Prevalence : Outer and Middle Ear Disorders in Black and Indian Preschool Children from Durban

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ABSTRACT

The aim of the study was to determine the prevalence of middle ear disorders in 4-5 year old Black and Indian children attending preschools in the Durban Central region. Thus, a sample of 728 subjects ($\bar{x}$ age = 4,6 years), 315 Black (135 male and 180 female) and 413 Indian (223 male and 190 female) subjects was screened using referral criteria based on a Middle Ear Screening Protocol (MESP). The results of this study indicated that there was a significant relationship (X^2=13,237,p<0,0001) between race and the likelihood of subjects passing and failing the MESP. A prevalence of 13,0% failures on the middle ear screening tests (visual inspection of the eardrum and tympanometry) was found in the Black subjects and 14,3% failure in the Indian subjects. No statistically significant differences were found between sex (Black male, Black female and Indian male, Indian female) and the likelihood of subjects passing and failing on the middle ear screening tests. Due to excessive cerumen, a significant percentage of Black (38,4%) and Indian (49,9%) subjects failed on outer ear tests. These results are discussed with reference to the literature. The limitations, research and practical implications of the research are also discussed.

OPSOMMING

Die doel van hierdie studie was om die voorkoms van middeloorprobleme van Swart- en Indiërkinders in die ouderdomsgroep 4-5 jaar wat voorskoolse skole in die gebied Durban Sentraal bywoon, te ondersoek. 'n Steekproef van 728 kinders met 'n gemiddelde ouderdom van 4,6 jaar is gebruik. 315 Swart- (135 manlike en 180 vroulike) proefpersone en 413 Indiër- (223 manlike en 190 vroulike) proefpersone is met behulp van die middeloorsiftingsprotokol (MOSP), wat as verwysings-kriteria gebruik is, geëvalueer. Die resultate van die ondersoek het 'n beduidende verhouding (X^2 = 13,237, p<0,0001) tussen ras en proefpersoon se resultate op die MOSP aangetoon. 13,0% Swart- en 14,3% Indiërproefpersone is geïdentifiseer, deurdat hulle nie die middeloorsiftingtoetse (ondersoek van die oordrom en timpanometrie) geslaag het nie. Geen stastisties beduidende verskil is tussen manlike en vroulike proefpersone ten opsigte van die resultate van die siftingstoets geïdentifiseer nie. 38,4% en 49,9% Swart en Indiërs onderskeidelik het nie die buite-oortoets, geslaag nie. Die resultate word met verwysing na die literatuur bespreek en sowel die beperkinge as die navorsings- en praktiese implikasies van hierdie ondersoek word bespreek.

KEY WORDS : prevalence, outer ear disorders, middle ear disorders, Black and Indian children, 4-5 years

INTRODUCTION

Professionals in the fields of medicine, education, speech-language pathology and audiology have concurred that otitis media is a serious health problem that requires early diagnosis and management (Gurrard & Clark, 1985). The prevalence of otitis media (OM) in a particular population group may be influenced by environmental and audiological factors as well as inadequate medical care (Halama, Voogt, Musgrave & Van der Merwe, 1987).

Klein (1977) has reviewed a number of studies that indicate clearly that middle ear infection is prevalent in the preschool age group. A study done by Davidson, Hyde & Alberti (1988), has shown that 20 - 25% of 1 year olds and 50 - 70% of 4 year olds have had at least one episode of acute suppurative otitis media (ASOM). Voogt, Halama & Van der Merwe (1986) have found that the highest immittance screening failure rate occurred in 3 to 5 year old Black South African preschool children attending day-care centres. This is in contrast to the findings in Danish day-care children (Birch & Elbrand, 1984) where the highest failure rate was found to be at one year, decreasing towards the age of 5. A study of British children, however, found that the highest failure rate was at 5 years (Fry, 1970; Platt, 1975). These findings seem to support the observation that significant differences exist in the tympanometric failure rate of children of different ethnic groups and that this rate interacts with age (Griffith, 1979; Robinson & Allen, 1984).

In the available literature, prevalence data have not

been reported for Indian South Africans. However, some data have been reported for Black South Africans, specifically from rural areas. Data obtained by Halama et al., (1987), have suggested the existence of considerable differences in the prevalence of otitis media between children in two comparable Black rural communities from Nigeria and Venda. Miller, Omene, Bluestone & Torkelson (1983) have reported a prevalence of 21,2% of OM in Black Nigerian children. Comparing this figure with those obtained by Halama et al., (1987), i.e., 8,2%, it appears that significant intraracial differences in prevalence rates could also exist.

Against the framework of this background, otitis media in the South African context presents two major problems. Firstly, there is a lack of epidemiological information on prevalence of middle ear disorders, particularly for South African Black and Indian preschool children, aged 4 - 5 years. According to the South African National Council for the Deaf (1990, p.30), "as yet no reliable prevalence or incidence rates of impaired hearing in South Africa are available". This is especially true for the Indian population. Secondly, there are inadequate and/or nonexistent hearing and middle ear screening programs in Durban, Natal. According to Nyembe (1992), hearing screening programs for the Black people, specifically in the Natal region, are, to date, nonexistent. Within the Durban region, the only available screening program in existence is that initiated by the House of Delegates in 1986, for Indian school-going children (Class 2 only), attending Government schools (Singh, 1992).

The significance of these problems is realised when one considers that the literature (Asha, 1990; Roeser & Downs, 1988) has indicated that preschool aged children, specifically 4-5 year olds, suffer a relatively high incidence of middle ear disease and concomitant hearing loss. Consequently, there has been growing interest in the use of audiometric and immittance screening programs to facilitate earlier identification of both hearing and otological disorders in this population.

The present study focused on identification of otological disorders, specifically outer and middle ear disorders using ASHA's modified revised criteria (1990) with 4 - 5 year old Indian and Black preschool children within the Durban Central Region. The purpose of this research would be to provide epidemiological information on middle ear dysfunction in children, between 4 - 5 years of age. Furthermore, it would indicate whether racial differences in prevalence rates do exist in the identified population groups. These results could form the basis for possible recommendations for further tympanometric and/or otoscopic follow-up.

METHOD

RESEARCH DESIGN

In order to realise the aims of the study, the methodology of research design used was the analytical (quantitative) survey method (Leedy,1989).

AIM

The aim of the study was to determine the prevalence of middle ear disorders in 4 - 5 year old, Indian and Black preschool children, attending preschools in the Durban Central Region. In order to realize this aim, the following sub-aims were formulated.

(a) To determine and compare the overall pass-failure rate of Black and Indian subjects on the selected and modified middle ear screening protocol (MESP) (Asha, 1990), using the referral criteria specified in Table 1 of Appendix A.
(b) Comparison of the overall pass-failure rate of Black and Indian subjects on outer and middle ear tests of the MESP.

SUBJECTS

A total of 728 randomly selected subjects (mean age 4,6 years), comprising 315 Blacks (135 males, 180 females) and 413 Indians (223 males, 190 females) contributed relevant data for the purpose of this study. All subjects attended preschools located in the magisterial district of Durban central. Table 1 presents the subject characteristics of this study. All subjects were required to fall within the age range of 48 - 60 months inclusive (4 -5 years) as a literature review has shown an increased prevalence of middle ear infection in this age range worldwide (Davidson et al.,1988).

Table 1: Subject Characteristics

	N(%)	Mean age in years	Age Range in years
Black	315 (43)		
Males	135 (43)	4,7	4,0-4,9
Females	180 (57)	4,6	4,1-4,9
Indian	413 (57)		
Males	223 (54)	4,6	4,2-5,0
Females	190 (46)	4,6	4,0-4,8
Total	728		

DATA COLLECTION PROCEDURE

All procedures for middle ear screening were completed on the same day, i.e., history, visual inspection and tympanometry for each subject. The screening was conducted on the school premises during school hours (08h00-12h30). Screening was scheduled between February and April 1992, to control for seasonal variations, since otitis media has its highest prevalence during the winter months (Roush, 1990; Sorensen, 1981). All subjects who met the subject selection criteria were included in the following research procedure. The criteria included : race (Black and Indian), age (4-5 year old), sex (male and female) and area of school (Durban Central Region).

- The teacher, verbally, provided the biographical details as well as information pertaining to observable history of pain and ear drainage, which was recorded on the record form (Appendix B).
- Following the collection of the above information, a visual inspection of the ear, head and neck was performed. Otoscopic examination of each ear was conducted to identify, ear-canal abnormalities, blood effu-

sion, occlusion, inflammation, excessive cerumen, tumor or foreign material. Each ear was then examined for eardrum abnormalities, and specifically for obvious perforation, obvious inflammations, and severe retractions.

- After visual inspection, tympanometry was performed except when the ear-canal was occluded with cerumen, or any other foreign material which prevented visual inspection of the tympanic membrane. Tympanometric measures were obtained using the Grason-Stadler 28A (Grason-Stadler, 1990).
- Immediate medical referral was made in cases of abnormally large canal volume estimates accompanied by low static admittance (when there was a reason to suspect a perforation of the tympanic membrane) (Asha, 1990).
- When tympanometric results were abnormal, (low static admittance and abnormal tympanometric peak pressure) rescreening was scheduled in 4 - 6 weeks from the date of the first screening. If the results were again abnormal, a medical referral was made.
- Normative data (Table 2 of Appendix A) based on the work of Margolis & Heller (1987) and Asha (1978) were used for analysis of results in the procedures above. The pass-fail criteria are indicated in this appendix.
- When a subject failed the first or second screening, the parents and school officials were informed by letter/report, of the test results and informed of a need for further evaluation. When medical review was indicated, parents were advised to consult with a general practitioner or their family doctor. A medical follow-up was requested from the attending doctor specifying his/her findings and treatment procedures for school records.

DATA ANALYSIS PROCEDURES

Statistical analysis of the data was performed utilizing the chi-square test. A probability value of less than 0,05 was considered to be significant. All results were calculated using one subject as the statistical unit and classifying each subject according to the poorest result obtained in either ear.

Failure rate was computed in terms of percentages and reflected in tables and graphs. The specific criteria for evaluation were as follows :

(i) Middle Ear Screening Protocol (MESP) included history, visual inspection and tympanometry.
The MESP consisted of two elements :
- Outer ear tests
- Middle ear tests.

(ii) Failure on Outer ear tests included :
- structural defects of the ear, head and neck
- ear-canal abnormalities.
(i.e., B_1 to B_9, refer to Appendix B).

(iii) Failure on Middle ear tests included :
- eardrum abnormalities
- tympanometry.
(i.e., B_{10} to B_{12} and C_1/C_2, C_3 and C_4 measures, refer to Appendix B).

(iv) Failure of a subject on any one of the categories under outer ear and middle ear tests independently, was regarded as a fail.

(v) Failure of a subject on either ear on each category independently was regarded as a fail.

(vi) Both ears of a subject had to pass the three screening procedures in order for that subject to be regarded as a pass.

RESULTS

(a) *RESULTS OF THE OVERALL PASS-FAILURE RATE OF BLACK AND INDIAN SUBJECTS ON THE MIDDLE EAR SCREENING PROTOCOL (MESP)*

The above was computed and the results are presented in Figure 1.

A X^2 (chi-square) statistic was computed to investigate the relationship between race and the likelihood of subjects passing and failing the middle ear screening protocol.

The chi-square statistic (X^2 = 13,237, df = 1) was found to be significant at the 0,0001 level ($p < 0,0001$), i.e., there was a significant relationship between race and the likelihood of subjects passing and failing the Middle Ear Screening Protocol.

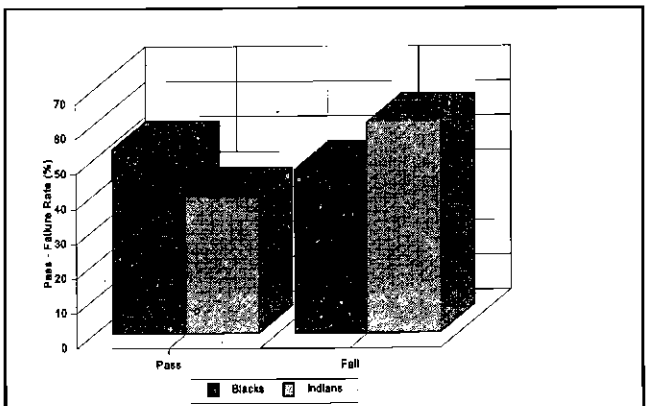
Significantly more Indian than Black subjects failed. Sixty-one and a half percent (61,5%) of the Indian sample failed, while 47,0% of the Black sample failed.

(b) *THE OVERALL PASS-FAILURE RATE OF BLACK AND INDIAN SUBJECTS ON OUTER AND MIDDLE EAR TESTS OF THE MESP*

The above was computed in order to determine the prevalence of middle ear disorders among Indian and Black subjects, and the contribution of outer ear tests to the overall failure rate. This information is presented in Figure 2.

It is important to take note of the fact that the above results have been computed using a total of 315 Black and 413 Indian subjects, for outer ear and middle ear tests independently.

A chi-square (X^2) statistic was computed to investigate the relationship between :



	Pass	Fail
Blacks	53.0%	47.0%
Indians	39.5%	60.5%

Figure 1: Overall Pass-Failure Rate (Number and Percentages) of Black and Indian Subjects on the Middle Ear Screening Protocol

i) RACE AND PASS-FAILURE RATE ON OUTER EAR TESTS
The chi-square statistic revealed with 95% confidence that a significant difference exists between race and likelihood of subjects passing and failing the outer ear tests (P< 0,05). Significantly more Indian subjects (49,9%) failed than Black subjects (38,4%).

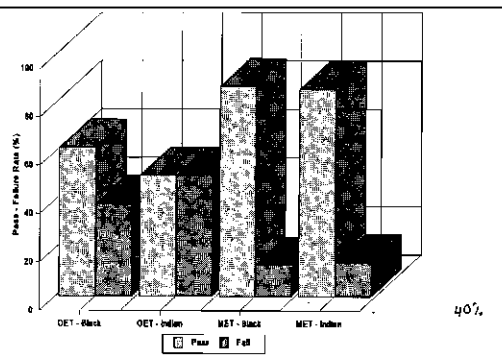
ii) RACE AND PASS-FAILURE RATE ON MIDDLE EAR TESTS
The chi-square statistic revealed with a 95% level of confidence that a significant difference did not exist between race and the likelihood of subjects passing and failing the middle ear tests.

Table 2 reflects the categories, chi-square values (X^2), degree of freedom (df), probability values (Prob) and significance at the 0,05 level (p_ 0,05) for outer and middle ear tests with reference to race.

DISCUSSION OF RESULTS

The results presented in Figure 1 reflect the pass-failure rate of Black and Indian subjects on the Middle Ear Screening Protocol (MESP). It is evident from the chi-square values (X^2 = 13,237, p< 0,0001) that there was a significant relationship between race, i.e., Black and Indian subjects and the likelihood of subjects passing and failing the MESP. Sixty one percent of Indian subjects failed and 47% of the Black subjects failed the MESP. However, these figures do not indicate the prevalence of middle ear disorders in the Black and Indian subjects because of the inclusion of outer ear problems. The prevalence of ME disorders can be determined by examining Figure 2. This figure reflects the analysis of results in terms of failure rate for outer and middle ear tests. It is evident from the pass-fail rates computed, that the prevalence of middle ear disorders in Black subjects is 13,0% and for Indian subjects, it is 14,3%.

Researchers have speculated about possible reasons for the lower prevalence of ME disorders in American Blacks which could be :



	OET - Black	OET - Indian	MET - Black	MET - Indian
Pass	61.6%	50.1%	87.0%	85.7%
Fail	38.4%	49.9%	13.0%	14.3%

KEY : OET - Outer Ear Tests
MET - Middle Ear Tests

Figure 2: Overall Pass-Failure Rate (Numbers and Percentages) of Black and Indian Subjects on Outer Ear and Middle Ear tests of the MESP

- due to immunological differences between American Blacks and American Whites (Griffith, 1979)
- due to more effective eustachian tube function in American Blacks (Doyle, 1977)
- middle ear anatomical differences (Griffith, 1979)
- due to absence of previous exposure to antibiotics (Senturia, 1974)
- genetic (Teele, Klein & Rosner, 1980)
- environmental or nutritional (Griffith, 1979)

Robinson et al. (1988), did not lend support to the immunological differences as a possible reason for racial differences between Black and White infants. They made the assumption from their study that Black infants have colds as frequently than do White infants. If so, they inferred that the obtained racial difference in middle ear disorders is not due to "less opportunity" in terms of frequency of upper respiratory infections. The racial difference may indicate a mechanical/anatomical difference that allows the middle ear to drain more readily in Blacks, rather than being physiological or immunological in nature. Drawing from subjective visual observations that in spite of a large percentage of Black subjects in the present study having a "runny nose" in comparison to Indian subjects, the prevalence of middle ear disorders was found to be lower for the Black subjects. It may be speculated that the Black subjects in this study may have anatomically well developed eustachian tubes which allowed for the middle ear to drain more readily.

This is a plausible speculation in view of Doyle's (1977) findings. He described the inter and intra-racial variability of the tubal system (ie., eustachian tube) and related these differences to possible functional correlates and dysfunctional states. He found that the tubal dilator mechanism is most efficient in the Black and Caucasian populations, followed by the American Indian population and finally the Eskimo population. Furthermore, he found the lowest prevalence of middle ear disease in Blacks and highest for Eskimos.

The writer acknowledges the fact that direct comparisons cannot be made because firstly, information regarding upper respiratory infections was not obtained in this study and secondly this study was not an osteologic study. However, the speculation that anatomical/mechanical difference in eustachian tube accounts for the racial difference in the prevalence of middle ear disease, is supported by the findings of Doyle (1977) and Robinson et al., (1988). Thus, it is speculated that the anatomy and mechanics of the eustachian tube is different in Black and Indian subjects, with the possibility of Blacks having a more efficient tubal dilator mechanism than Indians. It is therefore recommended that future research include history of upper respiratory tract infection as part of the case his-

Table 2: Chi-square Results for Outer Ear and Middle Ear Tests with Reference to Race

Category	X^2	df	prob	P≤0,05
(a) Outer Ear	9,896	1	0,002	SIG*
(b) Middle Ear	0,243	1	0,400	NS

* Significant at the 0,002 level
Key: NS - not significant

tory and relate the findings to eustachian tube anatomy and mechanics.

However, Senturia (1974) has speculated that the lower prevalence of ME disorders in American Blacks may be due to the absence of previous exposure to antibiotics. It is speculated that a Black child with middle ear disease may be rarely taken to the Western medical doctor for treatment, but rather to a 'sangoma', whose method of treatment may not include antibiotic therapy.

Furthermore, while little is written on the subject of cultural factors and the prevalence of OM as reflected in the available literature, it seems that cultural factors could play a strong role in whether Blacks obtain early medical care, follow-up and cooperation in treatment programmes. According to Teele et al., (1980,p.3), racial and genetic factors in the epidemiology of OM are not completely understood. However, they have stated that "clusters of cases of OM occur in families, suggesting that there is genetic predisposition to middle ear infection. Children who had single or recurrent episodes of OM were more likely to have siblings or parents with histories of significant middle ear infections than were children of parents who had no episodes of OM."

Considering the findings by Teele et al., (1980), the possibility of genetic factors contributing to the prevalence of middle ear disorders in Black and Indian children cannot be ruled out. However, due to lack of case history information on parent and sibling history of OM, it is not possible to make any conclusive statements.

Environmental factors have also been suggested as an explanation of racial differences in the prevalence of middle ear disorders. Detailed information regarding living conditions of Black and Indian children is necessary in order to determine the role of environmental factors in the prevalence of middle ear disorders.

Other studies, however, have indicated that serous and acute otitis media are more prevalent in an urban environment than rural environment, e.g., Griffith (1979). According to Bluestone et al., (1986), the crowded living conditions of urban life plus the placement of a steadily increasing number of children in day-care centres have increased the number of episodes of both upper respiratory tract infections and the otitis media that follows in one third of these cases.

This is further supported by Berman & Murphy (1984). Contrary to these findings, the present study which was done in an urban environment shows a prevalence of middle ear disorders to be lower in both the Black (13,0%) and the Indian (14,3%) subjects than the findings of Berman et al., (1984). A possible reason for this is that although the Black subjects from this study attended preschools in an urban environment, some subjects may have been residing in a rural environment and may have been transported daily. Furthermore, data obtained by Halama et al., (1987), on prevalence of otitis media in a Venda village, have suggested the existence of considerable differences in the prevalence of OM between comparable Black rural communities, i.e., interracial differences in prevalence rates also exist. However, this study did not consider the residential environment (i.e., urban or rural) of the subjects which prevents any scientific inferences and/or speculations being made in this regard.

In addition Berman et al., (1984) have postulated possible reasons of lower prevalence in Black children from a rural environment who were breast-fed. Possible reasons include the following:

- breast milk immunologic factors,
- the development of facial musculature that promotes improved eustachian tube functioning,
- decreased aspiration of milk, and
- avoidance of possible allergy to proteins in cow's milk.

Taking the above reasons into consideration, i.e., breast milk protects against infection and breast-feeding promotes eustachian tube functioning, it is plausible to state that the racial difference observed in the present study, may be accounted in part by the speculation that the Black subjects were breast-fed.

Only one study, by Voogt et al., (1986), is known to report prevalence data for South African Black preschool children. They revealed that 14,9% of the Black preschool children attending day care centres failed the immittance screening test and 47,2% failed because of only outer ear disorders (e.g., wax impaction and foreign bodies). Comparing these figures with those obtained in the present study for Black subjects (13,0% failed middle ear disorders and 38,4% failed outer ear disorders), it appears that there is good agreement between the two studies.
Seasonality has been suggested as having a bearing on the frequency of OM and upper respiratory tract (URT) infections, winter being associated with the highest incidence of both (Klein, 1977).

Voogt et al., (1986), in the Transvaal, found the highest immittance failure rate at the beginning of winter (22,05%). They further observed a gradual decrease in the immittance failure rate as the climate gradually became warmer. Considering the above findings, it can be speculated that the low prevalence of middle ear disorders found in this study could be due to the screening which was performed during Durban's mild summer months. Considering South Africa as a developing country, the question that arises is, will the prevalence of ME disorder be higher than in developed countries? There are some indications from existing literature that this question can be answered affirmatively. Various studies indicate a higher prevalence of various types of middle ear diseases in developing countries.

However, it is difficult to compare studies of racial groups because of differences in sampling techniques, screening criteria, methods of testing, age reports and seasonal variations. It seems that unless studies are done with the specific aim of replicating the findings of previous studies, precise comparisons between studies will always be confounded by multiple variables, including race, season, testing criteria and living conditions. As the present study was not aimed at replicating previous research, it is acknowledged that the comparisons made are tentative. However, valuable information, e.g., about patterns of prevalence of OM in South African Blacks and Indians can be discerned.

In considering the failure rate of Black and Indian subjects on Outer ear and Middle ear tests, the results of this study indicate a 13,0% prevalence of middle ear disorders and 38,4% prevalence of outer ear disorders in Black subjects. In contrast, Miller et al., (1983) found 53% of middle ear disorders and 24% of external ear disorders in Black Nigerian children. The chi-square statistics which were computed to investigate the relationship between race and the failure rate on Outer ear and Middle ear tests, indi-

cated a significant relationship between race and failure on Outer ear tests ($X^2 = 9,896$, $p < 0,05$) (Refer to Table 2). Significantly more Indian subjects (49,9%) failed Outer ear tests than Black subjects (38,4%). In contrast to Outer ear test results, the chi-square statistic ($X^2 = 0,243$, $p > 0,05$), revealed no significant difference between race and the likelihood of subjects passing and failing the Middle ear tests of the MESP. However, the overall failure rate of Black and Indian subjects on the MESP showed statistically significant racial differences as discussed earlier.

This study may be considered to be a pioneer of new information for the Indian preschool population group, since the only available information found on middle ear disorders in Indian children, was from a pilot study conducted by the House of Delegates (1990) on class 2 pupils, in Durban, Natal. Thus, the results of this study contributes new and relevant information to the area of paediatric audiology.

CONCLUSION AND RECOMMENDATIONS

The results of the present study indicated that the prevalence of middle ear disorders in Black subjects is different from the prevalence of middle ear disorders in Indian subjects, thus confirming the existence of a racial difference. It is therefore essential that hearing screening protocol be implemented to identify prevalence rates for other population groups in the RSA. Furthermore, the Middle Ear Screening Protocol (MESP) used in the present study could be used for identification of middle ear disorders in other ethnic groups. In addition, the MESP can be integrated with other protocols in existence to promote standardization of screening and referral criteria. Moreover, the MESP could be implemented in areas where such programmes are non-existent, thus providing the health care system with a screening tool which serves to identify middle ear disorders in preschool children.

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APPENDIX A

Table 1: Referral Criteria : Middle Ear Screening Protocol (MESP) used in the present Study

I History
- a. Otalgia
- b. Otorrhea

II Visual inspection of the ear
- a. Structural defect of the ear, head, or neck
- b. Ear-canal abnormalities
  - Blood or effusion
  - Occlusion
  - Inflammation
  - Excessive cerumen, tumor, foreign material
- c. Eardrum abnormalities
  - Obvious perforation
  - Obvious inflammation
  - Severe retraction

III Tympanometry
- a. Flat tympanogram and equivalent ear-canal volume (V_{ec}) outside normal range.
- b. Low static admittance (Peak Y) on two successive occurrences in a 4 - 6 week interval.
- c. Abnormally wide tympanometric peak pressure i.e., more negative than -200 daPa on two successive occurrences in a 4 - 6 week interval.

Modified From : ASHA (1990) and ASHA (1978)

Table 2: Interim Norms (Means and 90% Ranges) for Static Admittance (Peak Y), Equivalent Ear-Canal Volume (V_{ec}), and Tympanometric Peak Pressure (TPP) used in the present study

	Peak Y cm^3/ml*		V_{EC} cm^3/ml*		TPP daPa	
	Means	90% Range	Means	90% Range	Means	90% Range
Children	0.5	0.2 - 0.9	0.7	0.4 - 1.0	100	-200 - +100

The values were extracted from Margolis & Heller (1987), who employed an acoustic immittance screening instrument (226-Hz) probe tone; pump speed-200 daPa/s) that automatically compensated for ear-canal volume by subtracting the admittance at 200 daPa from all values. Normative values for children were obtained from preschool-aged children (3-5 years).

* cm^3 and ml are equivalent units (ASHA, 1990)

Modified : Roush (1990)

From : ASHA (1978)

APPENDIX B

Pupil Record Form

PERSONAL DETAILS Reference No. : _____

Name : _____ Sex : _____

School : _____ D.O.B. : _____

Date of Test : _____ Age: _____

Date of Retest : _____ Race: _____

Audiologist : Daksha Bhoola

KEY: Red = Right Ear, Blue = Left Ear

		First Screen		Second Screen	
A.	HISTORY				
A.1	OTALGIA	YES	NO	YES	NO
A.2	OTORRHEA	YES	NO	YES	NO
B.	VISUAL INSPECTION				
	STRUCTURAL DEFECT OF THE				
B.1	EAR	YES	NO	YES	NO
B.2	HEAD	YES	NO	YES	NO
B.3	NECK	YES	NO	YES	NO
	EAR CANAL ABNORMALITIES				
B.4	BLOOD EFFUSION	YES	NO	YES	NO
B.5	OCCLUSION	YES	NO	YES	NO
B.6	INFLAMMATION	YES	NO	YES	NO
B.7	EXCESSIVE CERUMEN	YES	NO	YES	NO
B.8	TUMOR	YES	NO	YES	NO
B.9	FOREIGN MATERIAL	YES	NO	YES	NO
	EARDRUM ABNORMALITIES				
B.10	OBVIOUS PERFORATION	YES	NO	YES	NO
B.11	OBVIOUS INFLAMMATIONS	YES	NO	YES	NO
B.12	SEVERE RETRACTIONS	YES	NO	YES	NO

FIRST SCREEN

						Actual Value R L
C.	TYMPANOMETRY					
C.1	TYMPANOGRAM	A	As	B	C	Ad
C.2	STATIC ADMITTANCE	<0,2	0,2-0,9		>0,9	
C.3	EAR-CANAL VOLUME	<0,4	0,4-1,0		>1,0	
C.4	TYMPANOMETRIC PEAK PRESSURE	<-200daPa	-200-+100daPa		+ 100daPa	
D.	SUMMARY					
D.1	HISTORY		FAIL		PASS	
D.2	VISUAL INSPECTION		FAIL		PASS	
D.3	TYMPANOMETRY		FAIL		PASS	
D.4	SEND LETTER TO PARENT		YES		NO	
D.5	SEND LETTER TO ENT		YES		NO	
D.6	RETEST		YES		NO	

SECOND SCREEN

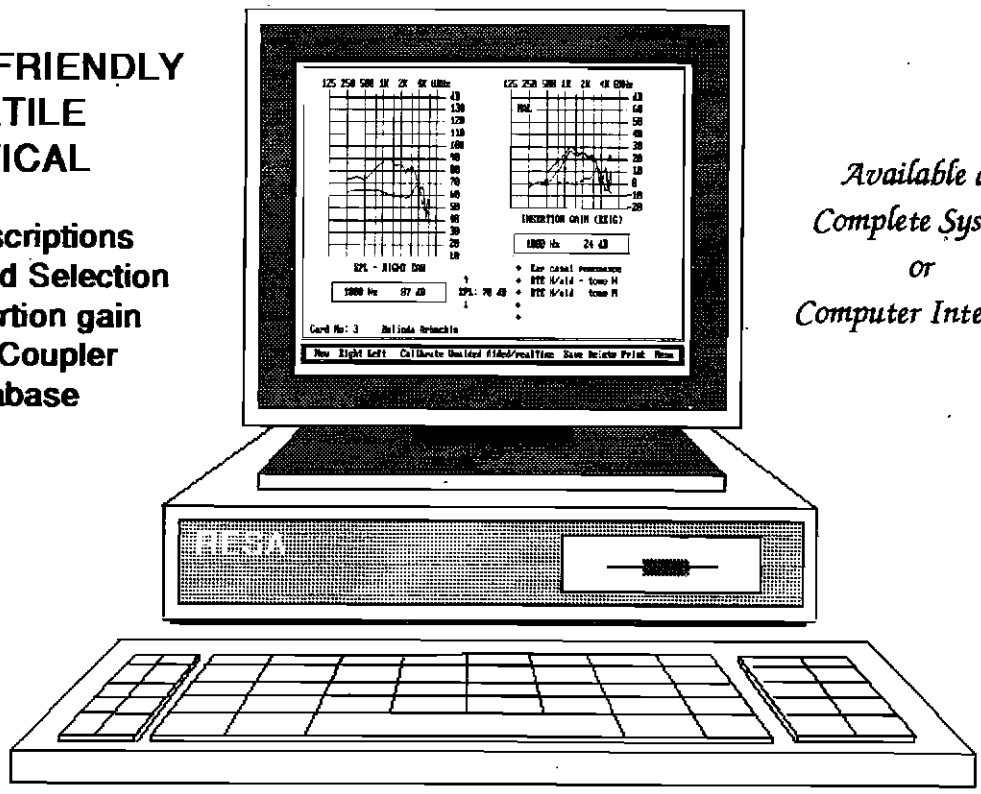
						Actual Value R L
C.	TYMPANOMETRY					
C.1	TYMPANOGRAM	A	As	B	C Ad	
C.2	STATIC ADMITTANCE	<0,2	0,2-0,9		>0,9	
C.3	EAR-CANAL VOLUME	<0,4	0,4-1,0		>1,0	
C.4	TYMPANOMETRIC PEAK PRESSURE	200daPa	-200-+100daPa		+100daPa	
D.	SUMMARY					
D.1	HISTORY		FAIL		PASS	
D.2	VISUAL INSPECTION		FAIL		PASS	
D.3	TYMPANOMETRY		FAIL		PASS	
D.4	SEND LETTER TO PARENT		YES		NO	
D.5	SEND LETTER TO ENT		YES		NO	
D.6	RETEST		YES		NO	

RESA

Hearing Aid Analyzer

USER FRIENDLY
VERSATILE
PRACTICAL

- **Prescriptions**
- **H/Aid Selection**
- **Insertion gain**
- **2cc Coupler**
- **Database**



Available as
Complete System
or
Computer Interface

From the company that made the first insertion gain system using Fourier analysis (FFT) and complex test signals - a versatile instrument with all the features needed for objective hearing aid evaluation.

Speech weighted signals are used for real ear measurements and pure tones for fully automatic 2cc coupler tests with text or graphic printout.

Full color high resolution displays make it easy to identify the measurements while the computer works in the background to simplify your task with ambient noise rejection of more than 30dB at 1000Hz.

Seven insertion gain prescription methods are provided. All are automatically adjusted for the 2cc coupler so that a manufacturer of custom aids can presume real ear response. Up to five test results can be displayed in different colors and saved in the client's file in the database. A graphical hearing aid selection technique is included.

The electronic circuits are on two circuit cards which plug into your computer - the only external components are the probe microphone, loudspeaker, mini-testbox and 2cc coupler set.

Convenience, speed and accuracy combined with high noise immunity make RESA ideal for use in a hearing aid clinic or workshop.

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