Author's response to reviews

Title: Assessment of the feasibility and coverage of a modified universal hearing screening protocol for use with newborn babies of migrant workers in Beijing

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Author's response to reviews: see over
Authors’ response to the reviewers of MS: 4258162058832502, entitled "Assessment of the feasibility and coverage of a modified universal hearing screening protocol for use with newborn babies of migrant workers in Beijing"

Reviewer(s)' Comments to Author:
Reviewer: Peter Watkin
Comments to the Author

3) Major Compulsory Revisions central to the report.
There are several major points that require further consideration and are pivotal to the entire report

a) The Aim of the screen was nowhere explicitly stated. Those with a >30 dB nHL ABR constituted the yield. Although most UNHS screens in Europe aim to identify babies with a moderate or worse permanent congenital deafness (because early identification and management of these cases is considered to offer the greatest benefit), some screens in the USA do indeed target hearing impairments of >30 dB nHL (summaries usefully tabulated in the Task Force Reviews of 2001 and 2008). However despite the mildness of the targeted condition, the aim of such screens is never-the-less to identify permanent childhood hearing impairment (PCHI) and although you report that cases of SNHL were referred for intervention, and you also discuss a screen yield of SNHL cases, the aim of your UNHS is not explicitly stated in your paper.

b) The Aim is important because I was unsure from your report that you were identifying cases of PCHI as your true positives. This is exemplified in your table I have addressed my concern about your ability to identify whether a temporary conductive loss was causing or contributing to the impairment in my review of your Methods.

Author response:

We agree entirely with the reviewer that identification of PCHI is an important aim of hearing screens for newborn babies. Nevertheless, in view of the various factors such as vast regional, traditional and practical difficulties, which lead to disparity between the overall screening rates for hearing loss in newborn babies of migrant and non-migrant workers in Beijing, and most likely other major cities in China, the primary aim of the present study was to develop a modified protocol, such that it specifically reflected the needs of the migrant population and improved the screening rates for hearing loss in their babies. Furthermore, it allowed detection of infants suspected to have permanent childhood hearing impairment, rather than identifying permanent childhood hearing impairment.

Consequently, this study used ck-ABR to identify the infants who had explicit hearing loss and when an infant was identified as having abnormal ABR, a series of audiology tests including OAE, ABR (AC and BC), 1 kHz tympanometry and CT (if necessary) were performed before 6 months, and appropriate intervention and rehabilitation were
suggested to his/her parents/guardians. This information has been added to the text as indicated on page 6.

**The aim of this study has been clarified as shown below:**

The aim of our study was thus to design a specific UNHS protocol based on the local social characteristics of internal migrants, such that it would improve the screening rates for hearing loss in their newborn babies, and additionally allow detection of infants suspected to have permanent childhood hearing impairment. This clarification has also been indicated in the text as shown on page 5.

c) This lack of aim also confused your description of the OAE positives. Throughout the text of the paper you describe OAE screen positives as having a hearing impairment. You don’t detail whether a unilateral OAE fail constituted a screen positive. You discuss the contribution of false positives, but because of the high false positive rate found in all OAE screens undertaken within the first 48 hours your screen fails cannot properly be described as having a hearing impairment. Interestingly you attribute misplaced significance to your high screen positive rate following the initial OAE screen in your programme. It is exactly the same as the rate I reported from my early TEOAE screen implemented 20 years ago and also from the Rhode Island Project (Karl White et al, Seminars in Hearing, 1993). At that age and using an OAE screen, a high false positive rate is predictable. It is to improve the specificity that many programmes have now introduced AABR as the second stage.

*Author response:*

Based on our main aim of finding more infants with suspected hearing impairment, a unilateral OAE fail was considered a screen positive. We agree with the reviewer that AABR would be a more appropriate and specific screening method compared to OAE in second stage of hearing screening, however, this technique is relatively new in Beijing (and indeed China), and was unfortunately not used at the time this study was conducted. However, in the discussion we had acknowledged that the positive rate of 27.22% noted after the first OAE screen in the present study was higher than that reported in several other studies and that this was likely to be at least in part due to a high false positive rate, as most of the infants received their first OAE screening before they were 48 hours old. This section has now been slightly revised as shown on page 12.
4) The Methods and the effect on the Data

The programme and its modifications are well detailed and I found the figures extremely useful. The TEOAE screening test is adequately described. However I’m afraid that I found some parts of the Methods required Compulsory Revision.

a) The description of the ABR was inadequate. To be able to assess the accuracy of the diagnostic assessment outcomes we need details of the filter settings, stimulus repetition rates, number of responses averaged and the ways you confirmed the validity of an ABR response. In addition details of stimulus calibration are useful – so that cross site comparisons can be made. There is also a confusion in your text about the use of clicks at frequencies from 2000Hz to 4000Hz. Clicks of course have a wide spectral waveform, but many studies have demonstrated that they correlate clinically with hearing thresholds from 2 to 4 kHz. I’m sure that these revisions can be readily addressed by the team.

Author response:

The settings employed for the ABR test have been tabulated as shown below and the new Table 1 incorporated in the manuscript as shown on page 21.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transducer</td>
<td>insert phone</td>
</tr>
<tr>
<td>Polarity</td>
<td>Alternating</td>
</tr>
<tr>
<td>Stimulate</td>
<td>Click (duration 100us)</td>
</tr>
<tr>
<td>Sweep times</td>
<td>15ms</td>
</tr>
<tr>
<td>Sweeps</td>
<td>1024</td>
</tr>
<tr>
<td>Rate</td>
<td>21.1/sec</td>
</tr>
<tr>
<td>Filter</td>
<td>High pass 100Hz</td>
</tr>
<tr>
<td>Gain</td>
<td>Low Pass 3kHz</td>
</tr>
<tr>
<td></td>
<td>100k</td>
</tr>
</tbody>
</table>

There are two basic approaches for the calibration of earphone. One is the “real-ear” method (Note: this type of real-ear measurement involves testing a group of people rather than placing a probe-tube in the ear, as is commonly done in hearing aid calibration), the other is the “artificial-ear” method. To do the procedure properly of “real-ear” method the sample should consist of at least 10 young (18–25 years of age), otologically normal hearing adults and follow one of the methods described for transfer of reference equivalent threshold values (see ANSI S3.6-1996).

My laboratory used the “real-ear” method, selecting 30 young (18–25 years of age), otologically normal hearing adults and average the detection threshold of click as 0 dB nHL (normal hearing level).

Also details of stimulus calibration for the test are provided as indicated on page 7.
b) My most significant concern is about your ability to diagnose the presence of PCHI – which has an important bearing on your yield data. How did you identify the presence of a PCHI – or the absence of a middle ear component to the impairment? Did you use Bone Conduction ck-ABR? Did you use high frequency (1000Hz) tympanometry? Did you use Latency Intensity Functions (LIF wave V)? If you simply used ck-ABR and TDH headphones without excluding the presence of effusions – and without long term follow up with behavioural confirmation – the yield data becomes very difficult to interpret. The children identified with a hearing impairment by your programme are now aged 3 years to 6 years. Can you underpin your yield by their subsequent behavioural assessments – or does the migratory nature of the cohort prevent this?

Author response:
As we have clarified above, the aim of this study was to identify newborns with suspected permanent childhood hearing impairment in migrant population using the modified protocol, and not to identify permanent childhood hearing impairment in these infants as the diagnostic endpoint. Thus, in our study the ck-ABR test was used to exclude the infants without hearing loss. The parents of infants who demonstrated explicit hearing loss were encouraged to have their children undergo a further series of audiology tests, including OAE, ABR (AC and BC), 1 kHz tympanometry and CT (if necessary), only to confirm the hearing impairment in their children. This has now been clarified as shown in the section on Hearing impairment Testing Protocol, as shown on page 6.

c) A minor error is that you have defined the degrees slightly differently in the Methods text and the Table.

Author response:
We thank the reviewer for pointing out this discrepancy and have revised and expressed each degree of hearing loss in the text as dB nHL units, as shown on page 7.

5) The Discussion and Drawing Conclusions from your Data
The discussion was interesting with good reference to the literature. There were some areas that I thought may benefit from Discretionary Revision.

a) I wondered why you would want to start the Background to your paper by justifying the implementation of a neonatal screen by referring to the psychosocial consequences of presbyacusis (ref 1) and the mental health of post-lingually deaf patients receiving Cochlear Implants (ref 2). More relevant studies underpinning the need for early detection of pre-lingual congenital deafness are summarised in such the US Task Force Reviews (including the American Academy of Paediatrics) as well as the UK NHS Critical Review (HTA 1997).

Author response:
We agree with the reviewer and have substituted references 1 and 2, with the references shown below. The reference listing has been revised accordingly as shown on page 16.


b) The success of your programme ultimately depends upon the yield of children obtained with a PCHI. Although you consider that the yield from the migratory population of Beijing was high, in fact if those with a mild assumed PCHI are removed because of diagnostic uncertainty, then the yield of bilateral moderate and worse PCHI is 0.36/1000 and whilst clearly this is a very worthwhile yield for these difficult to track children and their families - it is low with 95% CIs 0.01 to 0.72 (as stated in your Background – it is usually around 1/1000 or even higher in sub-populations with greater health care needs.

*Author response:*

*We emphasize again that the purpose of our revised protocol was to improve the existing protocol to meet the needs of a non-resident migrant population and not to identify newborns with PCHI. Another way of presenting the data, however, is to say that using this modified screening protocol we identified 35 newborns (out of nearly 11,000 newborns) with hearing loss, who may otherwise not have been identified (or treated) until much later in life. Although this revised protocol may not be the most ideal, we feel that it is nevertheless an improvement and a step in the right direction for assessment of a hearing loss in a specified study cohort.*

c) I also questioned the value of the 4th OAE. I understand entirely why this was done – offering a non-attending population an additional point of contact to have the test done – and this was a very reasonable hypothesis. But was it effective? The second in patient OAE clearly was – with 57% of those receiving the second OAE passing – but of 141 who received the 4th OAE almost 75% failed. The referral rate for ABR was only reduced by 0.35%. Was it really worth implementing the second out-patient OAE – or would you have achieved a higher yield by immediately arranging and pursuing ABR on those 228 that failed the initial OAE out-patient test?

*Author response:*

*Before 2010, parents had to pay for the first screening and all diagnostic hearing tests including ck-ABR, OAE, ABR (AC and BC), 1 kHz tympanometry and CT (if necessary), but*
the rescreening was free. The aim of the second out-patient OAE was to give parents a chance to give their infants another free test before having to pay. In fact, as the reviewer has indicated, this study showed it was really not efficient.

From 2011, both inpatient screening and 42-day rescreening were free, and parents only had to pay for extra rescreening (such as 4th OAE screening) and ABR test. Indeed, we have revised the modified protocol again, whereby the parents can now choose to accept the 4th OAE or ABR test.

d) A minor error is the 4th box from the bottom Figure 3

Author response: We thank the reviewer for pointing out this error on Figure 3, which has now been amended as required, as shown on page 22.
Reviewer(s)' Comments to Author:
Reviewer: Bolajoko O. Olusanya
Comments to the Author

The reviewer considers this work to be of solid methodology, with an exciting study design. Thereby an interesting evaluation of two experimental speech coding strategies in a tonal language setting is presented.

Major Compulsory Revisions
1. The authors should report the screening outcomes including drop-out rates using the recommended UNHS protocol for China among the migrant population as basis for evaluating the effectiveness/advantages of their modified UNHS protocol in this sub-population.

Author response:
We agree with the reviewer that it would be important to report the screening outcomes, including the drop-out rates among the migrant population, using the recommended UNHS protocol for China. However, to our knowledge no study has reported such data explicitly for this sub-population to date, and the present study is the first to address this issue in any format. This information has now been added to the text as shown on page 5 (lines 11-13).

2. Alternatively, the outcomes from the modified protocol among the migrant population should be compared to the outcomes from among the non-migrant population in the same hospital.

Author response:
We agree with the reviewer that a comparison of data for outcomes using the modified protocol among migrant and non-migrant population in the same hospital would be relevant to test the validity of the modified protocol. Assessment of results for a comparatively small cohort of non-migrant patients (shown below) indicated that these were not significantly different from the findings for the migrant population from the same hospital investigated in the present study, suggesting that the modified protocol was indeed sensitive to the needs of the migrant population. The effectiveness or otherwise of the modified protocol, however, needs to be confirmed in larger, well-matched cohorts of migrant and non-migrant populations from hospitals in larger catchment areas, and will be contemplated in future research projects in our department.

The statistic results of non-migrant population in the same hospital:

1. Inpatient Screening Results and positive rate

<table>
<thead>
<tr>
<th></th>
<th>Pass</th>
<th>Refer</th>
<th>Positive rate</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>First inpatient OAE</td>
<td>89</td>
<td>27</td>
<td>23.28%</td>
<td>0.135</td>
</tr>
<tr>
<td>Second inpatient OAE</td>
<td>98</td>
<td>18</td>
<td>15.52%</td>
<td></td>
</tr>
</tbody>
</table>

2. Outpatient Screening Results and referral rate
3. There is need to provide a median age at confirmation of hearing loss under the current and modified screening protocols.

**Author response:**

*Both the current and modified screening protocols have to abide by the principles and guidelines for early hearing detection and intervention programs in China, formulated by Ministry of Health P.R. China.* All newborns who do not pass the hearing screening have to undergo further audiology tests at about 3 months of age and hearing impairment has to be confirmed before 6 months. Thus, there is no significant difference of median age at first ABR test between current (103 days, this data obtained from another hospital) and modified (106 days) protocols. Furthermore, as an abnormal result of the ABR interval test does not unequivocally confirm a hearing impairment, it is not possible to stipulate a median age for confirmation of hearing impairment.