020) reported that there is correlation between high risk of persistent middle ear effusion and history of recurrence, daycare usage, environmental exposure to tobacco smoke, and not breastfeeding. The primary bacterial pathogens of AOM have been identified as *Streptococcus pneumoniae*, *Staphylococcus aureus*, non-typeable *Haemophilus influenzae* (NTHi), and *Moraxella catarrhalis*. Children with acute otitis media (AOM) were found to have *S. pneumoniae* as the most common bacterial pathogen in their middle ear, whereas children with recurrent acute otitis media (RAOM) and chronic otitis media with effusion (COME) are more likely to have NTHi in their middle ear (Ngo *et al.*, 2016). These bacteria are known to be potential reservoirs for bacterial pathogens that cause middle ear infections. They are part of the normal microbial community of the upper respiratory tract (URT), which includes the nasopharynx and adenoids (Schilder *et al.*, 2016; Fago-Olsen *et al.*, 2019; Thornton *et al.*, 2020). Various studies on otitis media have been conducted in different parts of the world. However, research on otitis media is sparse in Nigeria especially the Northeastern region of the country and people have little knowledge on the risk factors and even the causative agents of this infection. This study aimed to investigate otitis media's prevalence and risk factors in young children in Yola, Adamawa state. The results of this study will help improve the understanding, prevention, and management strategies for otitis media in the local population.

MATERIALS AND METHODS

Study Area: Adamawa State is encircled with states of Borno in the north, Taraba in the south, Gombe in the west, and Cameroun in the east. Its total area under cultivation is about 39,742 km², or 4.4% of Nigeria's total land area. As of 2021, the population was 4,902,100, with a density of 80 persons per km² (National Bureau of Statistics, 2021). The study was carried out in Yola, Adamawa State, Nigeria, at the Specialist Hospital, Yola, which is a medical facility.

Study Design and Population: This study was cross-sectional and descriptive. A practical sampling technique was employed to enlist research participants. Children 0 to 48 months old who were currently exhibiting symptoms of AOM at the otorhinolaryngology (ear, nose, and throat) unit at Specialist Hospital, Yola, in Adamawa State, were enrolled in the study. From June 2022 to April 2023, a span of 11 months, the study was carried out. The sample size was determined using the WHO sample size calculator. Only children who fit the age requirement, have an otitis media (OM) diagnosis that has been confirmed and verified, earache or discharge

symptoms or who manifested symptoms relevant to respiratory tract infections were included in the study while those children who have a history of severe allergies, autoimmune disorders, or other medical conditions that may affect the ear were excluded from the study.

Ethical Approval and Consent: Ethical approval was obtained from the Research and Ethics Committee of the Specialist Hospital, Yola. This study was conducted following the ethical principles outlined and approved by the institutional review board. Informed consent was obtained from the parents or legal guardians of the study participants before they participated in the study.

Sample and Data Collection: Ear swabs from 120 children with clinical manifestations of otitis media were collected aseptically using sterile swab sticks. Samples were collected with the help of physician present in the ear clinic or ward section by performing physical examination of the ear before sample collection. A sterile cotton swab was carefully inserted into the ear, and the ear wax or discharge was collected on the swab. Each sample was labelled with a code number and other clinical records. The samples were then transported to the Microbiology Laboratory for further processing. Before swab sample collection, a self-adapted questionnaire containing two sections was administered: section one requested for socio-demographic information (age, gender, mother's occupation, educational and socioeconomic status, etc.) of the child and the mother and section two was about the possible risk factors (feeding type, feeding position, related symptoms, use of cotton bud, etc.) associated with AOM and it was given to each parent or guardian to fill.

Sample processing: MacConkey and Blood agar media were prepared according to the manufacturer's specifications and were used for the isolation of possible pathogens present in the ear. The swab samples were aseptically inoculated with a sterile wire loop using the streak method on MacConkey and Blood agar plates following standard bacteriological techniques (Cheesbrough, 2006) and incubated aerobically at 37 °C for 24 h. After incubation, the plates were observed for growth through colony formation. The bacteria were further identified using biochemical techniques, such as microscopy and biochemical tests (Gram stain, catalase, citrate utilization, indole production, methyl red, Voges Proskauer (VP) test, etc.) following the standard procedures described by Cheesbrough (2006).

Data Analysis: Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 25. Descriptive statistics were calculated using means and standard deviations. Multivariate analysis was used to compare the mean differences between the prevalence and risk factors associated with otitis media. Statistical significance was set at $P < 0.05$.

RESULTS AND DISCUSSION

Of the 120 samples collected, 63 (52.5%) showed bacterial growth, whereas 57 (43.3%) showed no growth. The isolated bacteria were *Streptococcus pneumoniae* (20%), *Staphylococcus aureus* (18.3%), non-typeable *Haemophilus influenzae* (8.3%), *Streptococcus pyogenes* (3.3%), and *Klebsiella pneumoniae* (1.7%) (Table 1). The data obtained from the questionnaire provided sociodemographic information about the participants. Of the 120 participants investigated, 63 children were found to suffer from AOM with higher frequency of occurrence in males (54.2%) and lower in females (45.8%). This analysis showed that gender has no significant

association with otitis media ($P = 0.006$). AOM was also observed to occur most among the age group 0–12 months with frequency rate of 50%, while the age group with the lowest rate of occurrence was children within >36 – 48 months (5%), thus, an indication that there is significant relationship between age and otitis media ($P = 0.003$). The majority of the children's mothers were unemployed (71.7%), illiterate (45.8%), and had low socioeconomic status (61.7%) (Table 2). Based on the risk factors and clinical manifestations associated with AOM, the incidence was higher among children with; procumbent feeding positions (81.7%), those with one or more symptoms related to respiratory tract infection (78.3%), using cotton buds for ear cleaning (80%), not vaccinated with pneumococcal vaccine (68.3%), poor hygienic condition (56.7%), and bottle feeding type only (52.5%) (Table 3). At $P < 0.005$, the result of this analysis indicated significant association between these factors and otitis media in children. However, the relationship was found to have no significant difference in terms of family history of AOM and use of pacifiers ($P > 0.005$).

Table 1: Distribution of bacteria isolated from the study participants with Otitis media

Bacterial isolates	Number of isolates	Percentage (%)
<i>Streptococcus pneumoniae</i>	24	20
<i>Staphylococcus aureus</i>	22	18.3
Non-typeable <i>Haemophilus influenzae</i>	10	8.3
<i>Streptococcus pyogenes</i>	4	3.3
<i>Klebsiella pneumoniae</i>	2	1.7

Table 2: Distribution of socio-demographic features of participants

Variables	Group	Frequency	Percentage (%)
Age	0 – 12 months	60	50
	>12– 24 months	35	29.2
	>24- 36 months	19	15.8
	>36- 48 months	6	5
Gender	Male	65	54.2
	Female	55	45.8
Occupation	Employed	34	28.3
	Unemployed	86	71.7
Educational status	Illiterate	55	45.8
	Primary	31	25.8
	Secondary	22	18.3
	Tertiary	12	10
Mother's age	15 – 25 yrs	60	50
	26 – 35 yrs	36	30
	>35 yrs	24	20
Socioeconomic status	Low	74	61.7
	Middle	45	37.5
	High	11	9.2
Place of Residence	Normal house	93	77.5
	IDP camp	27	22.5

One of the most prevalent childhood disorders, AOM, has important information on its risk factors and causing agents that may be found in the results of the present study. Fifty two point five percent (52.5%) of

the study participants had otitis media. This prevalence was lower than the study reported by Ogbogu *et al.* (2013) and similar to a study by Atta and Umar (2021), but it was greater than other earlier

studies carried out in Nigeria by Amusa *et al.* (2005) and Tikaram *et al.* (2012). This inconsistent prevalence may be caused by unqualified healthcare professionals treating acute cases incorrectly, unavailable healthcare facilities, and detrimental cultural behaviours and attitudes of the people in that population.

The most prevalent bacterial pathogen were *Streptococcus pneumoniae* (20%) and *Staphylococcus aureus* (18.3%) which is consistent with earlier findings by Ekpo *et al.* (2009) and Imane *et al.* (2014). This outcome is also comparable to a comprehensive analysis that encompassed research done between 1993 and 2017 and found frequent isolation of *S.*

pneumoniae, *H. influenzae*, *S. aureus*, and *S. pyogenes*. This finding, however, is at odds with a report from the United States of America, where *Haemophilus* spp. was the most common pathogen (Hoffman *et al.*, 2003; Schleiss *et al.*, 2004), and also from Nigeria by Oni *et al.* (2002) and Attah and Umar (2021), where *P. aeruginosa* and *E. coli* were the most common organisms. These bacteria coexist as commensals in the nasopharynx and adenoid cavities of the upper respiratory tract (URT). Although *Staphylococcus aureus* is a typical component of the skin's microbiota, it can cause infections in the human body that affect tissues, mucous membranes, otitis media, and even the respiratory tract.

Table 3: Occurrence of risk factors and clinical symptoms of AOM among the participants

Risk factors/symptoms	Category	Frequency	Percentage (%)
Feeding type	Breastfeeding	45	37.5
	Bottlefeeding	63	52.5
	Both	22	18.3
Feeding Position	Procumbent	98	81.7
	Side by side	19	15.8
	Low fowler	13	10.8
Pacifier users	Yes	41	34.2
	No	79	65.8
Ear cleaning using cotton bud	Yes	96	80
	No	24	20
Hygienic condition	Good	52	43.3
	Poor	68	56.7
Pneumococcal vaccination status	Vaccinated	38	31.7
	Unvaccinated	82	68.3
Family history of AOM	Yes	43	35.8
	No	77	64.2
Presence of one or more of these symptoms (catarrh, sore throat, ear discharge, otorrhea and eardrum perforation)	Yes	94	78.3
	No	26	21.7

The contribution of sociodemographic traits to the emergence of AOM was ascertained by this investigation. Infants aged 0–12 months had the highest rate of AOM (50%) among all age groups. The finding that otitis media mostly affects young children is supported by earlier research, with the highest frequency of cases developing during the first year of life (Monasta *et al.*, 2012; Mohamed *et al.*, 2023). It has been established that the high incidence of otitis media in this age group can be linked to the immaturity of the Eustachian tube, both structurally and functionally, and the underdeveloped immune system. Compared to adults, an infant's Eustachian tube is thought to be smaller, with a wider diameter, and positioned more horizontally. These traits illustrate the anatomical variations that could give rise to an elevated prevalence of otitis media in infants and young children (Goulioumis *et al.*, 2022). The current

study's findings regarding the distribution of gender showed that male infants had a greater rate of AOM occurrence (55.2%) than female infants (45.8%). The results of research conducted in Pakistan and Nigeria (Orji *et al.*, 2010; Rasool *et al.*, 2020; Khan *et al.*, 2022) are consistent with this finding. Regarding the mothers of the children, the study's findings revealed that, in line with Kaspar *et al.* (2018), the rate of AOM was greater among infants with mothers who were illiterate (45.8%). Similarly, children with mothers between the ages of 15 and 25 without jobs had a greater frequency of AOM (71.7%). Divergent views have been expressed in several studies about the connection of mothers' age and job status with AOM (Al-Humaid and Abou-Halawa, 2014; Athbi and Abed-Ali, 2020). Nonetheless, this outcome aligns with the findings of Kaspar and colleagues (2018). Children with AOM were mostly mothers with low

socioeconomic status (61.7%). In line with this report, studies conducted in Pakistan and United States of America also demonstrated that women with low socioeconomic positions account for the majority of mothers with AOM children (61.7%) (Ren *et al.*, 2018; Khan *et al.*, 2022).

Additionally, potential risk factors and clinical traits linked to AOM were looked into. The study discovered that using cotton buds to clean one's ears, bottle feeding, procumbent feeding posture, and poor cleanliness were all important risk factors for infant's AOM. These results are supported by several investigations (Athbi and Abed-Ali, 2020; Hardani *et al.*, 2020). Children who are breastfed have a much lower chance of having AOM. In a similar vein, infants who were breastfed for longer than a year were less likely to develop AOM. It has been noted that infants' immune responses are either immature or faulty due to their low levels of immunoglobulin G. But against microorganisms, particularly those that cause lower respiratory tract infections, breast milk contains a variety of host defense mechanisms (Hokama *et al.*, 1999). According to Rasool *et al.* (2020), there is a substantial correlation between breastfeeding when lying down and a higher risk of AOM. Additionally, it has been noted that breastfeeding an infant upright helps prevent otitis media and respiratory tract infections in children (Avital *et al.*, 2018). The results of this investigation indicate that pneumococcal vaccination can avert the development of AOM. This result is consistent with a study carried out by Tawfiq *et al.* (2017). Infants without a history of ear infections in the family, as well as those who were not using pacifiers, reported a greater likelihood of AOM. However, this was not the case for other studies, which reported that pacifier usage and family history were strongly linked to AOM (Salah *et al.*, 2013; Athbi and Abed-Ali, 2020). Otitis media may be a prevalent disease among children, as evidenced by the fact that 78.3% of the children in the current study had one or more of the clinical symptoms linked to the condition. Therefore, information about ways to prevent this infection should be made public, especially for mothers.

Conclusion: According to the current study, there is a public health risk among young children in Adamawa State, Nigeria. It was discovered that *Staphylococcus aureus* and *Streptococcus pneumoniae* were the primary causal culprits. The bulk of the affected children were male infants under one year old, whose mothers had low socioeconomic levels, were unemployed, and had no formal education. The key risk factors that have been shown to increase the development of AOM in children include the usage of cotton buds to wipe their ears, upper respiratory tract

infections, procumbent feeding positions, bottle feeding types, inadequate hygienic conditions, and unvaccinated pneumococcal status. Nonetheless, it has been discovered that breastfeeding lowers an infant's risk of having otitis media.

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