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Tympanometry of a diverse group of preschool aged children

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Summary

Objective: Ethnicity has been previously described as a risk factor for middle ear disease. Little data exist on the presence of middle ear disease based on tympanometry screening comparing Asian children and children of other races.
Methods: Two hundred and seventy children aged 3—5 were screened with tympanometry at six Head Start sites in St. Paul, Minnesota during the months of September and October of 2004. Gender, age, and race/ethnicity was recorded and entered into a database, along with values for canal volume, static admittance, peak pressure, and tympanometric width.
Results: Criteria for abnormal tympanometry were based on American Speech-Language Hearing Association (ASHA) recommendations for a failed tympanogram for 1—5 year olds (admittance <0.3 mmho or width >200 daPa). There were no statistically significant differences in failure rates between males and females. There were, however, more failures for Asian (predominantly Hmong) children compared to children of other races/ethnicities after adjusting for age and gender differences (OR = 6.39, CI 3.65—11.2, $p < 0.001$) and for children $<$4-years-old compared to children 4—5-years-old after adjusting for race and gender differences (OR = 1.99, CI 1.03—3.84, $p < 0.05$).
Conclusions: Asian children were more than six times as likely to fail tympanometry as children of other races/ethnicities. The explanation for this difference is likely to be multifactorial, and further research is needed to characterize this difference.

1. Introduction

Tympanometry is a valuable tool for the assessment of evidence of middle ear effusion. Watters et al. and Nozza et al. compared pre-operative tympanometry to surgical findings and found tympanometry

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to be highly sensitive in predicting middle ear effusion [1,2]. Furthermore, tympanometry may help identify middle ear disease that may lead to chronic ear disease, hearing loss, and subsequent speech and language difficulties if not detected. However, recent research by Paradise et al. casts doubts on the relationship between persistent middle ear effusion and developmental outcomes at age six [3].

In recent years, the city of St. Paul, Minnesota has seen a large influx of refugees and immigrants from many Southeast Asian nations. According to the 2000 census, 41,800 Hmong (refugees and immigrants from Laos) reside in Minnesota, making it the most populous Asian ethnic group in the state [4]. The majority (58%) lives in St. Paul. As a result, many children of Hmong descent are enrolling in enrichment programs, including Head Start. In the past few years, staff from the Sight & Hearing Association (SHA), the organization that conducts both vision and hearing screening for Head Start programs in St. Paul, noticed that Hmong children had a high referral rate for abnormal tympanometry. The SHA approached researchers in the Department of Otolaryngology at the University of Minnesota with the hopes that this observation could be formally investigated.

In reviewing the literature, several studies support race or ethnicity as a predisposing factor for middle ear pathology [5–14]. However, only one study has compared rates of middle ear disease in Asian and White children. Authors reported that 9.5% of White children and 1.3% of Chinese children had middle ear disease as determined with tympanometry and otoscopy [15].

2. Methods

2.1. Data collection

Preschool aged children were screened with tympanometry by SHA personnel at six Ramsey Action Program Head Start sites in September and October 2004. Tympanometry was performed using a MAICO MI 26 Tympanometer/Audiometer that was routinely calibrated in August, prior to the start of screening in September. The same equipment was used at all screening sites and daily probe calibration checks were performed. A 226 Hz probe tone was presented with an intensity of 85 dB SPL measured in a 2 ml coupler. A positive to negative pressure sweep between +200 and −400 daPa was administered at a variable rate of 550 daPa/s maximum with 200 daPa/s near peak. Typical test time per ear was less than 3 s. Otologic examinations were not performed as part of the screening.

Tympanogram tracings were obtained and printed by SHA personnel, who labeled them with the child's age, gender, and race/ethnicity. At least two attempts were made to obtain a valid tympanogram. Race/ethnicity was determined by the screener from the child's Head Start registration. The tympanogram tracings were provided to the University of Minnesota Department of Otolaryngology for interpretation and analysis. The institutional review board approved secondary analysis of anonymous tympanometry data.

2.2. Data analysis

Ear canal volume (at 200 daPa), static admittance (compensated at +200 daPa), and peak pressure values were obtained from the tympanogram printout and entered into a database, along with identification number, age, gender, ethnicity, and screening site. One researcher (AM) measured tympanometric width to the nearest 1/16 in. at one-half the peak admittance and converted the value into daPa units with the following conversion: 1/16 in. is equal to 25 daPa. If the tympanogram was "noisy" as evidenced by upward departure from the defined peak, giving an erroneous admittance result, peak compensated admittance was also measured by hand. A 5% sample of tracings was re-measured by another researcher to check for accuracy against the data entered in the database.

Criteria for abnormal tympanometry were based on American Speech-Language Hearing Association (ASHA) recommendations for a failed tympanogram for 1–5 year olds based on normative studies. These criteria were admittance <0.3 mmho or width >200 daPa [16]. Comparisons by age, race and gender were done with chi-square analyses, and logistic regression was used to construct a predictive model for tympanometry failure. To allow comparisons with previous screening studies using a flat tympanogram (defined as static admittance <0.2, or 0.1) as evidence of middle ear effusion, criteria of static admittance <0.2 mmho or width >200 daPa were also used to determine tympanometry fail rates by age, gender or race.

3. Results

Among the children tested, 49% were female and 51% male; 20% were 3 years old, 54% were 4 years old, and 26% were 5 years old. Twenty-nine percent were African/African American, 39% were Asian (93% were Hmong), and 32% were Caucasian/other, which included Hispanic, Middle Eastern, and others.