Otoscopic and Tympanometric Outcomes in Haitian Children

Ellen May
CUNY Graduate Center
Faculty Mentor: Barbara Weinstein, PhD

Abstract

The purpose of this study was to collect otoscopic and tympanometric data on schoolchildren (ages 5 – 8) in a kindergarten and primary school in Port-au-Prince, Haiti. The otoscopic and tympanometric data were collected and statistically analyzed, and recommendations and referrals to proper medical professionals were issued. Issuing referrals is vital; especially since the prevalence of serious middle ear disorders (such as chronic suppurative otitis media) are more prevalent in developing countries, and, if left untreated, more serious middle ear disorders can occur, and have potentially devastating consequences.

Introduction

According to the World Health Organization, 32 million children under the age of 15 worldwide have a hearing loss which is considered disabling (WHO, 2013). A disabling hearing loss, according to the World Health Organization, is a hearing loss of 30 dB HL or poorer. The overwhelming majority of children with disabling hearing loss reside in developing countries, and, of these children, only a small fraction (~10%, or fewer than 1 out of 40 people with hearing loss) have access to amplification, or other hearing assistive technology (WHO, 2013). Of the 32 million children worldwide with hearing loss, half of the hearing losses are preventable, with the majority of them caused by ear infections, i.e. otitis media (WHO, 2013).

To date, many other researchers have conducted studies to determine the prevalence of outer and middle ear pathologies among children in developing countries. Many of these studies found cerumen impaction in the outer ear to be one of the most common otoscopic abnormalities among school-aged children subjects (Hatcher et al, 1995; McPherson & Holborow, 1985, White, 1988 – as cited in Hatcher et al,1995; Godinho et al, 2001; Adebola et al, 2013). The prevalence of middle ear disorders in developing countries in several studies varied from 7.3 – 36.2% (Elango et al, 1991, Jacob et al, 1997, Mourad et al, 1993, Seely et al, 1995, Olusanya et al, 2000, Hatcher et al, 1995, Prescott & Kilbel, 1991, Prasansuk, 2000 – as cited in Olusanya, 2001).

Extensive reviews of relevant literature did not come up with any data involving children in Haiti. Haiti was important to my research partner and I because, according to a report by the World Health Organization, Haiti is considered one of the poorest countries in the Americas. Furthermore, more than half of the population has little or no access to basic health care and medications, and tuberculosis, tetanus, measles, polio, malaria, and HIV are serious health concerns in the Republic of Haiti (Pan American Health Organization, 2010).

Immittance testing is a powerful tool for identifying possible cases of otitis media, as well as other possible outer and middle ear pathologies. Immittance testing involves measuring both the impedance and the admittance of the ear, i.e. the opposition and the ease of the flow of sound energy into the ear, respectively. A probe tip placed into a test subject's ear introduces air pressure, which in turn measures the equivalent ear canal volume, tympanometric peak pressure, tympanometric gradient/width, and the static acoustic admittance of the ear. The values obtained from each tympanogram are then compared to otoscopic findings and normative values. Additionally, immittance testing involves measuring the acoustic reflex of the middle ear (Gelfand, 2009).

Need and Research Questions

The purpose of this study was to collect data on the outer and middle ear status of approximately 40 school aged children (aged 5 – 8) attending *Ecole Presbyterale de St Vincent de Paul* (kindergarten and primary school in Port-au-Prince, Haiti). Once otoscopic and tympanometric outcomes were recorded, the data was organized, analyzed, and referrals were given to the parents for proper healthcare professionals. Parents were notified privately of any concerns found during testing.

The following research questions were sought to be answered:

1. What proportion of pre-school and school age children have fully impacted cerumen based on otoscopic examination?
2. What is the proportion of observed abnormal outer ear structural abnormalities in the population of children undergoing hearing screening and follow-up testing (e.g. microtia, stenosis, atresia)?
3. What proportion of children had normal tympanograms in one or both ears? What proportion of children had abnormal tympanometric and acoustic reflex screening results?
4. What is the relation between acoustic reflex screening outcomes and audiometric test results?

Methods

Testing was performed on 41 subjects (82 ears), aged 5 – 8, from the kindergarten and primary school at *Ecole Presbyterale de Vincent de Paul*. Prior to our arrival, permission forms were sent home with all children aged 5 – 8. On each day of testing, only students who had returned with signed permission forms were chosen randomly to participate in testing. Verbal assent was documented for each test subject prior to the start of testing, and if a child refused, he or she was excluded from testing. Since data was collected over the course of a week, if some subjects appeared to be recovering from colds, draining ears, or communicable diseases (and they possessed signed permission forms), they were included in testing. Otherwise, subjects with actively draining ears, colds, or other communicable diseases were excluded from testing, even if they returned to school with signed permission forms, which was a limitation of the current study. Subjects with asthma and cleft palate were not excluded from testing.

The instrumentation utilized for the tympanometric evaluations, otoscopic evaluations, hearing screenings and the complete audiological evaluations included the following: a Maico QT-1 Tympanometer, a Firefly video otoscope, a Welch Allyn standard otoscope, and a Maico (MA-41) Audiometer. Disposable probe tips for the tympanometer and otoscope as well as printer paper were also utilized for every test subject. All of the testing equipment (tympanometer and audiometer) was calibrated and was disinfected prior to and in between testing. All data obtained from the immittance instrument was printed, and recorded manually as well.

Prior to conducting otoscopic, tympanometric, and audiometric testing, an Extech digital sound level meter (model # 407730) was utilized to measure the sound levels in the testing environment. All testing environments were found to have ANSI acceptable sound levels between 40 – 42 dB SPL (Frank, 2000).

Otoscopy and visual inspection of the ear canals, tympanometry, and acoustic reflex testing were performed on each participant. Any abnormalities found during otoscopy were noted. Tympanograms were classified as Type A, AS, AD, B, or C based on normative values for children. Table 1 displays the different tympanogram types and their respective descriptions. Acoustic reflex screening results at 100 dB SPL were classified as "yes" (present) or "no" (absent). Following otoscopy and tympanometry, audiometric testing was performed by my research partner.

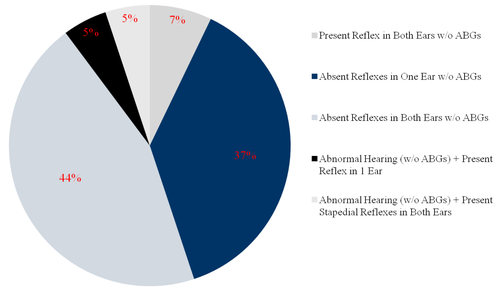
Table 1. Tympanogram Classification (Martin & Clark, 2006)

Type	Description
Type A	Normal tympanogram
Type A_D	Indicates high static admittance, usually associated with a flaccid tympanic membrane
Type A_S	Indicates low static admittance, usually associated with stiffening pathologies, e.g. stapes mobilization, otosclerosis
Type B	Indicates a flat tympanogram, usually associated with fluid in the middle ear, tympanic membrane perforations, or cerumen impaction
Type C	Indicates negative middle ear pressure, and is consistent with Eustachian tube dysfunction, or can be associated with head colds

Results

Forty one subjects (82 ears) aged 5 – 8, participated. Twenty six of the participants were male, and fifteen were female. The mean subject age was 6.5 years and the median age was 7 years. None of the participants tested had visual structural outer ear abnormalities. 81 of the ears examined did not have occluding cerumen noted. One ear was found to have occluding cerumen (the tympanic membrane could not be visualized). Upon analysis of the tympanometric data, 49% of the ears tested had Type A tympanograms, 32% had Type AS tympanograms, 2% had Type AD tympanograms, 2% had Type B tympanograms, and 0 ears had type C tympanograms. Tympanogram types could not be determined for 15% of the 82 ears tested, due to the inability to maintain a seal for testing. Ipsilateral acoustic reflex screenings at 100 dB SPL were performed on all of the participants' ears. The results from the screenings were as follows: 54% did not pass the acoustic reflex screening for both ears, 17% had reflexes present in one ear and absent in the other ear, 10% had present acoustic reflexes in both ears, 10% had a reflex absent in one ear with a seal not being able to be maintained in the other ear, 7% of the participants' results could not be analyzed due the inability to maintain a seal in either ear, and 2% had an absent acoustic reflex in one ear with a seal not being able to be maintained for testing for the other ear. The acoustic reflex results were then compared to the presence or absence of significant air-bone gaps (>10 dB HL) in the affected ears. None of the subjects' audiometric results revealed significant air-bone gaps, despite not receiving a pass on the acoustic reflex screening (as depicted in Figure 1).

Figure 1. Relationship between Acoustic Reflex Screening Outcomes and Air-Bone Gaps



Conclusions

Findings

The majority of children tested had normal otoscopic and tympanometric outcomes. Based on examination, no subjects exhibited any outer ear abnormalities, and only one ear was found to have impacted cerumen with otoscopy. Almost 50% of those tested had normal tympanometric results. Many children who had normal audiometric results did not pass the ipsilateral acoustic reflex screening at 100 dB SPL, but that is perhaps because the instrumentation utilized did not have the ability to conduct a threshold search for reflexes.

Significance of Results

Though to date no other published research studies have collected data on the outer and middle ear statuses of schoolchildren in Haiti, comparing the data to similar studies showed both similarities and differences. Upon visual inspection, no subjects tested presented with any suspected outer ear abnormalities. The majority of subjects tested had normal otoscopic results, and the majority of tympanograms were considered normal. Ipsilateral acoustic reflex screenings were not present at a screening level of 100 dB SPL for several participants, but it is possible these results would have been present, had the tympanometer had the ability to perform a threshold search for reflexes.

The expectations prior to testing (and based on examining other similar studies in developing countries) were that there would be more abnormal otoscopic and tympanometric results than were ultimately found, based on the lack of medical professionals, and adverse living conditions that are rampant in Haiti. This suggests that despite the adverse living conditions and lack of access of medical care, there was not a significant prevalence of abnormal otoscopic or tympanometric results among the 5 -8 year old subjects utilized in this study. It is of course possible that the prevalence of abnormal otoscopic and tympanometric results could be higher in both younger and older children in Haiti, but testing on other age groups was unfortunately beyond the scope of this present study. Despite the majority of participants presenting with normal otoscopic and tympanometric results, our research was beneficial in that it helped to generate referrals for a few subjects who presented with abnormal otoscopic and tympanometric results. Additionally, the research was valuable in that it provided data for a developing country that has a dearth of audiological data available. Beginning to collect data in a country where very little has been studied is necessary as well in that it will hopefully spearhead future research studies in other parts of Haiti, in order to collect audiological results on a wider scale (and on more subjects), to compare the results to our data, and to ultimately provide amplification if any hearing losses are identified.

Future research studies would be strengthened by utilizing a tympanometer with the ability to test both ipsilateral and contralateral acoustic reflex thresholds, testing otoacoustic emissions, using more test subjects, comparing results from subjects in different schools, and by including all subjects in testing, regardless of the outer or middle ear status. Since the research was conducted without licensed medical professionals, diagnoses were unable to be made regarding middle ear abnormalities that may have been present in the subjects. Additionally, collaborating with other medical professionals in order to provide on-site medical and audiological care (such as cerumen management and the provision of amplification) would be beneficial for future research studies.

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