



DEPARTMENT OF OTOLARYNGOLOGY-HEAD & NECK SURGERY

Prevalence of Otitis Media with Effusion and Associated Factors in Children Less than 14 Years with Sleep Disordered Breathing at Pediatric ENT Clinic, Saint Pauls Hospital Millennium Medical College, Addis ababa, Ethiopia.

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March,2026

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ST. PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE DEPARTMENT OF
OTORHINOLARYNGOLOGY-HEAD & NECK SURGERY

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Abstract

Background: Otitis media with effusion (OME) is a common cause of reversible hearing loss in children and is frequently associated with sleep-disordered breathing (SDB) due to upper airway obstruction and Eustachian tube dysfunction. Evidence on the burden of OME among children with SDB in Ethiopia is limited.

Objective: To determine the prevalence of otitis media with effusion and associated factors among children with sleep-disordered breathing attending the pediatric ENT clinic of Saint Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia.

Methods: A hospital-based cross-sectional study was conducted among 388 children aged under 14 years with sleep-disordered breathing. Sociodemographic, clinical, and environmental data were collected using structured questionnaires and clinical examination. Tympanometry was used to diagnose OME. Data were analyzed using SPSS. Bivariate analysis was performed, and variables with $p < 0.25$ were entered into a multivariable logistic regression model. Model fitness was assessed using the Omnibus test and Hosmer–Lemeshow goodness-of-fit test.

Results: Of the participants, 58.2% were males, and 89.7% resided in urban areas. Tympanometric findings showed type A in 52.6%, type B in 39.2%, and type C in 8.2% of children. The overall prevalence of OME was 39.2% (95% CI, 34.3%–44.1%). Children with OME were significantly younger than those without OME ($p < 0.001$). After adjustment, younger age (AOR = 0.59; 95% CI: 0.46–0.76), grade 3–4 adenoid hypertrophy (AOR = 10.20; 95% CI: 3.54–29.40), day-care or preschool attendance (AOR = 3.67; 95% CI: 1.84–7.30), and overcrowded living conditions (AOR = 3.32; 95% CI: 1.69–6.53) were independently associated with OME. The model demonstrated good fit ($p < 0.001$).

Conclusion: prevalence of OME in children with sleep disordered breathing is 39.2%. adenoid hypertrophy, daycare/preschool attendance, overcrowded living condition and younger age are factors independently associated with ome prevalence in this study.

Key words: otitis media with effusion , sleep disordered breathing, adenoid hypertrophy.

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Abbreviations

BMI	body mass index
ENT	Ear, Nose, and Throat
MEE	middle ear effusion
OME	otitis media with effusion
OSA	obstructive sleep apnea
SDB	sleep disordered breathing
SPHMMC	Saint Paul's Hospital Millennium Medical College

1. Introduction

1.1 Background

Otitis media with effusion (OME) is one of the most common causes of hearing loss in children worldwide. It is characterized by the presence of non-purulent fluid in the middle ear without signs of acute infection. OME can persist for weeks to months, often going undiagnosed due to its subtle or absent symptoms. It is one of the most common causes of hearing impairment in children. If left untreated, it may lead to speech and language delays, behavioural problems, and poor academic performance [1].

OME is most prevalent in preschool children, affecting up to 80% of children by age 4[2]. Risk factors include upper respiratory infections, Eustachian tube dysfunction, adenoid hypertrophy, allergic rhinitis, second hand exposure to cigarette smoke and attendance at day care centres [3,4]. In most cases, OME resolves spontaneously within three months, but recurrent or chronic cases may cause significant conductive hearing loss and affect cognitive and linguistic development [5].

Sleep disordered breathing (SDB) in children, which includes a spectrum from primary snoring to obstructive sleep apnea (OSA), is another common pediatric condition [6]. It results from partial or complete upper air way obstruction during sleep, leading to disrupted ventilation, hypoxia and sleep fragmentation [7]. The most common anatomical cause of SDB in children is adenotonsillar hypertrophy, which can also contribute to Eustachian tube obstruction and middle ear effusion [8]. Studies have shown that children with SDB are at increased risk for upper airway obstruction, which may contribute to Eustachian tube dysfunction—a known mechanism in the pathogenesis of OME.

There is increasing evidence of an association between SDB and OME due to shared anatomical and pathophysiological factors, particularly adenoid hypertrophy [9,10]. Studies have reported that children with SDB have a higher prevalence of middle ear effusion compared to those without sleep related breathing disorders and that adenoidectomy and tonsillectomy can improve both sleep quality and middle ear function [11,12].

While the association between SDB and OME has been explored in some high-income settings, data from low- and middle-income countries like Ethiopia remain scarce. Although SDB is increasingly recognized in Ethiopia pediatric ENT practice, data on its association with OME are limited [13]. In particular, there is limited evidence on the prevalence of OME among children diagnosed with SDB and the specific risk factors that contribute to this association in the local context.

Given that both OME and SDB are common, potentially reversible causes of hearing impairment, learning difficulties and poor quality of life in children, understanding the burden and associated factors of OME in this population is crucial for early diagnosis and management.

This research aims to fill that gap by investigating the prevalence of OME and its associated factors among children with sleep disordered breathing at Saint Paul's Hospital Millennium Medical College in Addis Ababa, Ethiopia. The findings may inform clinical screening practices and help develop guidelines for integrated management of both conditions.

1.2 statement of the problem

Otitis media with effusion (OME) is a highly prevalent middle ear disorder in children, characterized by the presence of fluid in the middle ear without acute infection [19]. Globally, it affects approximately 6–20% of school-aged children and is a leading cause of acquired hearing loss in this age group [3]. Although OME is often asymptomatic, persistent effusion can cause conductive hearing loss, speech and language delay, and poor academic performance, contributing to significant developmental and social challenges [1].

Sleep-disordered breathing (SDB) is another common pediatric condition encompassing habitual snoring, upper airway resistance, and obstructive sleep apnea, mainly resulting from adenotonsillar hypertrophy [8]. The anatomical and functional relationship between the nasopharynx, adenoids, and Eustachian tube predisposes children with SDB to middle ear ventilation problems, increasing the risk of OME [6]. Studies have shown that the prevalence of OME among children with SDB ranges between 40–60% in some populations [13].

Despite this recognized association, there is a scarcity of local data in Ethiopia and sub-Saharan Africa regarding the burden of OME in children with SDB. Most available evidence originates from developed countries, where risk factors, environmental exposures, and access to healthcare differ significantly [8]. In low-resource settings like Ethiopia, delayed diagnosis and limited access to audiologic evaluation can result in undetected hearing loss and impaired child development.

Therefore, identifying the prevalence and associated factors of OME among children with SDB at Saint Paul's Hospital Millennium Medical College is essential. This will provide baseline data to improve screening, early diagnosis, and management, ultimately preventing avoidable hearing impairment and its long-term developmental consequences.

1.3 significance of the study

Otitis media with effusion (OME) remains one of the most frequent causes of hearing impairment in children worldwide and is a major public health concern due to its impact on communication, learning, and social development [19]. Early detection and management are essential to prevent long-term speech, language, and cognitive delays that can adversely affect academic performance and quality of life [1].

Sleep-disordered breathing (SDB), a prevalent pediatric condition associated with adenotonsillar hypertrophy, has been increasingly recognized as an important predisposing factor for OME [8]. Children with SDB often experience Eustachian tube dysfunction due to upper airway obstruction, resulting in negative middle ear pressure and fluid accumulation. Understanding this relationship is crucial, particularly in low-resource settings where access to specialized ENT and audiology services is limited and hearing problems may go unnoticed until they cause significant developmental effects.

In Ethiopia, there is limited research exploring the prevalence of OME among children with SDB. Existing studies primarily focus on OME in the general pediatric population, without assessing specific risk factors such as adenotonsillar hypertrophy, allergy, or environmental exposures. This gap in local evidence makes it difficult for clinicians and policymakers to design appropriate screening protocols and preventive strategies.

Findings from this study will provide baseline data on the magnitude of OME in children with SDB and identify modifiable risk factors relevant to the Ethiopian context. This evidence can guide early screening, clinical decision-making, and resource allocation in ENT and pediatric services. Moreover, it will raise awareness among healthcare providers and caregivers regarding the importance of timely otologic evaluation in children presenting with sleep-disordered breathing symptoms. Ultimately, the study aims to contribute to reducing preventable childhood hearing impairment and its long-term social and educational consequences.

2. Literature review

2.1 Overview of OME and SDB

Otitis Media with Effusion (OME) is a non-suppurative inflammation of the middle ear characterized by the presence of fluid without signs of acute infection. It is one of the leading causes of hearing loss in children globally, with implications for speech development, academic performance, and quality of life. The worldwide prevalence of OME in children is estimated at 6%–26%, with peak incidence between ages 2 and 6 years [1]. In sub-Saharan Africa, limited diagnostic capacity leads to underreporting, but studies suggest a similarly high, if not greater, burden [18].

Sleep Disordered Breathing (SDB) is a spectrum of sleep-related respiratory disturbances in children, ranging from primary snoring to obstructive sleep apnea (OSA). SDB is most commonly caused by adenotonsillar hypertrophy and affects 1–5% of the pediatric population globally [8]. The anatomical proximity of the adenoids and eustachian tube orifice leads to impaired ventilation of the middle ear in children with SDB, increasing the risk of OME. Studies have shown that the prevalence of OME in children with SDB can range from 30% to over 50%, significantly higher than in the general pediatric population [14,15]. A meta-analysis by Lee et al. estimated that 43% of children with OSA had concurrent OME [16].

2.2 Existing data in African context

In Africa, though specific prevalence data are scarce, related studies underscore a high burden. A Nigerian study found that over 60% of children undergoing adenotonsillectomy for SDB symptoms had middle ear effusions detected intra operatively [17]. Similarly, South African school-based screening programs reported a high prevalence of undiagnosed OME, particularly in rural and low-income settings [31]. A hospital based study done in Tanzania The prevalence of MEE among children with adenoid hypertrophy was found to be 61.7% [33]. In case control study done in Kenya national hospital the incidence of OME in children with obstructive adenoid hypertrophy is found to be 67.3% [23]. Study in Rwanda found an OME prevalence of 46.1% in children with adenoid hypertrophy. In this study socioeconomic

status and history of sibling with OME were found to be factors that significantly affect risk of OME.

2.3 Associated factors and risk determinants

Numerous sociodemographic and clinical factors are known to influence the development of OME in children with SDB. The eustachian tube is shorter and more horizontal in young children, making those aged 2–6 years more susceptible [19]. Males may have a slightly increased risk, though findings vary across studies [20]. Obesity is a known risk factor for SDB and may contribute to OME by increasing upper airway resistance and inflammation [21]. Rural and peri-urban children may face increased risk due to environmental exposures and limited access to timely ENT care [18]. Chronic nasal inflammation impairs eustachian tube function, and studies from Egypt and Nigeria report a strong association between allergies and OME [22,23]. Exposure to tobacco smoke damages the mucociliary clearance system. A Kenyan study linked second-hand smoke to chronic otitis media in children [25]. Day care or School Attendance: Increased exposure to upper respiratory pathogens raises OME risk. Teele et al. found daycare attendance nearly doubled the risk of persistent middle ear effusions [25]. Congested Living Conditions: Overcrowded households promote the spread of infections and delay medical attention. A Ugandan study linked poor housing and family crowding to higher ENT morbidity [26]. Pacifier Use: Prolonged pacifier use has also been implicated in the development of OME. A Finnish cohort study found that children using pacifiers beyond infancy had a 33% higher risk of developing OME [20]. Despite its frequent use in African settings, pacifier-related data remain limited and under-investigated.

The severity of SDB has also been correlated with OME occurrence. Children with moderate to severe OSA demonstrate more significant eustachian tube dysfunction and higher rates of persistent effusions.

2.4 Summary of knowledge gaps

while global evidence supports a strong association between SDB and OME there is limited data from Ethiopia, there is a lack of published data examining the relationship between SDB and OME or evaluating the impact of common risk factors. The current study at Saint Paul's Hospital Millennium Medical College seeks to quantify the prevalence of OME among

children with SDB, assess its association with key independent variables (including pacifier use), and identify modifiable risk factors. The findings could support early screening and integrated management strategies for pediatric ENT and sleep disorders.

2.5 Conceptual framework

The development of otitis media with effusion (OME) among children with sleep-disordered breathing (SDB) is hypothesized to result from the interaction of multiple sociodemographic, clinical, and environmental factors. Sociodemographic factors, including age, sex, and socioeconomic status, may influence susceptibility to OME through differences in immunity, health-seeking behavior, and living conditions [4,5]. Clinical factors such as adenoid hypertrophy, tonsillar hypertrophy, allergic rhinitis, and nasal obstruction can impair Eustachian tube function, leading to negative middle ear pressure and effusion formation [19]. In addition, environmental factors like exposure to tobacco smoke and indoor air pollution contribute to chronic inflammation and mucosal congestion, further predisposing children to OME. The severity of sleep-disordered breathing is considered a mediating variable, linking these factors to OME through mechanisms such as intermittent hypoxia, increased negative intrathoracic pressure and Eustachian tube dysfunction during sleep.

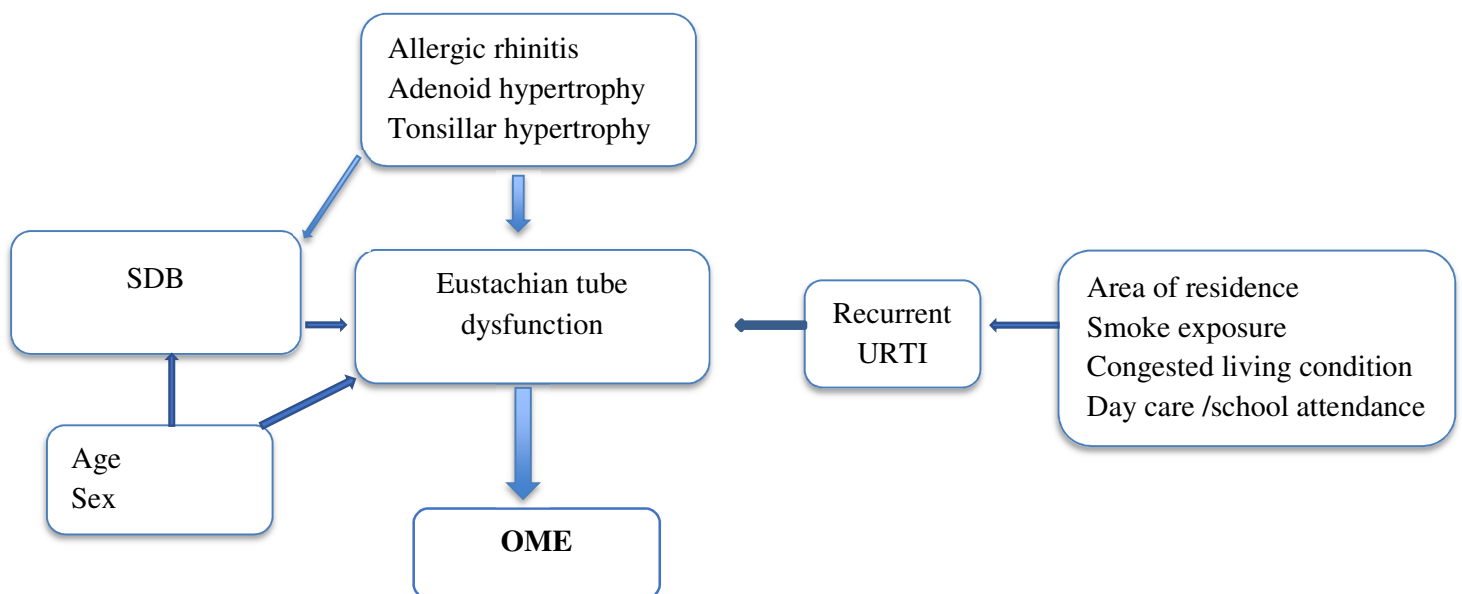


Diagram 1: conceptual frame work

3. Objectives

3.1 General Objective

To determine the prevalence of otitis media with effusion and identify associated factors in children with sleep disordered breathing at Saint Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia.

3.2 Specific Objectives

1. To determine the prevalence of otitis media with effusion in children diagnosed with sleep disordered breathing.
2. To assess sociodemographic and clinical factors associated with otitis media with effusion in children with sleep disordered breathing.

4. Methodology

4.1 Study Design

A hospital-based cross-sectional study was conducted to assess the prevalence of otitis media with effusion (OME) and associated factors among children diagnosed with sleep disordered breathing (SDB).

4.2 Study Area

The study was conducted at Saint Paul's Hospital Millennium Medical College (SPHMMC), located in Addis Ababa, Ethiopia. Saint Paul's Hospital is one of the largest tertiary referral and teaching hospitals in the country. It was established in 1969 and upgraded to a teaching hospital and medical college in 2007. The institution is under the Federal Ministry of Health and serves as a major training centre for undergraduate and postgraduate medical and health science students.

The hospital provides comprehensive health services to patients from Addis Ababa and various regions of Ethiopia. It has over 700 inpatient beds and serves an estimated 1,200–1,500 outpatients per day across multiple specialties. The Department of Otolaryngology–Head and Neck Surgery (ENT) is one of the key clinical departments within the hospital. It offers outpatient consultations, diagnostic services (including otoscopy, tympanometry, and nasopharyngoscopy), and surgical management for a wide range of ENT conditions.

The ENT outpatient clinic runs throughout the week and receives referrals from different departments within the hospital as well as from health centers and hospitals across the country. The department has a dedicated pediatric ENT service, where children presenting with symptoms of sleep-disordered breathing and ear-related complaints are evaluated. Diagnostic facilities for this study include otomicroscopic examination, tympanometry, and nasopharyngoscopy, which are available within the department. Audiology services are also accessible for hearing assessment.

The hospital is located in Gulele Sub-City, Addis Ababa. The hospital serves a diverse population with varying socioeconomic backgrounds, making it an ideal setting for studying both the prevalence and associated factors of otitis media with effusion among children with sleep-disordered breathing.

4.3 Study Period

The study was conducted over a period of 3 months, from 01/11/2025 to 30/1/2026

4.4 source population

Included all children aged less than age 14 year with sleep-disordered breathing (SDB) who seek medical evaluation and treatment at Saint Paul's Hospital Millennium Medical College.

4.5 Study Population

All children aged less than 14 years presenting to the pediatric ENT clinic of SPHMMC with symptoms consistent with sleep disordered breathing during the study period fulfilling the inclusion criteria

4.6 Study unit

Each individual child with sleep-disordered breathing (SDB) who fulfilled the inclusion criteria and is selected to participate in the study. Each child served as a single unit of analysis for whom data was collected through clinical evaluation, otomicroscopic examination, tympanometry, and a structured questionnaire assessing sociodemographic and clinical factors.

4.7 Inclusion Criteria

- Children aged less than 14 years diagnosed with sleep disordered breathing based on clinical assessment.

4.8 Exclusion Criteria

- Children with a history of ear surgery or tympanic membrane perforation
- Children currently on treatment for OME

4.9 Sample Size Determination

A census (consecutive sampling) approach was used. All children with diagnosis of SDB who fulfil the inclusion criteria and present to the Pediatric Otorhinolaryngology outpatient clinics of Saint Paul's Hospital Millennium Medical College during the study period were included in the study.

4.10 Sampling Technique

A consecutive sampling technique was employed in this study. All children who present to the ENT and pediatric clinics at Saint Paul's Hospital Millennium Medical College with features of sleep disordered breathing (SDB) during the study period and who meet the inclusion criteria were consecutively recruited until the study period ends. Consecutive sampling is chosen because it is practical and appropriate for hospital-based prevalence studies, ensuring that every eligible participant available during the study period has an equal opportunity to be included, thereby minimizing selection bias.

Eligible participants were identified during routine clinic visits by data collectors (ENT residents). Children who meet the inclusion criteria were enrolled. Those who do not meet the inclusion criteria were excluded and not replaced. Recruitment continued consecutively till the end of study period.

4.11 variables

4.11.1 Independent variables

- ✓ Diagnosis of SDB
- ✓ Grade of adenoid hypertrophy
- ✓ Grade of tonsillar hypertrophy
- ✓ Age
- ✓ Sex
- ✓ Area of residence(urban vs rural)
- ✓ History of allergic rhinitis
- ✓ Second hand smoke exposure
- ✓ Day care or school attendance
- ✓ Pacifier use
- ✓ Bottle feeding
- ✓ Overcrowded living condition
- ✓ Vaccination status

4.11.2 Dependent variable

- ✓ Diagnosis of OME

4.12 Data Collection Tools and Procedures

Data was collected using a structured questionnaire and clinical examination checklist. The questionnaire was prepared in English (to be translated to local language verbally by the physician during interview). The clinical examination checklist included findings from otomicroscopic and tympanometric examinations. Otomicroscopy was used to assess the tympanic membrane for dullness, retraction, or air-fluid levels. Tympanometry was performed using a calibrated middle ear analyzer to confirm the presence of effusion (Type B tympanogram). Nasopharyngoscopy was used to assess adenoid size.

Children presenting with symptoms of sleep-disordered breathing at the ENT outpatient department will first be evaluated by ENT residents or specialists. Those fulfilling the inclusion criteria were enrolled after obtaining informed consent from their parents or guardians. After enrollment, the parent or guardian were interviewed using the structured questionnaire to obtain sociodemographic and clinical information. A detailed ENT examination conducted, including anterior rhinoscopy, oropharyngeal inspection, otomicroscopic examination and nasopharyngoscopy. Tympanometry performed to objectively identify middle ear effusion. All findings were recorded on the data collection checklist immediately after each assessment.

4.13 Data Quality Control

Prior to data collection, ENT residents (data collectors) received detailed training on the objectives of the study, data collection tools, interviewing techniques, otomicroscopic and tympanometric examination procedures, and ethical considerations.

The principal investigator was closely supervising the data collection process. All completed questionnaires and checklists were reviewed daily for completeness and consistency before data entry. Any missing or ambiguous responses were immediately clarified.

All otomicroscopic examinations were performed using the same standard equipment, and tympanometry was conducted using a calibrated middle ear analyzer to ensure consistent diagnostic results. The tympanometer and other diagnostic instruments were checked and calibrated regularly during the study period to maintain accuracy of measurements

4.14 Data Analysis

Data was checked for completeness, coded, and entered into EpiData version 4.6 and then exported to SPSS version 27 for statistical analysis. The study being a cross-sectional quantitative design, analysis focused on determining the prevalence of otitis media with effusion (OME) and identifying factors associated with its occurrence among children with sleep disordered breathing (SDB). Descriptive statistics was used to summarize sociodemographic and clinical characteristics of the study participants. Frequencies, percentages, means and standard deviations presented in tables and figures as appropriate. The prevalence of OME calculated as the proportion of children diagnosed with OME among the total number of children with SDB included in the study. In the inferential analysis, bivariate logistic regression was performed to assess the association between OME and each independent variable. Variables with a p-value less than 0.25 in the bivariate analysis were entered into a multivariable logistic regression model to identify independent predictors of OME while controlling for potential confounders.

The adjusted odds ratios (AOR) with 95% confidence intervals (CI) was reported to show the strength and direction of associations. A p-value less than 0.05 was considered statistically significant. The model fitness was evaluated using the Hosmer–Lemeshow goodness-of-fit test, and Omnibus Tests of Model Coefficient. results were presented in the form of tables, graphs, and charts.

5. Ethical Considerations

This study was conducted in accordance with the ethical standards set forth by the Saint Paul's Hospital Millennium Medical College Institutional Review Board (IRB) and the Declaration of Helsinki. Ethical clearance was obtained from the Institutional Review Board (IRB) of Saint Paul's Hospital Millennium Medical College prior to data collection. Informed consent was obtained from parents or legal guardians of all participating children. For children aged 7 years and above, verbal assent was also sought in age-appropriate language. All data collected was kept strictly confidential. Data was stored securely and used solely for research purpose. There is minimal risk to participants, as procedures (otomicroscopic exam, tympanometry, and questionnaires) are non-invasive and standard parts of ENT evaluations. Participants found to have OME or other ENT issues were given appropriate treatment. Participation was entirely voluntary.

6. Dissemination of the Results

Based on the work plan, after data is analysed, a conclusion will be drawn, a discussion will be made, and public defence will be done at the SPMMC department of ENT. After accommodating the examiner's comment and getting permission from the concerned authority, information will be disseminated to the concerned body, and the findings will be considered for publication.

7. Result

Socio demographic characteristics: A total of 388 children with sleep-disordered breathing were included in the analysis. Of these, 226 (58.2%) were males and 162 (41.8%) were females.

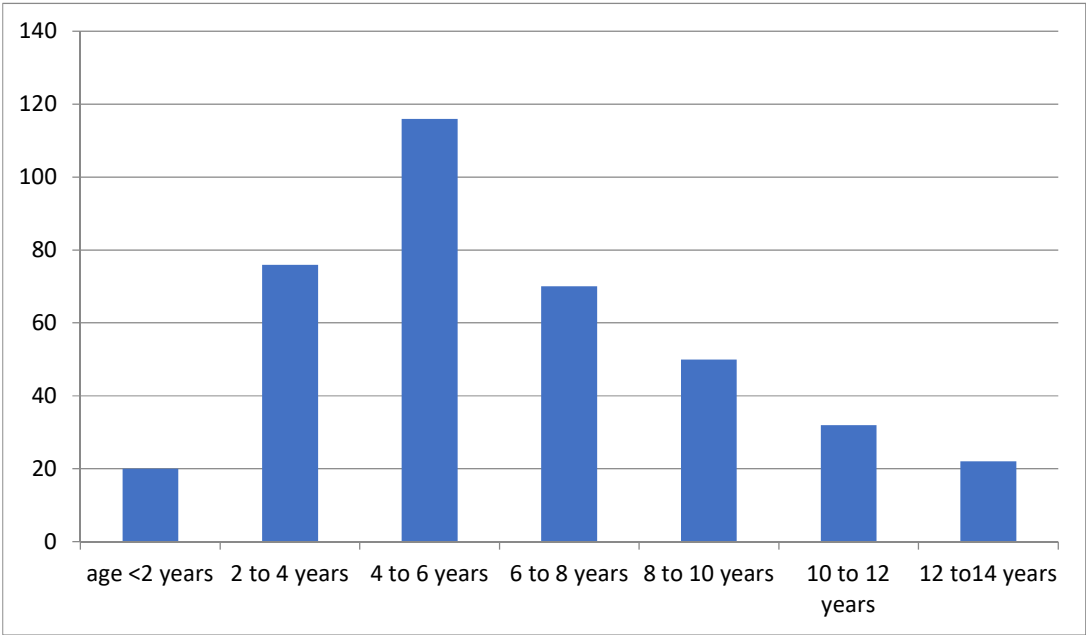
The majority of participants were from urban areas 348 (89.7%), while 40 (10.3%) were from rural areas.

Table 1: distribution of study participants by gender and area of residence (N=388)

Variable	category	frequency	Percentage
Gender	Male	226	58.2%
	Female	162	41.8%
Residence	Urban	348	89.7%
	rural	40	10,3%

Age distribution of participants: the mean age of participants is 5.7 years and median age is 5. 287(74 %) of the participants are in the age range of 2 to 8 years, 20(5%) participants are below the age of 2 years and 79 (20%) are above the age of 8 years.

Figure 1: Age distribution of participants



Tympanometric Findings and Prevalence of OME

Tympanometric assessment showed type A tympanogram in 204 (52.6%) children, type B in 152 (39.2%), and type C in 32 (8.2%). Otitis media with effusion, defined as the presence of a type B tympanogram in at least one ear, was diagnosed in 152 children, giving an overall prevalence of 39.2% (95% CI, 34.3%-44.1%) among children with sleep-disordered breathing.

Table 2: frequency distribution of tympanometry result types

Tympanometry type	Frequency	Percent
Type A	204	52.6
Type B	152	39.2
Type C	32	8.2

Bivariate Analysis

Table 3: bivariate analysis of factors associated with OME

Independent variable	category	Dependent variable	category	Test statistics	p-value
Age	Continuous	OME diagnosis	Yes or NO	Mann-whitney U=11627	<0.001
Sex	Male vs Femal			$\chi^2=0.53$	0.46
Area of residence	Urban vs Rural			$\chi^2=4.69$	0.03
Adenoid hypertrophy	Grade categories			$\chi^2=69.36$	<0.001
Tonsilar hypertrophy	Grade categories			$\chi^2=9.32$	0.025
Second hand cigarette smoke exposure	Yes or No			$\chi^2=10.91$	<0.001
Day care/preschool attendance	Yes or No			$\chi^2=4.11$	0.043
Overcrowded living condition	Yes or No			$\chi^2=26.26$	<0,001
Allergic rhinitis	Yes or No			$\chi^2=0.13$	0.72
Pacifier use	Yes or No			$\chi^2=1.14$	0.28
Bottle feeding	Yes or No			$\chi^2=0.03$	0.87
Vaccination status	Yes or No			$\chi^2=2.30$	0.32

Age was not normally distributed; therefore, a Mann–Whitney U test was used. There was a statistically significant difference in age between children with and without OME ($U = 11,627$, $p < 0.001$).

In bivariate analysis, area of residence ($\chi^2 = 4.69$, $p = 0.03$), adenoid hypertrophy grade ($\chi^2 = 69.36$, $p < 0.001$), tonsillar grade ($\chi^2 = 9.32$, $p = 0.025$), second-hand cigarette smoke exposure ($\chi^2 = 10.91$, $p < 0.001$), day-care or preschool attendance ($\chi^2 = 4.11$, $p = 0.043$), and overcrowded living conditions ($\chi^2 = 26.26$, $p < 0.001$) were significantly associated with OME.

Sex ($\chi^2 = 0.53$, $p = 0.46$), allergic rhinitis ($\chi^2 = 0.13$, $p = 0.72$), pacifier use ($\chi^2 = 1.14$, $p = 0.28$), bottle feeding ($\chi^2 = 0.03$, $p = 0.87$), and vaccination status ($\chi^2 = 2.30$, $p = 0.32$) were not significantly associated with OME.

Multivariable Logistic Regression Analysis

Table 4: multivariable logistic regression analysis of factors associated with OME

Variable	category	df	Sig.(p-value)	AOR(Exp(B))	95% CI
Age	Continuous	1	<0.001	0.591	0.460-0.758
Tonsillar hypertrophy	Grade1-2(ref) vs grade 3-4	1	0.141	0.608	0.313-1.180
Adenoid hypertrophy	Grade1-2(ref) vs grade 3-4	1	<0.001	10.204	3.541-29.401
Area of residence	Urban(ref) vs rural	1	0.380	0.628	0.222-1.774
Day care/preschool attendance	No(ref) vs Yes	1	<0.001	3.665	1.841-7.301
Overcrowded living condition	No(ref) vs Yes	1	<0.001	3.323	1.691-6.531
Second hand smoke exposure	No(ref) VS Yes	1	0.165	4.849	0.522-45.066

Variables with p-value < 0.25 in bivariate analysis were entered into a multivariable logistic regression model. The Omnibus test of model coefficients was statistically significant ($p < 0.001$), indicating that the model explained a significant proportion of the variability in OME. The Hosmer–Lemeshow goodness-of-fit test demonstrated adequate model fit ($\chi^2 = 6.54$, $df = 8$, $p = 0.587$).

After adjustment, younger age, moderate to severe adenoid hypertrophy, day-care or preschool attendance, and overcrowded living conditions remained independently associated with OME.

Each one-year increase in age was associated with a 41% reduction in the odds of OME (AOR = 0.59, 95% CI: 0.46–0.76, $p < 0.001$). Children with grade 3–4 adenoid hypertrophy had more than tenfold increased odds of OME compared to those with grade 1–2 hypertrophy

(AOR = 10.20, 95% CI: 3.54–29.40, $p < 0.001$). Attendance at day-care or preschool was associated with higher odds of OME (AOR = 3.67, 95% CI: 1.84–7.30, $p < 0.001$), as was living in overcrowded conditions (AOR = 3.32, 95% CI: 1.69–6.53, $p < 0.001$).

Tonsillar grade, area of residence, and exposure to second-hand cigarette smoke were not independently associated with OME after adjustment.

8. Discussion

This study assessed the prevalence of otitis media with effusion and its associated factors among children with sleep-disordered breathing attending a tertiary referral hospital in Ethiopia. The findings demonstrate a high burden of OME (39.2%) in this population and identify younger age, adenoid hypertrophy, day-care or preschool attendance, and overcrowded living conditions as independent predictors.

The prevalence of OME observed in this study is considerably higher than that reported in the general pediatric population but is consistent with studies focusing on children with sleep-disordered breathing or upper airway obstruction. Previous reports from different settings have documented OME prevalence ranging from 30% to over 50% [11,14,16,37] among children with adenotonsillar hypertrophy or habitual snoring. The prevalence in this study is comparable to the finding of a study in Rwanda which is 46.1% [36]. The slight higher prevalence can be explained by the inclusion of only those with adenoid hypertrophy whereas in this study all those with diagnosis of sleep disordered breathing included. The sub group prevalence of OME in participants with grade 3-4 adenoid hypertrophy is 46.6% which is in line with the Rwandan study above. Significantly higher incidence (55.9%) was reported in Nigerian study [34] but, the study included only those with adenoid hypertrophy and they used both type B and type C tympanometry to diagnose OME which explains the high prevalence found in the study. A study in Kenya also reported a prevalence of 67.3% [35]. In this study they included only those with adenoid hypertrophy in the age range of 1 to 8 years, an age range in which OME is more prevalent.

The elevated prevalence observed in the present study reinforces the strong pathophysiological link between upper airway obstruction and middle ear disease. Adenoidal obstruction may impair Eustachian tube function through mechanical compression and chronic nasopharyngeal inflammation, leading to negative middle ear pressure and effusion formation. This mechanism likely explains the high prevalence of OME in children presenting with sleep-disordered breathing.

Younger age was independently associated with OME, with each additional year of age associated with a significant reduction in the odds of disease. This finding is consistent with numerous epidemiological studies that demonstrate a higher susceptibility to middle ear

effusion in younger children [19]. Anatomical and immunological immaturity, including a shorter, more horizontal Eustachian tube and increased vulnerability to upper respiratory infections, likely contribute to this association. As children grow older, maturation of the Eustachian tube and immune system may explain the declining prevalence of OME.

Adenoid hypertrophy emerged as the strongest independent predictor of OME in this study. Children with moderate to severe adenoid hypertrophy had more than tenfold increased odds of developing OME compared with those with mild hypertrophy. This finding is in agreement with previous studies from both high-income and low-resource settings, which have consistently demonstrated a strong association between adenoid enlargement and middle ear effusion [9,36]. The adenoids can act as a reservoir for pathogenic bacteria and contribute to chronic nasopharyngeal inflammation. Additionally, enlarged adenoids may mechanically obstruct the Eustachian tube orifice, leading to persistent middle ear effusion. These findings support the clinical importance of adenoid assessment in children with sleep-disordered breathing and suspected OME.

Although tonsillar hypertrophy and exposure to second-hand cigarette smoke were significantly associated with OME in bivariate analysis, these associations did not persist after adjustment for confounders. This suggests that their effects may be mediated through other factors, such as adenoid hypertrophy or environmental exposures. The lack of an independent association with allergic rhinitis contrasts with some previous studies [22,37,38] but may reflect differences in diagnostic criteria, population characteristics, or sample size.

Attendance at day-care or preschool was independently associated with OME, a finding that aligns with existing literature [25]. Increased exposure to respiratory pathogens in group care settings may lead to recurrent upper respiratory tract infections, which in turn predispose children to Eustachian tube dysfunction and middle ear effusion. Similarly, overcrowded living conditions were significantly associated with OME. Overcrowding is a well-recognized risk factor for infectious diseases and may reflect increased exposure to respiratory pathogens, poor ventilation, and limited access to preventive healthcare. These findings highlight the influence of social and environmental determinants on pediatric ear disease, particularly in low- and middle-income countries [26].

Clinical and Public Health Implications

The high prevalence of OME observed in children with sleep-disordered breathing has important clinical implications. OME is a leading cause of conductive hearing loss in children and may adversely affect speech, language development, and academic performance [1]. Routine middle ear assessment, including tympanometry, should be considered in children presenting with sleep-disordered breathing, particularly in those with adenoid hypertrophy or adverse environmental exposures.

From a public health perspective, interventions aimed at reducing overcrowding and improving infection control in day-care settings may help reduce the burden of OME. Early identification and appropriate management of adenoid hypertrophy may also play a key role in preventing persistent middle ear disease.

Strengths and Limitations

Strengths of the Study

Institution-based data with adequate sample size: The study included 388 participants, providing sufficient statistical power to estimate the prevalence of OME and assess associated factors.

Objective diagnostic method: Use of tympanometry (Type B tympanogram) ensured an objective and standardized diagnosis of otitis media with effusion, reducing misclassification bias.

Focused study population: Inclusion of children with sleep-disordered breathing allowed targeted evaluation of a high-risk group, improving clinical relevance.

Assessment of multiple risk factors: The study comprehensively evaluated sociodemographic and clinical variables enabling identification of independent predictors.

Limitations of the Study

Cross-sectional study design: The study design limits the ability to establish causal relationships between risk factors and OME.

Single-center study: Conducted at Saint Paul's Hospital Millennium Medical College, which may limit generalizability to the wider Ethiopian pediatric population.

Selection bias: As participants were recruited from a tertiary hospital ENT clinic, they may represent more severe cases of sleep-disordered breathing, potentially overestimating prevalence.

Potential recall bias: Information on exposures such as second-hand smoke, daycare attendance, and feeding practices relied on caregiver reports.

9. Conclusion and Recommendation

9.1 Conclusion

Otitis media with effusion is highly prevalent among children with sleep-disordered breathing. Younger age, adenoid hypertrophy, day-care or preschool attendance, and overcrowded living conditions are independently associated with OME. These findings underscore the need for integrated evaluation of upper airway obstruction and middle ear status in pediatric ENT practice, particularly in resource-limited settings.

9.2 Recommendations

Routine screening for otitis media with effusion (OME) using tympanometry should be considered for all children presenting with sleep-disordered breathing, particularly those with higher grades of adenoid hypertrophy.

Clinicians should maintain a high index of suspicion for OME in children with identified risk factors, including significant adenoid hypertrophy. Comprehensive ENT evaluation should be integrated into the standard care of children with sleep-disordered breathing.

Further multicenter and longitudinal studies are recommended to establish causal relationships and assess the long-term outcomes of OME in this population.

References

1. Rosenfeld RM, Shin JJ, Schwartz SR, Coggins R, Gagnon L, Hackell JM, et al. Clinical practice guideline: Otitis media with effusion (update). *Otolaryngol Head Neck Surg*. 2016;154(1 Suppl):S1–41.
2. Dong L, et al. Global, regional, and national burden of otitis media in children from 1990 to 2021: a systematic analysis. *Eur Arch Otorhinolaryngol*. 2024.
3. Zielhuis GA, et al. The prevalence of otitis media with effusion: a review. *Clin Otolaryngol Allied Sci*. 1990;15(3):283–288.
4. Daly KA, et al. Risk factors for otitis media with effusion. *Ann Otol Rhinol Laryngol*. 1999;108(11 Pt 2):48–53.
5. Paradise JL, et al. Eustachian tube dysfunction in young children. *Pediatrics*. 2013;131(2):e421–e428.
6. Stool SE, et al. Otitis media with effusion in young children. *N Engl J Med*. 2000;342(2):100–107.
7. Kaditis AG, et al. Sleep-disordered breathing in children. *Pediatr Pulmonol*. 2016;51(8):1020–1030.
8. Marcus CL, et al. Diagnosis and management of childhood obstructive sleep apnea syndrome. *Pediatrics*. 2012;130(3):e714–e755.
9. Mitchell RB, et al. Adenotonsillar hypertrophy and OME: relationship and outcomes. *Laryngoscope*. 2014;124(1):101–105.
10. Ahn J, et al. Relationship between sleep-disordered breathing and otitis media with effusion in children. *Int J Pediatr Otorhinolaryngol*. 2018;107:71–75.
11. Cayir S, et al. Association of OME with adenoid hypertrophy and OSA in children. *Sleep Breath*. 2019;23(1):231–236.
12. Al-Azab AA, et al. Effect of adenotonsillectomy on middle ear effusion and hearing in children with OSA. *Egypt J Otolaryngol*. 2020;36(1):38–44.

13. Yilmaz MD, et al. Effect of adenoidectomy on otitis media with effusion and hearing. *Int J Pediatr Otorhinolaryngol.* 2017;99:83–88
- Marcus CL, Brooks LJ, Ward SD, Draper KA, Gozal D, Halbower AC, et al. Diagnosis and management of childhood obstructive sleep apnea syndrome. *Pediatrics.* 2012;130(3):e714–55.
- 14.. Yildirim N, Sahan M, Karsligil T, Karsligil B, Demirhan H. Otitis media with effusion and obstructive sleep apnea in children. *Eur Arch Otorhinolaryngol.* 2013;270(12):3069–72.
- 15.. Sahin B, Kayhan FT, Ozturk EA. Relationship between otitis media with effusion and adenoid hypertrophy in obstructive sleep apnea syndrome in children. *Int J Pediatr Otorhinolaryngol.* 2011;75(8):1034–7.
16. Lee DW, Kim MG, Hong SM, Boo SH, Yeo SG. Prevalence and risk factors of otitis media with effusion in children with snoring. *Int J Pediatr Otorhinolaryngol.* 2018;107:79–83.
17. Adebola SO, Ofoegbu VC, Olatoke F, Dunmade AD. Adenoid and tonsillar hypertrophy in Nigerian children: A hospital-based study. *Niger J Surg.* 2014;20(1):23–7.
18. Swanepoel DW, Eikelboom RH, Margolis RH. Hearing and middle ear pathology in a South African primary school population. *South Afr Med J.* 2013;103(12):909–13.
19. Bluestone CD, Klein JO. Otitis media in infants and children. 4th ed. Hamilton: BC Decker; 2007.
20. Uhari M, Mäntysaari K, Niemelä M. A meta-analytic review of the risk factors for acute otitis media. *Clin Infect Dis.* 1996;22(6):1079–83.
21. Smith DF, Schmidt H, Hanley T, Simpson D, Ishman SL. Body mass index and pediatric obstructive sleep apnea. *Int J Pediatr Otorhinolaryngol.* 2011;75(1):95–100.
22. Abdel Tawab HMA, Zaki MM, El Desouky SS, Abd El-Hamid DH. Allergic rhinitis and its impact on otitis media with effusion in children. *Egypt J Otolaryngol.* 2015;31(4):245–52.
23. Ibekwe TS, Nwaorgu OG, Ijaduola GT. Rhinitis, sinusitis and otitis media among school children in Nigeria. *East Afr Med J.* 2010;87(7):274–9.

24. Ngugi DK, Otieno M, Wanjohi Z. Passive smoking as a risk factor for chronic otitis media among children in Nairobi, Kenya. *East Cent Afr J Otolaryngol*. 2018;4(1):8–13.
25. Teele DW, Klein JO, Rosner B. Epidemiology of otitis media during the first seven years of life in children in greater Boston: A prospective, cohort study. *J Infect Dis*. 1989;160(1):83–94.
26. Tumwine JK, John CC, Agaba E, Babirye J, Mpairwe H. Overcrowding and ENT morbidity in Ugandan children: A case for housing reform. *Afr Health Sci*. 2010;10(2):120-6.
- 27..life in children in greater Boston: a prospective, cohort study. *J Infect Dis*. 1989;160(1):83-94.
- 28..Basha SI, Chakravarthy VC. Otitis media with effusion and obstructive sleep apnea: correlation and clinical significance. *Indian J Otolaryngol Head Neck Surg*.
- 29..Sadé J. Pathogenesis and definition of otitis media with effusion. *Ann Otol Rhinol Laryngol Suppl*. 1980;89(2 Pt 3):21-26.
- 30.World Health Organization. *Chronic suppurative otitis media: burden of illness and management options*. Geneva: WHO; 2004.
- 31.Ethiopian Ministry of Health. *National strategy for ear and hearing care in Ethiopia 2020–2024*. Addis Ababa: MoH; 2020.
- 32.Overcrowding and ENT morbidity in Ugandan children: A case for housing reform. *Afr Health Sci*. 2010;10(2):120–6.
- 33.Abraham et al. Prevalence of middle ear effusion among children with adenoid hypertrophy at a national referral hospital in Tanzania. *South Sudan Medical Journal*, 2023;16(3):102-105 © 2023. DOI: [https:// dx.doi.org/10.4314/ssmj.v16i3.5](https://dx.doi.org/10.4314/ssmj.v16i3.5)
- 34.Nwosu C, Uju Ibekwe M, Obukowho Onotai L. Tympanometric Findings among Children with Adenoid Hypertrophy in Port Harcourt, Nigeria. *Int J Otolaryngol*. 2016;2016:1276543. doi: 10.1155/2016/1276543. Epub 2016 Aug 2. PMID: 27563311; PMCID: PMC4985572.
35. A. M. Kiama, “Prevalence Of Otitis Media With Effusion In Children With Obstructive Adenoid Disease Compared With Normal Controls At Kenyatta National Hospital .,” 2014.

36. Prevalence and risk factors of otitis media with effusion in patients with adenoid hypertrophy at Kigali University Teaching Hospital (CHUK).Dr. UMUTONI, Josiane
37. Songu M, Islek A, Imre A, Aslan H, Aladag I, Pinar E, Oncel S. Risk factors for otitis media with effusion in children with adenoid hypertrophy. *Acta Otorhinolaryngol Ital.* 2020 Apr;40(2):133-137. doi: 10.14639/0392-100X-2456. PMID: 32469007; PMCID: PMC7256910.
38. X. Cheng, H. Sheng, R. Ma, Z. Gao, Z. Han, F. Chi, N. Cong, J. Wang, X. Liu, X. Luo, J. Yu, Y. Ra, Allergic rhinitis and allergy are risk factors for otitis media with effusion: A meta-analysis