

# Teacher Accuracy in the Identification of Pre-School Pupils with Hearing Loss

Nicole Chambers and Ilona Anderson

Department of Speech Pathology and Audiology  
University of the Witwatersrand

## ABSTRACT

*Teachers of 110 pre-school pupils used a questionnaire to identify which children they thought would fail a hearing screening. Following screening, the data was compared to both audiometric only, and combined audiometric and tympanometric screening results. Teachers identified one out of six pupils who failed audiometric screening, and one out of seven who failed combined screening. We concluded that teachers could not accurately identify pupils with hearing problems and should not be used to detect hearing losses in pupils without prior education and training.*

## OPSOMMING

*Onderwyseresse van 110 voorskoolse kinders is gevra om 'n vraelys te voltooi en aan te dui watter kinders hulle sou identifiseer as die wat nie 'n gehoorsifting sou slaag nie. Hierdie resultate is vergelyk met die siftingsresultate ten opsigte van slegs oudiometrie sowel as 'n kombinasie van oudiometrie en timpanometrie. Een uit ses kinders, wat nie die oudiometriese sifting geslaag het nie, en een uit sewe kinders wat nie die gekombineerde sifting geslaag het nie is deur die onderwyseresse geïdentifiseer. Die gevolgtrekking was dat onderwyseresse nie kinders met gehoorprobleme kon identifiseer nie en dus nie sonder verdere inligting en opleiding as betroubare identifiseerders gebruik kon word nie.*

**KEYWORDS:** teachers, pre-school children, hearing loss, identification

## INTRODUCTION

Undetected hearing loss in children can be of detrimental consequence. Hearing-impaired children may not receive adequate auditory, linguistic or social stimulation necessary for speech and language learning, social development and emotional development (NIH Consensus statement, 1993). Even a mild loss can place a child at risk for language and learning problems; place an unbearable strain on their coping abilities; and put them at a disadvantage in the classroom (Roeser & Downs, 1988; Davis, Elfenbein, Schum & Bentler, 1986; Menchor & McCulloch, 1970). Furthermore, entire family functioning may be affected by a child's hearing loss (NIH Consensus Statement, 1993).

Hearing loss is a problem of significant magnitude and ranks as the commonest form of sensory deprivation (Swart, 1995; 1996a). Considering the magnitude of the problem of hearing-impairment and its detrimental consequences it becomes clear that early intervention is of critical importance. In developed countries universal screening is usually implemented (Swart, 1996b). Unfortunately the adoption of such an approach in South Africa is unlikely due to problems of inadequate resources, lack of services, lack of facilities, inadequate technology for the underprivileged majority, and lack of personnel (Swart, 1995). Hearing impairment and deafness affect at least 3 million individuals in South Africa (Swart, 1995); yet there are only 1094 registered speech and hearing therapists and 5 registered audiologists to provide services for these

individuals (SAMDC, 1997). There are also a number of primary health care workers, nurses and speech and hearing diplomats who are trained to administer hearing screening testing (Roeser & Downs, 1988) but they are also too few in number to service the entire population. Primary health care professionals have little training in the early identification and management of hearing-impairment and ear disease (Swart, 1995), and nurses already have a high work-load with which they need to cope. Thus the implementation of hearing screening programmes in South Africa is problematic.

In spite of these problems we need to extend hearing screening services to the whole community. A screening method needs to be developed that is easy to teach, learn and administer. It should be cost-effective, be developed with consideration of the context in South Africa, be linguistically and culturally appropriate (Child Health Policy Group, 1996), and not require expensive training or high level salaries (Northern & Downs, 1991). One such approach which is user friendly and fits these criteria is the questionnaire approach (Swart, 1996a).

Questionnaires incorporating at-risk registers have been used quite extensively with neonates, however, they have been used less frequently for the screening of the pre-school population. There have been reports of a slight incidence peak of otitis media within the two to seven year age range, possibly due to increased infection at entry to pre-school or school. Furthermore, the two to five year age range gives us problems in identification because the children are of-

ten not seen by doctors or clinics (Northern & Downs, 1991). The use of a questionnaire as a screening method for this age group could therefore, be especially valuable.

At-risk registers would incorporate risk factors that are different from those used for neonates. Unlike neonates, pre-school children have begun to use speech and language. Delay, deviance or regression in their use of speech and language could serve as new at-risk behaviours for pre-schoolers. Many authors emphasize that the first signs of hearing loss in children are changes in behaviour, learning and language (Savary & Ferron, 1982). The recognition of these changes as at-risk behaviours could serve as an important screening test.

Those individuals who have frequent contact with children should be utilized as key personnel for the screening of disabilities (Child Health Policy Group, 1996). This would include parents or other caregivers, pre-school teachers, community health workers, traditional healers, nurses and doctors. Unfortunately, there is a significant gap of time between the age of eighteen months and five years, where children are often not seen by health professionals (Child Health Policy Group, 1996), thus utilizing community health workers, traditional healers, nurses or doctors in the screening process may not be very efficient for children in this age range. Parents or caregivers, and pre-school teachers usually do have frequent contact with children in this age group and as a result, could prove useful in administering questionnaires and at-risk registers as part of the hearing screening process during this period. Teachers were found to be able to identify one out of four (Curry, 1950) or one out of six (Kodman, 1956) children who had a hearing loss. Nodar (1978) found similar results when the teachers' data was compared with the results of audiometric screening test results, as was done in the above two studies. When the teachers' data was compared with the results of rescreening and tympanometry followed by otoscopy, agreement doubled and teachers were found to be able to identify 47% of the children who had a hearing loss (Haggard & Hughes, 1991). Savary and Ferron (1982) found that out of 265 children who were identified by teachers as having 'school pathology', 35% had audiographic abnormalities and 45% had ear conditions requiring otolaryngologic management.

In South Africa it is becoming increasingly common for young children to be placed in pre-schools while both parents or single parents attend work. Pre-school teachers see the children in their classes on a regular, daily basis and often spend more time with them than any other individual. This study suggests utilizing teachers in the hearing screening process for a number of reasons: they are already available; no additional salaries need to be paid; they have some knowledge about speech and language in children; they are easier to educate than parents as there are fewer of them, and they may be easier to reach; they can educate parents about hearing problems; they see the children on a regular basis; and they can administer the questionnaire a number of times throughout the year. In addition to this, they may be able to pick up subtle changes in children's behaviour because they see them so frequently. This study aims to determine teacher accuracy in the identification of pre-school pupils with hearing loss by means of a questionnaire. Teacher identification will be compared firstly to audiometric only and then to combined audiometric and tympanometric screening results.

## METHOD

### SUBJECTS

#### *Subject Selection Criteria*

##### - Teachers

The teachers selected as subjects for the study had to be those who were the class teachers of the pupils involved in a hearing screening practical carried out by second year Speech and Hearing Therapy students from the University of the Witwatersrand. This practical took place from September 1996 to April 1997.

##### - Pupils

The pupils selected had to fall into the three year to six year eleven month age range and had to be involved in the second year hearing screening practical.

#### *Description of Subjects*

##### - Teachers

Thirteen teachers from three nursery schools and two childcare centres were involved in the study. Table 1 gives a description of the teachers' qualifications and their number of years of teaching experience. There was much diversity in the qualifications, but the most common qualification was a diploma in pre-primary education. The years of teaching experience ranged from one year to nineteen years with the mean being ten years experience.

##### - Pupils

In total, questionnaires were completed for 210 children. Of these, 100 pupils were not used. This was due to the following: many did not have their hearing screened as they were either absent or did not return their consent forms; the birth dates for some of the children were not filled in and thus their ages were not known; two of the pupils had joined the nursery school two weeks before the screening and the teacher did not feel that she had enough knowledge to complete the questionnaire for them; and one of the children for whom the questionnaire was completed was younger than three years. The mean age of the final sample was 4 years 7 months and the ages ranged from 3 years to 6 years 8 months with the most common age range being 3 years 6 months to 3 years 11 months. Refer to figure 1 for the pupil-age distribution.

Table 2 gives a description of the teacher-pupil distribution across the pre-schools according to the 110 pupils in the sample. The average ratio of teachers to pupils involved in the study is 1:8.5.

## EQUIPMENT AND MATERIALS

### *Equipment*

##### - Portable Audiometers

These included two Interacoustics AS7 screening audiometers with Peltor Type A earphones, two Eckstein Brothers 390MB audiometers with MAICO 78711 earphones,

one MAICO MA20 audiometer with TDH 39P earphones, and one MAICO MA 40 audiometer with TDH 39 earphones. All of the audiometers were calibrated in June 1996.

**- Immittance Machines**

Three Interacoustics AT22 impedance audiometers were used. These were calibrated in June 1996.

**- Oscopes**

Welch Allyn Clinic Oscopes with detachable speculae were used.

**Table 1: Teacher qualifications and teaching experience**

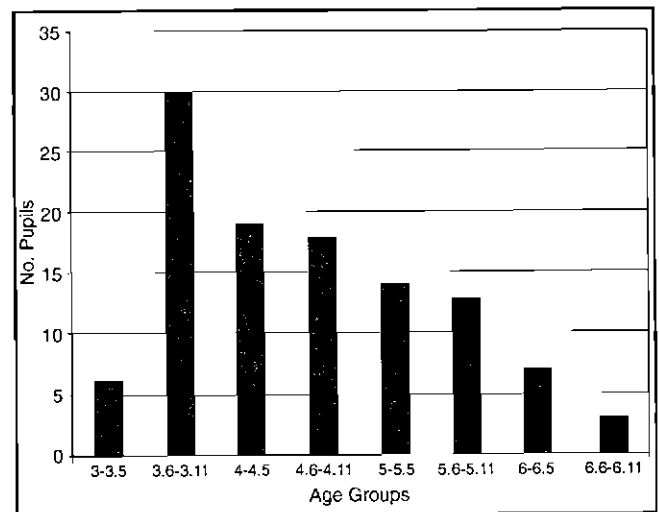
| Teacher | Qualifications   | Years Experience |
|---------|--|------------------|
| 1       | N3; Presently studying N4 to N6 through the Johannesburg College of Education        | 1                |
| 2       | National higher certificate in child care  | 8                |
| 3       | Degree in education from the University of Liverpool                                 | 12               |
| 4       | Diploma in pre-primary education   | 14               |
| 5       | Diploma in pre-primary education; Diploma in child care                              | 5                |
| 6       | 1 year child care qualification  | 4                |
| 7       | Senior primary higher education diploma  | 7                |
| 8       | Higher education diploma in pre-primary and primary; Degree in pre-primary education | 15               |
| 9       | Diploma in junior primary education  | 14               |
| 10      | Bachelor of arts degree  | 4                |
| 11      | Diploma in nursing psychology  | 13               |
| 12      | LMC training in London   | 14               |
| 13      | AMI training in France   | 19               |

**Materials**

A questionnaire was used to gain information from the teachers about the school performance, speech, language and hearing of each of their pupils (see Appendix A). The questionnaire was especially brief because the teachers were required to complete the questions for all of their pupils. It was kept as simple as possible requiring only a cross or tick or one word response for each question. An example was given of how the questionnaire should be completed so that the teachers knew what responses were expected and where they were meant to respond to each question.

The questions in the questionnaire were divided into seven main groups.

- I. Identifying information: i.e., 'Name' and 'Date of Birth'
- II. School Performance: e.g., 'Concentration and Attention' (Roeser & Downs, 1988)
- III. Hearing Information: e.g., 'Hears and answers when first called' (Roeser & Downs, 1988; American Speech and Language Foundation Pamphlet, 1986; Masland, 1970) and 'Turns head to where sound came from' (Swart, 1996b)
- IV. Speech and Language Information: e.g., 'Says all sounds other than r, l, th, s' (Roeser & Downs, 1988; American Speech and Language Foundation Pamphlet, 1986)
- V. Medical Information: e.g., 'Has had ear infections' (Roeser & Downs, 1988) and 'Child has allergies' (Swart, 1996; Haggard & Hughes, 1991)



**FIGURE 1: Pupil - Age Distribution in years and months.**

**Table 2: Teacher - pupil distribution across pre-schools according to the specific sample used in this study**

| SCHOOL              | Aletta Sutton Educare Centre | Greenhouse Child Care Centre | Hansel and Gretel Nursery School | Hug-A-Bug Nursery School | Melville Montessori Nursery School | Total |
|---------------------|------------------------------|------------------------------|----------------------------------|--------------------------|------------------------------------|-------|
| <b>NO. TEACHERS</b> | 4                            | 2                            | 2                                | 3                        | 2                                  | 13    |
| <b>NO. PUPILS</b>   | 17                           | 15                           | 14                               | 38                       | 26                                 | 110   |

- VI. Other problems or any other important information
- VII. Main Question: i.e., 'Do you think the child would pass/fail a hearing test?'

The questions in groups II - V were included in the questionnaire as the information obtained from them could alert one to the possible presence of a hearing loss and might prove useful to teachers in identifying potential hearing loss.

**PROCEDURE**

Teachers were given questionnaires which they were required to complete to the best of their ability. No form of intervention or training was given in the use of the questionnaire or on speech, language and hearing. The questionnaires were collected on the day of the hearing screening.

The second year Speech and Hearing Therapy screened the hearing of each pupil; provided they had parental permission. The students were supervised by staff members from the University of the Witwatersrand Department of Speech Pathology and Audiology.

The hearing screening included otoscopy, tympanometry, and pure tone audiometry via air conduction at 1000 Hz, 2000 Hz and 4000 Hz at 20 dB calculated using biological calibration (Katz, 1994). Otoscopy was used to check for perforated tympanic membranes, impacted wax or foreign bodies in the external ear canal to ensure appropriate testing and ENT management. Criteria for failure were a Type B or Type C tympanometric result (Northern & Downs, 1991) and / or failure to respond to any two frequencies during pure tone testing (irrespective of whether they occurred in one or two ears).

Pure tone testing was performed in the quietest available room at each of the pre-schools. The windows and doors of the rooms were closed in order to reduce background noise. However, some background noise still existed. Biological calibration was used in an attempt to account for the effects of the noise but it must be noted that the lack of a soundproof environment may have had an affect on the accuracy of the pure tone results.

**RESULTS**

Pupils were classified into two groups: those who passed the screening and those who failed the screening. They were first classified on the basis of audiometric screening results and then on the basis of combined audiometric and tympanometric screening results. Figure 2 is a comparison of the teacher identification results and the audiomet-

|                        |                 | Audiometric Identification |                 |
|------------------------|-----------------|----------------------------|-----------------|
|                        |                 | No. pupils Fail            | No. pupils Pass |
| Teacher Identification | No. pupils Fail | 1                          | 8               |
|                        | No. pupils Pass | 5                          | 96              |

**FIGURE 2: Error matrix comparing teacher identification with audiometric identification**

ric screening results. The teachers identified 8.2% of the total sample as having a hearing problem, whereas only 5.5% of the pupils tested failed the audiometric screening. Furthermore, there was agreement between teacher identification and audiometric identification on only 1% of the total sample.

The McNemar chi square was computed and found to be 0.31 for 1 degree of freedom, and indicated that no significant difference existed between teacher identification and audiometric identification (McCall & Kagan, 1994). The confidence interval for proportion was calculated and indicated that the probability is 0.95 that the proportion of pupils who were classified differently by teacher identification and audiometric identification, lies between 5.78% and 17.84% of total cases with the best estimate being at 11.81% (McCall & Kagan, 1994).

Figure 3 compares teacher identifications with combined audiometric and tympanometric screening results. The agreement between the two procedures has increased to 3.7%; it has tripled with regard to hearing loss.

The McNemar chi square was computed and found to be 12.03, which is significant beyond 0.01 for 1 degree of freedom (McCall & Kagan, 1994). This indicates that there was a significant difference between teacher identification and combined audiometric and tympanometric identification. The confidence interval for proportion was calculated and indicated that the probability is 0.95 that the proportion of pupils who were classified differently by teacher identification and combined identification, lies between 18.97% and 35.57% of total cases (McCall & Kagan, 1994).

Descriptive analysis of the teacher responses on the questionnaire was carried out. In the cases where the teachers correctly identified the pupils who failed the hearing screening, the following responses were noted (from most to least common): poor grammar, vocabulary and syntax; poor concentration and attention; lack of understanding of most speech; inability to pronounce 'r', 'l', 'th' or 's'; presence of allergies; below average class performance; loud speaking voice; and second language English. Perhaps these factors alerted the teachers to the presence of hearing problems.

In the cases where the teachers failed to identify the pupils who failed the hearing screening, two factors were noted by the teachers but did not seem to alert them to the presence of a hearing problem: poor classroom interaction, and an inability to hear and answer when first called. It is somewhat surprising that the latter factor did not alert the teachers to a hearing problem, as it would

|                        |                 | Audiometric and Tympanometric Identification |                 |
|------------------------|-----------------|--|-----------------|
|                        |                 | No. pupils Fail                              | No. pupils Pass |
| Teacher Identification | No. pupils Fail | 4  | 5               |
|                        | No. pupils Pass | 25   | 76              |

**FIGURE 3: Error matrix comparing teacher identification with combined audiometric and tympanometric screening results**

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appear to be an obvious indicator of a hearing problem.

For the teachers who correctly identified one or more pupils who failed the hearing screening, years of teaching experience ranged from thirteen to nineteen years with a mean of fifteen years, and qualifications included a diploma in nursing psychology, LMC training in London, and AMI training in France. For those teachers who did not correctly identify any pupils, years of teaching experience ranged from one to fifteen years with a mean of eight years. These results would suggest that successful teacher identification is associated with greater years in teaching experience. This did not hold true for all cases, however, as four of the teachers who did not identify any pupils, had between twelve and fifteen years teaching experience.

## DISCUSSION

The results of this study suggest that without prior education or training in the use of a questionnaire, pre-school teachers are not accurate in identifying pupils with hearing problems, and should not be used to detect hearing losses in the pre-school population. Findings tend to support those of Kodman (1956) who found that teachers could correctly identify one out of six pupils with hearing losses, as determined by audiometric testing. Results are also similar to those obtained by Curry (1950) who found that in comparison to audiometric testing, teachers could identify one out of four hearing loss cases.

Results obtained by Nodar (1978) were more favourable than the results obtained in this study. He found that in comparison to audiometric testing teachers identified one out of three hearing loss cases, while in comparison to combined audiometric and tympanometric testing they identified one out of two. Perhaps these differences in results are due to the fact that the pupils in Nodar's study were in the 5-12 year age range, while the pupils involved in this study were between 3 years and 6 years 11 months of age. Results found, both in this study and in Nodar's study, support the view that there is a decrease in hearing problems with an increase in age, so one would expect a much higher incidence of hearing problems in this study than in Nodar's. Findings in fact do support this as 4% of the total sample were found to have hearing problems in Nodar's study, while 26% were identified with hearing problems in this study. One would expect to find a higher incidence of otitis media in this study than in Nodar's study because of the younger age range of the sample. Otitis media often leads to mild hearing losses, which may be more difficult for teachers to identify. This could account for their poorer performance in identification which was noted in this study. Perhaps teachers find it easier to identify hearing problems in older pupils due to differences in the behaviour of older children as compared to younger children. The teachers reported having difficulty determining whether some of their pupils had hearing problems, or were simply having difficulties due to the fact that they were second language English speakers. For example, they were unsure whether some of their pupils with poor language, poor concentration, and inappropriate responses were hearing-impaired or simply experiencing these problems due to a poor understanding of the English language. The majority of the children in this study were second or third language English speakers and this could have had a negative effect on teacher identification. There were also methodological differences that

might have accounted for the difference in results obtained between Nodar's study and this study. Nodar (1978) used a 25 dBHL audiometric screening level, while this study used a 20 dBHL level. Nodar (1978) also included the 250 Hz, 500 Hz and 6000 Hz frequencies in his audiometric screening, while these frequencies were excluded from the audiometric screening in this study. Perhaps these variations also contributed to the differences in results.

The results of this study also differed from those of Savary and Ferron (1982). They found 35% of pupils identified by teachers had audiographic abnormalities while 45% had otolaryngologic disease processes. Once again methodological differences existed between the two studies. Savary and Ferron (1982) instructed teachers to identify any pupils who experienced a drop in grades; or who developed behavioural, language or learning problems. Perhaps this extra instruction led to better teacher performance. Because Savary and Ferron (1982) believe that hearing impairment is a hearing disorder at any level of severity, their criteria for failure included any air-bone gap of 10 dB or more on three conversational frequencies. This does not follow the screening criteria recommended by Katz (1994). It is generally considered that hearing threshold levels of above 25 dB constitute hearing loss; that an air-bone gap of 10 dB or less is not clinically significant (Hodgson, 1985); and that bone conduction testing is not included as part of hearing screening procedures. Because Savary and Ferron (1982) used stricter criteria than these, perhaps it is possible that their audiological testing identified some false positive cases. If this is the case then it is possible that some of the teacher identifications were also false positives, and that teacher identification was not actually as good as reported. If the screening criteria recommended by Katz (1994) were used in the Savary and Ferron (1982) study, the results may have been similar to those obtained in this study.

The teachers from the pre-schools involved in this study demonstrated a willingness and eagerness to learn more about speech, language and hearing in their pupils. They responded favourably to offers of a workshop to their pre-school staff, covering these areas. In addition to this, the many other advantages of utilizing teachers in the screening process still remain: they are already available and see their pupils on a regular basis; no additional salaries need to be paid; and they have some knowledge about speech and language in children. Perhaps future research could repeat this study with the inclusion of teacher education and training in the use of a questionnaire in identifying hearing problems in pupils. Teachers could be given guidelines on when to fail pupils. For example, if the child displays one or more of a given list of behaviours and physical symptoms that may indicate a hearing problem (Roeser & Downs, 1988).

The educational background of audiologists equips them to assume the role of 'educators' and to be responsible for the effective training of teachers. This brings us back to the problem of having too few audiologists in South Africa to deal with all the demands of the population. To overcome this problem perhaps a course on hearing education and training in the use of a questionnaire, could be included in the final year syllabus of teaching students. This would ensure that all teaching students are reached and that they are educated and trained in the identification of hearing problems. It would be cost-effective, time-effective, and would require fewer audiologists to act as 'edu-

cators'. It could also serve to heighten general awareness of hearing-impairment. Bearing the results of this study in mind it might be useful to increase the training and education period for those teachers with fewer years teaching experience.

## CONCLUSION

This study looked at teacher accuracy in the identification of pupils with hearing loss compared to audiometric screening results, and combined audiometric and tympanometric screening results. Findings from the study revealed that teachers identified only one out of six pupils who failed audiometric screening, and one out of seven pupils who failed combined audiometric and tympanometric screening. Agreement between teacher identification and audiometric identification was only on 1% of the total sample while there was agreement between teacher identification and combined identification on 3.7% of the total sample. It was concluded that teachers were not accurate in identifying pupils with hearing loss and thus should not be used to detect hearing problems in their pupils, unless they are given prior education, and training in the use of a questionnaire. Thus it appears imperative that in order to overcome various screening problems by utilizing teachers in the screening process, a period of teacher education and training in the use of a screening questionnaire is essential.

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