The Accuracy of Parents' and Teachers' Judgement of Inuit Children's Hearing Status

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Abstract

Hearing loss due to middle ear disease is a major health problem among Inuit children living in Arctic Quebec. Audiological screening procedures are of significance to this remotely located population. This study assessed the accuracy of parents' and teachers' identification of unilateral hearing loss. The sensitivity, specificity and predictive values for both parents' and teachers' detection of hearing loss was poor. Results have implications for the use of parents and teachers as sources of referral for selective screening of hearing.

Introduction

Hearing loss due to middle ear disease is a major health problem among Inuit children living in Arctic Quebec (Julien et al. in press). Previous studies done in the Northwest Territories have documented that approximately one third of Canadian Inuit children suffer from chronic otitis media (Ling, Katsarkas, Baxter, 1974; Stewart, 1985). Health services for the measurement and treatment of otological problems are not readily available in Arctic areas. Health professionals from the south are flown into a community for a short period of time in which they are expected to screen an entire school population and to make the appropriate recommendations for the treatment and management of those children with significant otological and/or audiological problems. One way to improve the efficiency of such procedures would be to have referral agents select a high-risk group of children to be seen by the specialists.

The following article describes a preliminary study designed to evaluate the accuracy of parents' and teachers' reports of hearing loss among the school-aged pediatric population of Kuujjuaraapik (Great Whale), a community on the Hudson Bay Coast in Arctic Quebec. The extent of the agreement between the parents' and teachers' evaluation of the child's hearing status was compared with audiometric measures. The sensitivity, specificity and predictive values of the parents' and teachers' evaluation of the child's hearing status was determined. If these measures reflect a high degree of accuracy, then in future it may be advantageous to use parents and teachers as referral agents or as preliminary screening agents.

A screening procedure to evaluate audiometric status should provide a preliminary indication of those individuals who actually have a hearing loss and those who do not. This is referred to as the validity of the measure. In epidemiological research, validity of a screening test is defined as having two components: sensitivity and specificity. Sensitivity is defined as the ability of a test to identify correctly those who have a hearing loss. Specificity is defined as the ability of a test to identify those who do not have a hearing loss. To determine these measures, the results obtained by the screening procedure are compared with those derived from some definitive diagnostic procedure which is referred to as the "gold standard". The extent to which the screening results agree with those derived by the more objective tests provides a measure of sensitivity and specificity. An ideal screening procedure would be 100% sensitive and 100% specific. However, this does not occur in practice because sensitivity and specificity are usually inversely related (Mausner and Bahn, 1985).

Other parameters of a screening test are the positive and negative predictive values. The positive predictive value is the proportion of true positives (i.e., those individuals with a hearing loss) among all those who have positive results on the screening test. Similarly, the negative predictive value of a test is the proportion of normally hearing individuals who have negative test results. Predictive values depend both on the sensitivity and specificity of the test and the prevalence of disease.

Figure 1 displays the measures used to assess a screening instrument. These measurements will be used to evaluate the accuracy of the parents' and teachers' reports of hearing loss among the study population. Although sensitivity and specificity are academically important, the predictive values of screening tests play a larger role in clinical decision making.

Methods

Between October 22 and October 28, 1984, a research team surveyed the medical, audiological and educational status of all school-aged children living in Kuujjuaraapik. The clinical research team included two otolaryngologists, one community health pediatrician, three audiologists and one Inuit hearing specialist. The project was conducted with the cooperation of the

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	AUDIOMETRIC RESULTS — GOLD STANDARD		
	Hearing Loss	**Normal Hearing**	
Test Result — Positive: Affirmative response to question	True positive a	False positive b	a+b
Test Result — Negative: Negative response to question	False negative c	True negative d	c+d
	a+c	b+d	a+b+c+d

a/(a+c) = sensitivity
a/(a+b) = + predictive value
d/(b+d) = specificity
d/(c+d) = - predictive value

Figure 1 Evaluation of screening techniques.
Note Adapted from Haynes, R.B. (1981). How to Read Clinical Journals: II. To Learn About A Diagnostic Test. *Canadian* Medical Association Journal 124: 703-710.

health personnel of the nursing station and the local education and health committees.

One hundred and sixty-six Inuit children participated in the survey. An ENT examination and audioscopic and audiometric tests were conducted on each child. Two questionnaires were used to obtain information from the parents and their teachers in which they were asked to identify those students who had a hearing loss. Due to the small number of bilaterally impaired children and the difference in clinical presentation, only the data for unilaterally impaired children were used in the evaluation of accuracy.

In most cases, the parent's first language was Inuktitut making it necessary for the questionnaires to be translated. The local education and health committees assisted in the translation and administration of the questionnaires. The teachers of the children in kindergarten to grade 2 were Inuit. These teachers were usually fluent in both Inuktitut and English. The teachers of grade 3 and up were non-Inuit English- and French-speaking North Americans.

Results

Pure Tone Audiometry

Pure tone audiometry was completed on 166 Inuit children. The results shown in Table 1 indicate that 23% of the children demonstrated a hearing loss of 25 dB or greater. As would be expected, unilateral hearing loss was more prevalent than bilateral impairment.

Response Rate

The response rate of the parents with children who had unilateral hearing loss was 73.3% and for parents of children who had no hearing loss 82.3%.

The response rate of teachers of hearing-impaired children was lower than that of the parents. Only 66.7% of teachers of unilaterally impaired children responded. The response rate of teachers of normally hearing children was the highest in the survey at 87.0%. The analysis presented in the text is based on these response rates.

Table 1: **Audiological Results of Inuit School Children**

Hearing Status	Inuit School Children	Percentage
Within Normal Limits	128	77
Unilateral Loss	30	18
Bilateral Loss	8	5
Total	166	100

Note A hearing loss was defined as an audiometric threshold greater than 25 dB.

Accuracy of the Parents' Judgement of Hearing Loss

The accuracy of the parents' judgement of hearing loss was assessed by comparing their response to the question, "Does your child have a hearing loss?" with the audiometric results. The results are illustrated in Figure 1 and computations in Table 2. They indicate that the sensitivity of the parents' response for unilateral hearing impairment was relatively low at 45.5%, and the specificity of the test was 82.2%.

The positive and negative predictive values for unilaterally impaired children was 34.5% and 88.0% respectively. This means that approximately 66% of the children who are identified by the parents as having a hearing loss have hearing within normal limits, and that 12% of the children who are not identified by the parents as having a hearing loss actually do.

Table 2: **Accuracy of parents' evaluation of unilateral hearing loss**

		Audiometric Results		
		Unilateral Hearing Loss	Hearing Within Normal Limits	
Test Result	Positive: Parent detected hearing loss	10	19	29
	Negative: Parent did not detect hearing loss	12	88	100
	Total	22	107	129

Notes Sensitivity = 10/22 = 45.5%; specificity = 88/107 = 88.2%; (+) predictive value = 10/29 = 34.5%; (-) predictive value = 88/100 = 88.0%.

Accuracy of the Teachers' Judgement of Hearing Loss

The accuracy of the teachers' judgement of hearing loss was determined in a similar manner to that of the parents. The teachers' ability to identify the children in their classrooms who were unilaterally hearing impaired are shown in Table 3. Both the sensitivity and specificity of their evaluation for unilateral impairment was 60.0%. This indicates that there was a high number of false negatives and false positives.

The positive and negative predictive values obtained from the teachers' responses were 38.7% and 70.8% respectively. This means that approximately 61% of the children who are identified by the teachers as hearing impaired do not have a hearing loss, and conversely, approximately 29% of the children who teachers judge not to have a hearing loss in fact are hearing impaired.

Discussion

As has been stated previously, the prevalence of hearing loss among Inuit children is much higher than among non-native Canadian children. Specifically, 23% of the children had a clinically significant hearing loss. Disease prevalence is an important consideration when making policy decisions regarding screening programs. It is often not efficient or useful to screen an entire population if the prevalence of a disease is less than 15% to 20% (Mausner and Bahn, 1985). Thus, while screening for hearing impairment in many areas in Canada may not be recommended, audiological screening in Arctic Quebec may be warranted.

In this study, it has been demonstrated that neither parents nor teachers can accurately detect unilateral hearing loss in Inuit children. If we base our evaluation of

Table 3: **Accuracy of teachers' evaluation of unilateral hearing loss**

		Audiometric Results		
		Unilateral Hearing Loss	Hearing Within Normal Limits	
Test Result	Positive: Teacher detected hearing loss	12	45	57
	Negative: Teacher did not detect hearing loss	8	68	76
	Total	20	113	133

Notes Sensitivity = 12/20 = 60.0%; specificity = 68/113 = 60.2%; (+) predictive value = 12/57 = 38.7%; (-) predictive value = 68/76 = 70.8%.

parent and teacher accuracy on the calculated predictive values, it is apparent that for both parents and teachers many more children are suspected of having a hearing loss than actually do. Also, both parents and teachers failed to detect a significant number, 12% and 29% respectively, of children who do have a hearing loss. For these reasons, neither parents nor teachers can be considered accurate detectors of hearing loss. Clearly it is unacceptable to miss true cases, but there is also a price to be paid for over-identification. Economically, over-identification places an undue stress on the health care system by necessitating needless diagnostic tests and follow-up, and undue emotional stress may be created in parents and children by identifying children as having a hearing problem when in fact they do not.

Since neither the parents nor the teachers were accurate detectors of hearing loss, it is both necessary and appropriate to structure a program to improve the value of the parents and teachers as referral agents. One objective of this program would be to increase the awareness of the behavioural components and physical symptoms of hearing loss. Due to the rapid turnover of non-native personnel in the North, it is important to have native individuals who can educate the parents and teachers regarding hearing loss. Currently, four Inuit women are being trained at McGill University's School of Human Communication Disorders to do this work. (Ayukawa, Crago, Elijassiapik, 1985).

The results of this study indicate that until parents and teachers have been educated and proven to be more accurate referral agents, an alternative method for screening should be used.

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