

# Compliance and Usability of Weber and Rinne's Tests For Audio Acuity Among Primary School Children From a Health Resource Poor Community

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## Introduction

Sound is the sensation produced when longitudinal vibrations or waves of molecules generated by condensation and rarefaction otherwise called sound waves strike the tympanic membrane<sup>1</sup>. The amplitude of a sound wave can be expressed in terms of the maximum pressure change at the eardrum, known as decibel scale (dB)<sup>1</sup>. Finitzo et al<sup>2</sup>, in 1998 reported the prevalence of congenital hearing loss in newborns to range from 1 to over 3 infants per 1,000 each year. Recent information indicates that the current prevalence is 1.4 per 1,000 in the United States<sup>3</sup>. It is estimated that 9-10 per 1000 children will have identifiable hearing loss in one or both ears by school-age<sup>4</sup>. Little or no information on impaired auditory acuity exist in our environment and possibly in other developing countries. Reason for this could be lack of funding, shortages of trained professionals, problems with follow-up, poor coordination of services

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## Abstract

**Background:** Normal auditory acuity is needed for transmission and reception of speech between teachers and students, and from student to student for effective communication and learning. Hearing impairment in school children will potentially cause difficulty perceiving speech clearly in the educational environment. **Materials and Methods:** Auditory acuity measurements were conducted on 300 primary school children using the Weber and Rinne's tests. **Results:** Nearly all the children 292 (97.3%) had good hearing. Eight (2.7%) had ipsilateral conduction hearing impairment. Of these, 5 (62.5%) occurred on the right and 3 (37.5%) on the left ear; they were referred to the otorynolaryngologist for further evaluation and management. **Conclusion:** Our subjects demonstrated high compliance to Weber and Rinne's tests which were found to be usable in screening hearing impairment in school children. These tests can be incorporated into the school health programmes in resource poor countries where high tech hearing screening facilities are not readily affordable and available. In addition, the test can be conducted at primary health centers thereby decongesting both secondary and tertiary health facilities.

**Key words:** Weber and Rinne's test, hearing impairment, school children, Bama, Maiduguri, North-eastern Nigeria.

and programs, inadequately informed families, and lack of access to or inadequate use of new technology.

Early Hearing Detection and Intervention (EHDI) programs have become the standard of care and screening for hearing impairment now in mostly

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developed countries. However, EHCI will still miss some hearing impairment in newborns especially those with delayed onset of hearing loss according to the Joint Committee on Infant Hearing (JCIH)<sup>5</sup>. To buttress this point, Fortnum et al<sup>6</sup>, in 2001 observed that 50% of 9 year old children would pass for normal the neonatal hearing screening. More so other investigators have added that hearing loss could not be picked by care givers of children based on a child's behavior<sup>7</sup>. On the basis of these, all newborns are to be screened in accordance with the JCIH position statement with additional hearing screening to be performed at 4, 5, 6, 8, and 10 years of age respectively<sup>5</sup>. Unfortunately, hearing screening is an uncommon practice in our health care system possibly due to lack of appropriate age facility to detect hearing loss in children. High frequency sound waves from 500 hertz have been employed for auditory acuity screening using pure tone audiometry, tympanometry, turning fork, among others. Among these, the high frequency turning fork is most available and can be affordable for use in health resource poor countries. Furthermore, it may be cost effective, and compliance could be good in older children. This report aimed at, 1) Reporting measurability rates for auditory acuity using the Webers and Rinne's test in primary school pupils aged 8 to 10 years. 2) Relay information that would have public health significance and relevance to policy development and program implementation, such as the School Health Programme. To our knowledge, no such survey was performed before in Bama community of Borno state, Nigeria.

## Materials and Methods

### Study site

The study was carried out at Bama local government area of Borno state in conjunction with the University of Maiduguri Teaching Hospital (UMTH), North-Eastern Nigeria. The UMTH is the largest health facility in North-Eastern Nigeria and also serves as a referral centre for the six North-Eastern States and neighboring countries of Chad, Cameroon and Niger Republics.

### Ethical Considerations

The study protocol was authorised by the Bama local government authority, medical research and ethics committee of the UMTH, department of education and principals of the chosen schools. Consent was sought from the parents/care givers of our participants. The approval was on the agreement that anonymity must be maintained, best practices be ensured, and that every finding would be treated with utmost confidentiality and for the purpose of this research only. All work was performed according to the international guidelines for human experimentation in clinical research<sup>8</sup>.

### Study design/ Sampling Technique/ Study Population

A cross-sectional randomized descriptive study on primary school pupils between 8 and 10 years of age from five different primary schools in Bama locality was conducted. Sixty pupils were selected from each primary school. Primary schools were selected using simple random sampling method, whereas the pupils that participated in this study were enrolled using the stratified random sampling method. Children were requested to obtain permission from their parents or guardian to participate in the study.

The minimum sample size was determined using statistical formula that computes 22.2% prevalence for hearing loss at 95 confidence interval and alpha levels of 0.05<sup>9,10</sup>. This equalled 264; however, 14% of this was added to maximize power. Therefore, the study population comprised of 300 primary school pupils. Participation in this study was voluntary. A child was eligible for participation in the study if he/she is between (8-10) years age bracket. Pupils who did not obtain parental consent or personally refused to participate in the study were excluded from the study.

Measurement of auditory acuity using Weber and Rinne's tests was then conducted on the study participants and those that were found with impaired auditory acuity were referred to the otorynolaryngologist for further evaluation and management.

### Data Analysis

Frequencies, percentages and ratio were used to describe the data that was generated using a statistical package for social science (SPSS) statistical software version 16, Illinois, Chicago USA. Tables were used for data presentation.

## Results

Three hundred pupils participated in the study, out of which 180 (60%) were males and 120 (40%) were females (Table 1). The male to female ratio was 1.5:1. All the children (100 %) complied with the tests. Successful testing occurred in nearly all the children 292 (97.3%), only 8 (2.7%) had impaired auditory acuity in keeping with conduction hearing impairment (Table 2). Of these, 5 (62.5%) occurred on the right and 3 (37.5%) on the left ear.

**Table 1:** Sex distribution of the 300 children

Sex	Number (n=300)	Percentage (%)
Males	180	60
Females	120	40
<b>Total</b>	<b>300</b>	<b>100</b>

**Table 2:** Visual acuity test profile of the study subjects

VAT	Number	Percentage
Successful	292	97.3
Un-successful	8	2.7
<b>Total</b>	<b>300</b>	<b>100</b>

VAT = Visual acuity test

## Discussions

There was high compliance rate for auditory acuity testing using the Weber and Rinne's tests among the pupils. Age could be an important factor responsible for the high compliance because all of them understood the tests processes after adequate briefing. Only (2.7 %) of our subjects had conduction hearing impairment, and were referred to otorynolaryngologist for further evaluation and management. This concurred finding of Fonseca et al<sup>11</sup>, in 2005 where advice to parents, referral to education services, watchful waiting, medical, surgical and amplification treatment were offered to their subjects. Some authors abroad however, reported higher rates of hearing impairment relative to the rates identified in present report<sup>6</sup>. Several reasons were advanced for the high rates of hearing impairment in school pupils<sup>5</sup>. These are: 1) Universal newborn hearing screening (UNHS) programs utilize screening devices primarily designed to target hearing loss averaging 30 to 40 dB or more; therefore lower dB units will not be picked. 2) Infants not passing their newborn hearing screening do not receive needed diagnostic services; and would add up to the number detected during school age, and 3) UNHS does not identify late onset, acquired or many cases of progressive hearing impairment.

Our entire participants with hearing impairment had it on either left or right ipsilateral ear. One study has reported a higher rate of ipsilateral hearing impairment compared to current study<sup>4</sup>. Differences observed between our survey and the latter study could be explained by variation in methodology. The latter study employed pure tone audiometer which has sensitivity and specificity higher than tuning fork that was used in our survey. Pure tone audiometry requires health manpower and financial resources to operate, these however are lacking in resource poor settings like ours. The typical classroom is an auditory verbal environment where accurate transmission and reception of speech between teachers and students, and from student to student, is critical for effective learning to occur. The result of hearing impairment in one or both ears will be that school pupils potentially will have difficulties perceiving speech clearly in the educational environment. Hearing loss can contribute to difficulties with attention, learning, and social function if these students are not identified and provided the medical and/or educational assistance needed<sup>2-5</sup>.

Most children in our environment are enrolled into secondary schools without the opportunity of having their auditory acuity tested possibly due to lack of appropriate technology and expertise for it. These children could benefit from the use of simple and appropriate technology (Rinne's and Webber's test) for their auditory acuity testing before enrollment into secondary schools. In addition, these tests are simple, cheap and do not require a highly skilled expert. Information obtained from this study may be of public health benefit because health policy makers can implement auditory screening of children even at primary health care center because the procedure is easy, thereby decongesting secondary and tertiary health facilities.

## Conclusion

We conclude from our findings that Weber and Rinne's tests for auditory acuity are useable and may be used successfully as a screening tool in older children as demonstrated in this survey. In addition to hearing screening testing, Weber and Rinne's tests could also be used for epidemiologic studies; and in clinical setting especially where health resources are inadequate. We recommend these tests to school health programmes to identify children with hearing problems, especially before enrollment in secondary schools to better their school performance.

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