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Early detection of hearing loss: exploring risk-based hearing screening within a developing country context

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ABSTRACT

Purpose: The main objective of the current study was to explore risk-based newborn hearing screening within a developing country by conducting early hearing detection in high-risk neonates within an academic hospital complex in Gauteng, South Africa. Specific objectives included describing the case history factors and audiological function in a group of high-risk neonates; determining the relationship between the case history factors and audiological function; establishing the true- positive (TP) and true-negative (TN) results with different combinations of screening measures; establishing the percentage of TP and TN screening results in the total sample; and exploring the factors associated with follow-up return rate for hearing screening and diagnostic audiological assessment.

Participants: A total of 325 participants, including both males and females comprised the initial study sample. However, due to the longitudinal, repeated measures design of the study, some participants did not attend the repeat hearing screening and/or the diagnostic audiological assessment. All participants' data was analysed for the descriptive analysis aspects of the study. However, the total number of participants differed for inferential statistical analysis as not all participants attended the follow-up appointments.

Design: A descriptive, longitudinal, repeated measures, within-subjects design was employed for the current study. All participants underwent an initial hearing screening, and were booked for a repeat hearing screening (six weeks post discharge). Some participants underwent a re-screening two to three weeks after the repeat hearing screening when transient middle ear pathology was suspected. All participants who *passed* the repeat hearing screening or re-screening were booked for a diagnostic assessment at six months corrected age; whereas those who *referred* were booked soon after the screening.

Methods and materials: Hospital files were reviewed to extract case history information. Participants underwent hearing screenings that comprised of transient otoacoustic emissions (TEOAEs), distortion product otoacoustic emissions (DPOAEs), automated auditory brainstem response (AABR), and high frequency tympanometry when indicated. Diagnostic auditory brainstem response testing was conducted on infants who *referred* at the repeat hearing screening or re-screening. Visual reinforcement audiometry was conducted for infants at six month corrected age. When possible, diagnostic OAE testing was also conducted.

Data Analysis: Descriptive and inferential statistics were used to analyse data from the current study. Inferential statistics included the chi-squared (X^2) test, Fisher's exact test or Wilcoxon rank sum test for associations between variables; the McNemar's test for paired data; the z-test or paired t-test (or one-way repeated measures ANOVA for more than two groups) for comparisons.

Results: Preterm birth (95.7%), exposure to ototoxic medication (87.7%), neonatal jaundice (NNJ) (80.6%) and birthweight below 1500 g (66.7%) were the most frequently occurring case history factors in the study sample. Three hundred and twenty five participants underwent an initial hearing screening, of which 216 returned for a repeat hearing screening. With regard to audiological function, a higher number of participants *passed* the initial hearing screening (n= 192) and repeat hearing screening (n=133), compared to those who *referred* (n=133, n= 27). A total of 93 participants attended the diagnostic audiological assessment. Ninety one presented with hearing within normal limits and two had inconclusive findings as they did not return for the follow-up appointment as recommended. The proportion of true hearing loss based on diagnostic audiological findings was 0%. The relationship between case history variables and auditory function could not be investigated using diagnostic audiological findings, as none of the participants with conclusive diagnostic findings presented with hearing impairment. In addition, the combinations of screening measures yielding TP results could not be investigated. Although the percentage of TN findings was highest at the repeat hearing screening using any combination of screening measures, the TEOAE/AABR yielded the highest percentage specificity. The percentage of TN screening results in the total sample was 60.4% and 89.0% for the initial and repeat hearing screening respectively. The factors associated with follow-up default were mostly unknown for both the repeat hearing screening and behavioural audiological assessment, as caregivers of participants could not be reached telephonically. Results indicated a significant, but weak association between the hospital (research site) and whether or not infants returned for the repeat screening. The mean maternal age for those who returned for behavioural assessment was significantly higher than the mean maternal age of those who did not return.

Conclusion: The current study highlights the important role that audiologists play in the design, piloting and implementation of NHS programmes, with careful consideration of context.Risk-based hearing screening can be conducted in a hospital setting, particularly if appropriately aligned with medical follow-up clinics. However, more research is required into the risk factors associated with hearing loss as current study findings differ from

literature. The inclusion of AABR is valuable within the screening protocol. The feasibility of a risk-based surveillance programme needs to be carefully deliberated, particularly due to high follow-up default. The development of a national database is essential for EHDI programmes in South Africa to allow for tracking of infants.