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Magnitude of Hearing Loss and Associated Factors Among Children with Sleep-Disordered Breathing Attending St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia

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ABSTRACT

Background: Worldwide, sleep-disordered breathing is an important cause of morbidity in children, affecting various systems. Its prevalence is increasing due to different factors, including Ethiopia. Among others, it causes auditory consequences if not timely managed. However, its estimates regarding hearing problems along with its contributing factors are not adequately investigated in the study setting.

Objective: To assess the magnitude and the association of hearing loss among children with sleep-disordered breathing attending otorhinolaryngology clinic of St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia.

Methods: A cross-sectional study design employing retrospective chart review was conducted. Data were collected using structured checklist. Systematic random sampling technique was employed to recruit medical records of children diagnosed with sleep-disordered breathing. Data were cleaned via Epi-info and analyzed using SPSS version 27. Data were summarized using descriptive statistics. Multiple logistic regression was performed to identify association between dependent and independent variables, computing odds ratio. A p-value <0.05 was considered significant. Texts, tables and figures were used to present the results.

Results: Out of 211 studied children, 122 (57.8%) were males and children's age ranged from three months to fourteen years, with median (interquartile range) of 4 (3-6) years. Of all children, 22.3% (95% CI: 17-28) were diagnosed of hearing loss. After adjusting for sociodemographic and clinical characteristics, it was found that patients with sleep apnea were more likely to develop hearing loss than their counterparts (AOR, 2.10; 95% CI, 1.04,4.21).

Conclusion: Hearing loss is a common health problem in patients with sleep-disordered breathing. There is a serious need for better ear care and screening programs for early detection and management of this problem.

Keywords: Sleep-disordered breathing, Hearing loss, Children, Ethiopia

Abbreviations: AOR: Adjusted Odds Ratio; CHL: Conductive Hearing Loss; COR: Crude Odds Ratio; ENT: Ear, Nose and

Throat; ET: Eustachian Tube; HL: Hearing Loss; MHL: Mixed Hearing Loss; OME: Otitis Media Effusion; OSAS: Obstructive Sleep Apnea Syndrome; SDB: Sleep Disordered Breathing; SNHL: Sensorineural Hearing Loss; SPHMMC: St. Paul's Hospital Millennium Medical College; WHO: World Health Organization

1. Introduction

1.1. Background of the study

Sleep-disordered breathing is a syndrome of upper airway dysfunction during sleep that is characterized by snoring and/or increased respiratory effort as a result of greater upper airway resistance and pharyngeal collapsibility. They are grouped into Obstructive Sleep Apnea Syndrome (OSAS), central sleep apnea, sleep-related hypoventilation and sleep-related hypoxemia disorder. OSAS is characterized by intermittent partial and/or complete upper airway obstruction during sleep (hypopnea or obstructive apnea, respectively) that may compromise normal ventilation and sleep pattern. Primary snoring is defined as noisy breathing (snoring) with-out obstructive sleep apnea, frequent arousals from sleep or gas exchange abnormalities[1,2].

OSAS is a common disorder encountered in clinical practice that is increasingly being recognized because of the obesity epidemic and greater public and physician awareness[2]. Aden tonsillar hypertrophy is the most common cause of OSAS in children and obesity, hypotonic neuromuscular diseases and craniofacial anomalies are other major risk factors[3,4]. Its main symptoms include snoring, sleepiness and significant reports of sleep apnea episodes[1]. Although snoring is the most common presenting complaint in children, but the clinical presentation varies according to age[4].

Pediatric OSAS has become widely recognized only in the last few decades as a likely cause of wide range of morbidities among children[1]. The prevalence of parent-reported 'habitual snoring ranged from 1.5 to 6% while parent-reported apneic events during sleep span from 0.2% to 4%. Moreover, prevalence of SDB by varying constellations of parent-reported symptoms was estimated to range 4% to 11%; and OSA diagnosed by varying criteria on diagnostic studies is approximately 3% in children[4], with the range extending from 1% to 4%. The overall prevalence of parent-reported snoring by any definition is estimated to stand at 7.45[5]. Mean prevalence of mild to severe possible OSAS and severe possible OSAS in children across all grade levels was 9.5% and 1.6%, respectively[6].

Pediatric OSAS prevalence has two peak periods. The first peak occurs in children from 2 to 8 years of age, with the presence of enlarged adenoids and/or tonsils. A second peak arises during adolescence in relation to weight gain[4]. Aden tonsillar hypertrophy, obesity, craniofacial anomalies and abnormal neuromotor tone are the main conditions predisposing to OSA in childhood[7].

SDB and particularly in the form of OSA, affects many systems, including the cardiovascular, endocrine, neuropsychiatric, cognitive and vestibular systems[8-11]. The auditory system is affected by Eustachian tube dysfunction and hypoxia-induced cochlear and vestibular dysfunction[12,13].

In general, risk factors for hearing impairment include host-related and environmental factors. Host factors include male sex, genetic susceptibility, craniofacial deformities, immunosuppression and adenoid hypertrophy. Environmental variables include low socioeconomic status, URIs, the fall and winter months, daycare, having older siblings, exposure to tobacco smoke, allergies, obesity and GERD[14,15]. Despite the possibility of burden of hearing impairment among patients with SDB, there is scarcity of data from Ethiopian perspective. Hence, the present study was designed with the aim assessing the magnitude of hearing loss among children with sleep-disordered breathing attending otorhinolaryngology clinic of St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia.

1.2. Statement of the problem

The adverse consequences of pediatric OSAS may not simply be confined to the child's immediate well-being and development but may continue to be detrimental to the patient's long-term health in adulthood[14]. Children with OSAS may experience a range of problems, including delayed growth, failure to thrive, cardiovascular issues, enuresis, attention-deficit/hyperactivity disorder, poor academic performance and emotional instability. Furthermore, it results in hearing loss in children[3,4,16]. Hearing loss in children causes lifelong deficits in speech and language acquisition, poor academic performance, personal-social mal-adjustments and emotional difficulties[17].

An estimated 1.57 billion people globally had hearing loss in 2019, accounting for one in five people[18]. The World Health Organization (WHO) reported that hearing loss is the fourth highest cause of disability globally, affecting around 6.1% of the world's population. Current data suggest that approximately 466 million people of the world's population have disabling hearing loss, therefrom, 34 million children, thereby impacting their quality of life. It has been estimated that 8.6% of children in Sub-Saharan areas have hearing problems (i.e. almost 18 million children[19].

Untreated hearing loss is estimated to cost over 660 billion euros annually, including expenditures for the health care and education systems, lost productivity and costs for accessibility, adaption and social inclusion for individuals with impairments, according to a report by the WHO[19]. In 2000 in the United States, severe to profound hearing impairment was estimated to cost society $297 000 over the lifetime of an affected individual, mostly due to reduced work productivity. The average overall medical expense for a child in South Africa for the first five and ten years following cochlear implantation in 2015 was $27,000 and $40,000[20]. Additionally, hearing loss is independently associated with impairment of executive function and behavioral difficulties among such patients[21].

The WHO research states that South Asia, Asia Pacific and Sub-Saharan Africa are the main global regions afflicted by hearing loss that is debilitating, with prevalence rates that are over four times higher than in high-income regions. Under 15 years of age, 60% of hearing impairment cases result from preventable causes, 31% of which are related to infections[19].

Therefore, it is important to invest in the early detection, diagnosis and rehabilitation of hearing impairment in children so that the proper interventions can be carried out.

In Ethiopian context, despite the fact that there is scarcity of data regarding the exact magnitude and impact of SDB, otic complications are usually neglected conditions due to insufficient funds, work force, facilities and knowledge. Thus, the audiological aspect of SDB has received only little attention although it has been shown to result in profound negative impact. Hence, there is a need to conduct such studies to its magnitude and its contributing factors in Ethiopian context. This paper aims to give data about the prevalence and association of pediatric hearing loss among SDB patients, by taking case of children visiting otorhinolaryngology clinic of St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia.

1.3. General objective

To assess the magnitude of hearing loss and associated factors among children with sleep-disordered breathing attending otorhinolaryngology clinic of St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2022.

1.4. Specific objectives

- To find out the magnitude of hearing loss among children with sleep-disordered breathing attending otorhinolaryngology clinic of St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2022.
- To identify factors associated with hearing loss among children with sleep-disorder breathing attending otorhinolaryngology clinic of St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia.

1.5. Significance of the study

The findings of this study will be an input to the country's health sector transformation plan, which aims to improve equity, coverage and utilization of essential health services. Understanding disease prevalence, that is, the proportion of a population with the condition, is critical to anticipating health care needs and allocating appropriate resources. In addition, comparisons of the burden by demographic factors may yield etiological clues and identify subgroups at particularly high risk for targeted case finding. Moreover, this study is expected to contribute to the existing body of knowledge regarding magnitude of hearing impairment and its associated factors among children with SRBD attending otolaryngology clinics at the study setting, thereby shedding some light to the potential areas for evidence-based mitigation measures. Furthermore, the findings are expected to be of particular importance to local planners and health-policy makes to design policies that would alleviate this growing health burden among vulnerable age groups. Finally, this study will also serve as a baseline information to other interested investigators in similar research endeavors.

2. Methods and Materials

2.1. Study area and period

St. Paul's Hospital Millennium Medical College (SPHMMC) was founded bin July 1947 during the reign of Emperor Haile Selassie and it is the second largest hospital in Ethiopia. The hospital has more than 2500 clinical, academic and administrative staff. While the inpatient capacity is more than 700 beds, the college sees more than 2000 emergency and outpatient clients daily. The clinic is run five times a week by a team of seniors, residents, nursing and other staff. The hospital was selected for presence of organized ENT clinics providing services for a relatively large population size belonging both to pediatric and adult age groups. Data were collected from October 1st to October 31st, 2022.

2.2. Study design

A cross-sectional study design employing retrospective chart review was conducted.

2.3. Source population

Children with sleep-disordered breathing visiting Ear, Nose and Throat clinic of St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia.

2.4. Study population

Randomly selected children with sleep-disordered breathing visiting Ear, Nose and Throat clinic of St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia from September 1st, 2021 to August 31st, 2022 and who fulfill the inclusion criteria.

2.5. Eligibility criteria

2.5.1. Inclusion criteria:

- Children with clinical diagnosis of sleep-disordered breathing.
- Children aging 14 years or younger by the time of data collection

2.5.2. Exclusion criteria

- Children with pre-existing or congenital hearing disorder
- Children whose charts are lost or incomplete

2.6. Sample size determination

The sample size for this study is calculated using a single population proportion formula. Considering the population proportion of estimate proportion of patients with sleep-disordered breathing that, develop hearing problem to be 50% due to absence of previous study done at the current study setting and with the intention of obtaining maximum sample size:

$$n = \frac{z^2 p(1-p)}{e^2}$$

n = the required sample size
p = proportion of patients with SDB that develop hearing loss =0.5
$Z_{\alpha\backslash 2}$ = the critical value at 95% confidence level = 1.96
e = precision (margin of error) = 5%
Accordingly,

$$n^0 = \frac{(1.96)^2 * 0.5(1-0.5)}{0.05^2}$$

$$n^0 = \frac{(1.96)^2 * 0.5(0.5)}{0.05^2}$$

$$n^0 = 384.16$$

Hence, to compute the final sample size using the correction formula as the total source population from the hospital is less than 10,000 (N=465)

$$n = \frac{n^0 N}{n^0 + (N-1)}$$

$$n = \frac{384^*465}{384 + (465-1)}$$

$$n = \frac{178{,}560}{848} = 211$$

Therefore, adding 5% for contingency on the calculated sample size, the final sample size obtained was 222.

2.7. Sampling procedures

The study participants were selected by means of systematic random sampling technique, as the total number of children with SDB was estimated to be 465 during the study period. The first patient was selected *via* lottery method and then after every other patient was approached for data collection, with K being 2 (that is, 465/222).

2.8. Data collection tools and procedures

Patients' medical records were retrieved and reviewed. Data were collected from charts using structured checklist. Caregivers were contacted virtually via phone calls whenever need arises. The data collection format includes questions divided into three parts (background information, clinical variables and otoscopic, endoscopic and audiometric parameters) and it was adapted from related literatures[22]. Data were gathered from logbook records of ENT patient registry over one year (from September 1st, 2021 to August 31st, 2022). Two professional healthcare workers were recruited and trained on data collection procedures.

2.9. Study variables

2.9.1. Dependent variable

- Hearing loss

2.9.2. Independent variables

Age of the child	Subjective hearing loss
Sex	Ear discharge
Residence	Adenoid size
History of SDB symptoms	Tonsillar size

2.10. Operational definition

- **Sleep-disordered breathing:** Represent those sleep disorders, which are characterized by abnormal respiration during sleep. It includes Obstructive Sleep Apnea Syndrome (OSAS), central sleep apnea, sleep-related hypoventilation and sleep-related hypoxemia disorder[2].
- **Hearing loss:** Refers to any degree of hearing impairment as assessed clinically including history and physical examination (tympanometry included), with or without audiometric confirmation.

2.11. Data processing and analysis

Data entering, coding and cleaning were performed using Epi-info version 7.2.2.2 and then exported to SPSS version 27 to carry out statistical analysis. Frequency and cross tabulation were used to check for missed value and variables. The demographic and clinical characteristics of patients were computed by using descriptive statistics such as mean, median, percentage, frequencies, interquartile range and standard deviation. Multiple logistic regression was used to determine associations between the independent and dependent variables. Those variables with p value of ≤0.25 in bivariable logistic regression were included in the multivariable logistic regression model to compute adjusted odds ratio at 95% confidence interval. Hosmer-Lemeshow goodness-of-fit test was run to test the fitness of the model, where p value of >0.05 was used to declare data fitness. Variables with p-value ≤0.05 were considered as statistically associated with the outcome variable. Finally, the study findings were presented using diagrams, tables and figures.

2.12. Data quality management

To ensure data quality, data collection tool was prepared after thorough review of relevant literatures and related studies. An English version, pretested questionnaire was used to collect data. Brief training for the data collectors (two health professionals) about the process of data collection was given before the actual data collection. The data collection procedure was closely supervised and each day, filled questionnaires were double-checked manually for consistency and completeness by data collectors and principal investigator before proceeding to statistical analysis.

2.13. Dissemination of the study findings

The findings of this study will be submitted to Department of Otorhinolaryngology, Head and Neck Surgery, St Paul's Hospital Millennium Medical College as a partial fulfillment of the requirements for the specialty certificate in Otorhinolaryngology-Head and Neck Surgery. The outcome of this study will be presented to the higher officials of the college. Additionally, the manuscript will be submitted to a peer-reviewed scientific journal for possible publication.

3. Results

3.1. Socio-demographic characteristics

This study included data derived from two hundred and eleven patients with sleep-disordered breathing, making a response rate of 95%. Among the studied children, more than two-thirds (122; 57.8%) were males and the remaining 89 (42.2%) were females. Children's age ranged from three months to fourteen years, with median (interquartile range) of 4 (3-6) years. Regarding current residence, about three-fourths (158; 74.9%) of the study population were urban whereas the remaining quarter (53; 25.1%) were documented to rural residents. (Table 1).

Table 1: Socio-demographic characteristics of children with sleep disordered breathing attending otorhinolaryngology clinic of St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2022.

Variable	Frequency	Percent (%)
Child's age		
<2 years	19	9
2 to 5 years	129	61.1
>5 years	63	29.9
Child's sex		
Male	122	57.8
Female	89	42.2
Residence		
Urban	158	74.9
Rural	53	25.1

3.2. Clinical characteristics

With regard to clinical characteristics of the studied children, all had snoring episodes during sleeping while two-third (136; 64.5%) of the children were described to be mouth breathers. A third (70) were documented to have sleep apnea. Close to half (98;46.4%) of the children had history of night-time awakenings whereas only two (0.9%) had enuresis. Seventy-four (35.1%) had history of restless sleep, while 22 (10.4%) had caregiver-reported subjective hearing loss and only three (1.4%) had some form of aural discharge. Regarding adenoid size, more than

half (107;50.7%) had grade III on endoscopic evaluation while 83 (39.3%) and 59 (28%) children had grade III and grade IV tonsillar hypertrophy based on Brodsky grading scale (Table 2).

Table 2: Clinical characteristics of children with sleep disorder breathing attending otorhinolaryngology clinic of St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2022.

Variable	Frequency	Percent (%)
Snoring		
Yes	211	100
No	0	0
Mouth breathing		
Yes	136	64.5
No	75	35.5
Sleep apnea		
Yes	70	33.2
No	141	66.8
Nocturnal awakening		
Yes	98	46.4
No	113	53.6
Enuresis		
Yes	2	0.9
No	209	99.1
Restless sleep		
Yes	74	35.1
No	137	64.9
Subjective hearing loss		
Yes	22	10.4
No	189	89.6
Ear discharge		
Yes	3	1.4
No	208	98.6
Adenoid grade		
Grade 0	6	2.8
Grade I	14	6.6
Grade II	47	22.3
Grade III	107	50.7
Grade IV	37	17.5
Tonsillar grade		
In situ	9	4.3
Grade I	12	5.7
Grade II	48	22.7
Grade III	83	39.3
Grade IV	59	28

3.3. Magnitude of hearing loss

Of the total, 22.3% (95% CI: 17-28) of the study participants were diagnosed of hearing loss, as depicted in (Figure 1). Moreover, most (39; 83.0%) of the hearing losses were bilateral while the remaining 8 (17.0%) were unilateral. Additionally, audiometric evaluation showed conductive hearing loss in all of the children who had the test done.

3.4. Factors affecting hearing loss

In this study, thirteen variables, namely child's age, child's sex, residence, snoring, mouth apnea, breathing, sleep nocturnal awakening, enuresis, restless sleep, subjective hearing loss, ear discharge, adenoid grade and tonsillar grade were considered in the regression analysis. In order to determine the factors associated with hearing loss while controlling possible confounders, independent variables that yielded p value of ≤0.25 in binary logistic regression were exported to multiple regression model to compute adjusted odds ratio in determining odds of hearing loss.

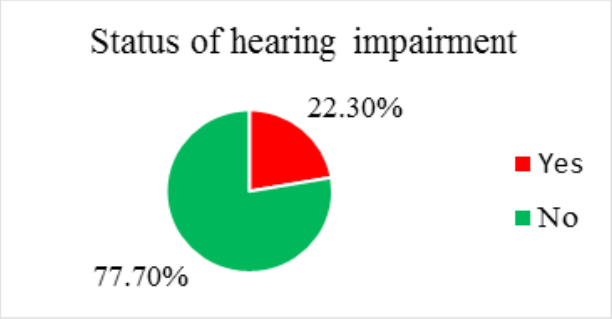

Figure 1: Magnitude of hearing loss among children with sleep-disordered breathing attending otorhinolaryngology clinic of St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2022.

Accordingly, five factors, namely child's sex, child's age, residence, sleep apnea and adenoid grade were observed in the bivariable analysis to be associated with presence of HL among the studied children. Following multivariable logistic analysis, the only variable that showed statistically significant association with HL was presence of sleep apnea. Specifically, this study showed that when compared to those who were described not to have sleep apnea, children with sleep apnea were more likely to have hearing loss [AOR=2.10 (95%CI:(1.04,4.21)] (Table 3).

Table 3: Factors associated with hearing loss among children with sleep-disordered breathing attending otorhinolaryngology clinic of St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2022.

Variable	Hearing loss		COR (95%CI)	AOR (95%CI)
	Yes	No		
Child's sex				
Male	31	91	1.55(0.79,3.06)	1.58(0.75,3.31)
Female	16	73	1	1
Child's age				
<2 years	9	10	3.83(1.28,11.47)	2.42(0.69,8.56)
2 to 5 years	26	103	1.07(0.50,2.30)	0.83(0.36,1.90)
>5 years	12	51	1	1
Residence				
Urban	41	117	2.75(1.09,6.90)	2.75(1.01,7.51)
Rural	6	47	1	1
Sleep apnea				
Yes	21	49	1.90(0.98,3.69)	2.10(1.04,4.21)*
No	26	115	1	1
Adenoid grade				
Grade 0	3	3	3.11(0.53,18.22)	3.12(0.52,18.79)
Grade I	7	7	3.11(0.86,11.29)	3.07(0.83,11.35)
Grade II	11	6	0.95(0.36,2.78)	0.99(0.36,2.78)
Grade III	17	90	0.59(0.24,1.46)	0.54(0.22,1.37)
Grade IV	9	28	1	1

Only variables with p value <0.25 in bivariable logistic regression are shown here.

4. Discussion

The present study aimed to assess the magnitude of hearing loss among children with sleep-disordered breathing by analyzing children attending otorhinolaryngology clinic of St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia. Subsequently, it has discovered several important findings. The study showed that a significant portion of children with SDB have hearing impairment, affecting more than one-fifth of them. Moreover, it was revealed that hearing loss was independently contributed by the presence of sleep apnea.

Specifically, this study demonstrated that more than a fifth of children with SDB have hearing loss. This finding was marginally higher than the observation in American setting, where 14.8% of patients with sleep-disordered breathing had hearing loss[23]. The current finding is supported by the works of Hill and co-authors, who observed that snoring children had significantly poorer hearing and greater past exposure to hearing loss than non-snoring controls[21]. This finding is much higher than the Taiwanese report in which only 0.33% of OSAS patients were observed to experience subsequent hearing loss in 9 years[16].

The large burden of HL among patients with SDB is plausible since there is hypoxia/hypercapnia, chronic noise exposure to the cochlea and persistent inflammatory status in sleep apnea, which in turn cause damage to the cochlea, which is highly sensitive to circulatory alterations due to its lacks of adequate collateral blood supply[24,25]. Yet, this finding is of serious concern given the fact that hearing loss can be irreversible, with long lasting impact on the lives of the victims[26].

The large difference in the magnitude of hearing loss between this study and the previous estimates in other settings could be attributed to the relative abundance of poverty-related factors and poor access to health care including medical and surgical intervention among children in resource-challenged regions such as ours. Moreover, the inter-regional variation can be explained by differences in length of follow-up, sample size, the characteristics of the studied population and methodological design. For example, the current study employed a one-year chart review while the Taiwanese study followed patients for nine years. Besides, it should be remembered that this study was done during Coronavirus disease (COVID-19) pandemic, which was quoted to be associated with the development of Sudden Sensorineural Hearing Loss (SSNHL)[27].

On the other hand, the current study highlighted that SDB children with caregiver reported sleep apnea have higher risk of developing hearing loss. This is more or less in line with the South Korean report that demonstrated that lowest oxyhemoglobin saturation be an independent factor influencing auditory function in severe obstructive sleep apnea[28]. The possible explanation for this finding can be multiple and it includes the fact that chronic periodic hypoxia associated with sleep apnea can provoke oxidative stress and impaired vascular endothelial function and it may also harm the vasa nervorum, with collective damage to the hearing function of the auditory system[29].

5. Strengths and Limitations

5.1. Strengths

The study was done at one of the leading tertiary hospitals of the country where the highest numbers of sleep-disordered breathing patients with varying socio-demographic characteristics are expected to be represented.

5.2. Limitations

- This study is expected to be prone for the limitation of a cross-sectional study design and as a consequence, establishing causal relationship would be impossible.
- The current study was done at a single otorhinolaryngology center, making it difficult to generalize to other populations attending different public health facilities.
- Being a chart-based retrospective study, some important information in patients' clinical records were missing due to improper filling of patients' particulars.
- There was lack of confounder method adopted to measure hearing loss (E.g. ABR).

6. Conclusion

This study showed that hearing loss is a common health problem in patients with sleep-disordered breathing, affecting about one in four children with SDB have hearing impairment. Moreover, presence of sleep apnea was the only factor that contributed to hearing loss in the studied population.

7. Recommendation

Based on the findings obtained in the study, the following recommendations can be forwarded.

For health professionals: Whenever possible, trained health professionals should screen children with sleep-disordered breathing for auditory complication, with emphasis to those with predisposing factors such as sleep apnea.

For local health policy makers: Local policy makers, along with concerned stakeholders, should consider awareness creation modalities via mass media and health extension workforce to consolidate the caregivers' knowledge on the care of affected children on top of the need for early screening and diagnosis of such vulnerable population.

For researchers: Future studies should be done to validate the current findings and they should employ stronger study designs including comprehensive set of variables to have deeper understanding.

8. Deceleration

Ethical clearance was obtained from Ethical Review Committee of SPHMMC. Clearance letter was submitted to the medical director before carrying out the actual data collection for the study. This was followed by introduction and familiarization of the data collectors with the study subunits. Before interviewing clients, the purpose of the study was briefly explained and written informed consent was sought. During data collection, study participants were informed that the information collected will be kept anonymous and confidential. Consent for publication was obtained from the patient and is available upon request from the corresponding author.

9. Authors' Contributions

Dr. Mohammedsefa Arusi and Dr. Martha Driba contributed substantially to the conception, design, drafting of the manuscript and final approval of the version to be published.

Dr. Addis Asfaw, Dr. Wale Limeh and Dr. Zeyneb Saleh contributed to data acquisition, interpretation of data, critical

revision of the manuscript and final approval of the version to be published. All authors reviewed and approved the manuscript.

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Annex

001. Data collector: code ____/___/___ Name _____

002. Date of data collection ____/___/____ Time _____

003. Checked by Supervisor: Signature _____day _____month _____ year____

S.No	Questions	Response	Remark
1	Sex	1. Male 2. Female	
2	Age	_____ years	
3	Address	1. Urban 2. Rural	

Section II presenting symptoms

S.No	Question	Response	Remark
1	Snoring	1.Yes 2.No	
2	Mouth breathing	1.Yes 2.No	
3	Sleep apnea	1.Yes 2.No	

4	Restless sleep	1.Yes 2.No	
5	Frequent awakenings	1.Yes 2.No	
6	Enuresis	1.Yes 2.No	
	Parental reported Hearing loss	1.Yes 2.No	
	Duration of hearing loss	1.<3month 2.3-6month 3.>6month	
	Unilateral or bilateral hearing loss	1.Unilateral 2.Bilateral	
	Progression	1.Progressive 2.Suddene	
	Ear discharge	1.Yes 2.No	

Section III Endoscopic /Otoscopic/Physical finding

S.No	Question	Responses	Remark
1	Tympanic membrane	1.Normal 2.Bulged 3.Erythematous 4.Retracted 5.perforated	
2	Grade of tonsil	1.grade I 2.grade II 3.grade III 4 .grade IV	
3	Endoscopic Grades of adenoid	1.grade I 2.grade II 3.grade III 4 .grade IV	
4	Pure tone average	1.CHL 2. SNHL 3. MHL	
5	Tympanometry	1.B-type 2.AS-type 3.AD-type 4.A –type	
6	Objective Hearing loss	1. Yes 2. No	