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<td>Chan, Shu-ying, Rita; 陳書瑩</td>
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Otoacoustic Emissions and Sudden Infant Death Syndrome

Rita, S. Y. Chan

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Otoacoustic Emissions and Sudden Infant Death Syndrome

Rita S. Y. Chan

Abstract

Exploratory research findings suggest that otoacoustic emissions (OAE) results may be predictive for infants at risk of sudden infant death syndrome (SIDS). The present study aimed to investigate whether the actual SIDS prevalence rate in Hong Kong was comparable to OAE classified rates for at risk status. Previously collected OAE results from 521 infants in Hong Kong were used for analyses and compared to the 2006 SIDS prevalence rate in Hong Kong. Results showed that the OAE classified rates were significantly more than the actual SIDS prevalence in Hong Kong. The use of OAE screening to identify infants at risk for SIDS is therefore not practical, using the present criteria, as false alarm rates will be very high and this will cause unnecessary parental anxiety.
Introduction

Sudden infant death syndrome: definition and prevalence

Sudden infant death syndrome (SIDS) is defined as “the sudden death of an infant” under the age of 12 months during sleep and when the death cannot be explained by a thorough investigation, including review of medical history, death circumstances and postmortem examination (Krous et al., 2004). Thus, SIDS is an exclusive diagnosis when other metabolic conditions have been ruled out and if possible accidental asphyxia (the condition of decrease in oxygen concentration in the body with increased concentration of carbon dioxide) or inflicted injuries is evidenced, SIDS should not be used as a diagnosis (Gilbert-Barness, 2007). SIDS is found to peak in prevalence when infants are between two to four months old (Gilbert-Barness, 2007; Harper, Woo, & Alger, 2000) and 95% of the infants who die of SIDS are under the age of 6 months (Gilbert-Barness, 2007; Valdes-DaPena, Naeye, & Gilbert-Barness, 1997, cited in Woido, Saggioro, Ferro, & Peres, 2008).

While other countries have reported relatively high prevalence rates of SIDS—such as 3.6-7.4/1000 live births in New Zealand and 1-2/1000 in the United States and Europe in 1987—it was reported that Hong Kong had a very low prevalence rate, 0.29/1000, in the same period (Nelson et al., 2005). The reported rates dropped from 0.8/1000 to 0.3/1000 from 1990 to 2002 in Canada (Hunt & Hauck, 2006) and from 1.2/1000 to 0.67/1000 from 1992 to 1999 in the US (Malloy & MacDorman, 2005). In Hong Kong, the prevalence reduced nearly 45%
to 0.16/1000 in 1999-2002 (Nelson et al., 2005), which was still comparatively lower than Western countries. In 2006, there were totally 65,626 live births (Census and Statistics Department, 2007) in Hong Kong and only 1 case of SIDS was reported (Hospital Authority, 2007), and hence the prevalence was only about 0.015/1000 live births.

_Sudden infant death syndrome: risk factors_

Prone sleeping (placing an infant to sleep on his/her stomach), secondary prone (placing the infant non-prone to sleep but where the infant is later found prone), bedsharing, parents not sleeping in the same room as the infant, an infant not using a pacifier during sleep, overheating, and maternal smoking during pregnancy have been suggested as contributing factors for SIDS (Blair et al., 1999; Kleemann et al., 1998; Li et al., 2006; Nelson et al., 2005; Øyen et al., 1997; Rao & Greenough, 2005; Vennemann et al., 2005). Among these risk factors, many are modifiable and practitioners have been promoting campaigns and intervention strategies to reduce the incidence of SIDS. After promotion of sleeping on the back campaigns in many countries, the prevalence of SIDS has greatly reduced (Li et al., 2006; Malloy & MacDorman, 2005; Øyen et al., 1997). This outcome indicated that sleeping conditions and environments are highly related to SIDS, although the underlying mechanisms have not been identified. Besides environmental risk factors, some predisposing factors such as prematurity, low birth weight, as well as male gender, with which the environmental risk factors may interact (Hunt & Hauck, 2006), have also been identified as putting infants at risk.
for SIDS (Blair et al., 2006; Øyen et al., 1997; Rao & Greenough, 2005).

**Identifying infants at risk for SIDS – the use of OAEs**

An issue of concern to many SIDS researchers is whether there are any screenings or examinations which can identify an infant at risk for SIDS. A recent study suggested that the transient evoked otoacoustic emission (TEOAE) hearing screening results of infants who died of SIDS showed a significant decrease in signal to noise ratios at 2000, 3000 and 4000 Hz in the right ear, when compared to healthy controls (Rubens et al., 2007).

Otoacoustic emissions are sounds that can be found in the ear canal (Kemp, 2008) as the tympanum, or the eardrum, receives vibrations from the cochlea of the inner ear via the middle ear (Kemp, 2002). According to Kemp (2008), OAEs cannot be defined just as sounds emitted by the cochlea as the sound pressure generated by the cochlea can be measured only when the tympanum is set to vibrate against the air in the ear canal. To detect the signals from the inner ear, a clear pathway in the external ear canal and normal functioning of the middle ear including the tympanum are the prerequisites (Chan & Leung, 2004). Thus, normal OAEs reflect normal functioning from the outer hair cells to the external ear canal and this technology is usually applied for screening sensory hearing loss (Chan & Leung, 2004; Hall, 2000).

Transient evoked otoacoustic emissions (TEOAEs) are induced by presenting an external stimulus to the external ear canal and measuring the acoustic response (Hall, 2000). The
external stimulus presented can be a click or a tone burst and they are then called click-evoked OAE (CEOAE) or tone-burst OAE respectively (TBOAE) (Hall, 2000). The use of TEOAEs has been found to be effective and valid for universal hearing screening (Chan & Leung, 2004; Hall, 2000).

Although the pathogenesis of SIDS is not clearly known, according to Ruben et al. (2007), problems in the respiratory system are believed to play a crucial role. It has been found that, during sleep, the inner ear vestibular apparatus takes some part of the responsibility for respiratory control and vestibular stimulation has been found to control the “firing of the respiratory central pattern generator” (Ruben et al., 2007). Thus, it was hypothesized that an inner ear insult, which leads to the damage of the function of the vestibule, might play a crucial role in the predisposition for SIDS (Ruben et al., 2007). Therefore, Ruben et al. suggested that perinatal insult found in the inner ear might be associated with the results of the TEOAE screening and thus using a TEOAE recording technique might detect this abnormality.

In addition, Ruben et al. (2007) postulated that the right ear was more prone to insult due to the fact that during maternal labor, placental transfusion may lead to pressure through the newborn’s veins. Since the right innominate vein is straight while the left one has a 90° angulation which can protect the left inner, the pressure created during labor is more likely to be directed to the right inner ear (Ruben et al., 2007). Hence, the right-sided insults found in
Ruben et al.’s (2007) study could have a physiological basis.

The Ruben et al (2007) study has given rise to much discussion among scientists. Farquhar and Jennings (2008) did not find similar results in their cohort of 150 SIDS cases—none of these cases had right-sided TEOAE screening failure in their ears. In addition, Krous and Byard (2008) argued that the diagnostic parameters for SIDS were important for evaluating the results, and these were not mentioned in Ruben et al.’s (2007) study. Hamill (2008) also criticized the methodology of Ruben et al.’s study, suggesting that the use of repeated paired-sample t-tests was not valid and recommended the use of independent sample testing involving larger samples of non-affected infants.

**The present study: aims and research questions**

Since Ruben et al.’s (2007) study has led to extensive discussion, this gives rise to the purpose of this study, to investigate the feasibility of using the abnormal pattern of right-sided TEOAE findings as a reference to predict the risk for SIDS.

For this to be possible, abnormal TEOAE results should have:

1. a relatively low prevalence, as SIDS is a low prevalence disease. As mentioned, the prevalence of SIDS in Hong Kong in 2006 is only 0.015/1000. Relatively high prevalence would lead to an unacceptably high false positive rate in an SIDS-TEOAE screening programme.

2. an association with known risk factors for SIDS, such as gender and prematurity.
The research questions therefore posed in this study are:

(1) Is the prevalence of right ear abnormal TEOAE response screening results consistent with the prevalence of SIDS?

(2) Are predisposing factors for SIDS (e.g., gender, birth weight, gestation duration, etc.) significantly associated with a right ear abnormal TEOAE screening response?

**Method**

This research project used data collected in a previous study that evaluated conventional and alternative OAE methods – the TEOAEs and TBOAEs respectively – to screen hearing in newborns. The combined use of both OAEs might reduce the referral rate in initial screening (Zhang, McPherson, Shi, Tang, & Wong, 2008). The use of the data set was permitted by the researchers.

Although Ruben et al.'s (2007) study mainly focused on the use of TEOAE screening to investigate whether this could predict SIDS, TBOAE screening results would were also used for analysis in the present study as they were also collected for the previous study. It is aimed to determine whether the percentage of suspected SIDS cases found by both TBOAE and TEOAE screening was comparable to the true SIDS prevalence rate in Hong Kong. The TBOAE data collected were analyzed similarly to the TEOAE recordings. Further description of how the data were collected and analyzed follows.
Participants

The Hong Kong Adventist Hospital (HKAH) was involved in the study. A total of 521 neonates with mean age of 2.50 days (S.D. = 0.97), in which 52.78% were male and 47.22% were female, were enrolled in a universal neonatal hearing screening programme between April 2006 and July 2007. These neonates had birth weights between 2.45 and 4.74kg with mean weights of 3.23 kg (S.D. = 0.35) and had 35 to 42 weeks of gestational age with mean of 38.91 weeks (S.D. = 1.07). All these neonates were recruited after the parents agreed to participate, on a voluntary basis. Ethical approval was also obtained in the original study and for the present study.

Screening personnel

The TEOAE and TBOAE screening was conducted by an experienced audiologist. The screening sessions took place at least 2 times a week for totally 18 months.

Equipment

A non-sound treated room was used for taking all the measures in the department of obstetrics at the hospital. The average ambient room noise level using the OAE equipment during operation was below 50 dBA, which was an acceptable level for screening according to Rhoades, McPherson, Smyth, Kei, and Baglioni (1998). OAE equipment, a laptop computer with an Echoport ILO 292 USB system using the V6 software (Otodynamics Ltd., UK) installed, was used. Before each test session began, the standard ILO system clinical
neonatal probe that was needed in the session was calibrated according to the manufacturer’s instructions.

The ‘QuickScreen’ mode was used for TEOAE measurement and its response window was 12.8 ms, and the analysis window for the TBOAE mode was 20.48 ms. To consider a recorded stimulus as acceptable for both TEOAE and TBOAE, it should have 75 – 80 dB equivalent sound pressure level (peSPL) in the ear canal. Besides, in order to elicit a TBOAE response for each infant, the tone burst stimulus having a 1 kHz centre frequency was used in the screening. At least 70 OAE quiet responses were required as the response stopping criteria in both OAEs measurements. In addition, the noise rejection level was set lower than 8mPa (52 dB SPL). The ILO V6 software with half-octave bands was used for analyzing the data collected.

**Procedures**

Before inserting the OAE probe tip, if debris was found in the ear canal, it was cleared off using a cotton swab. The probe tip was checked if it was adequately fit for the neonates. And it was refitted or changed when necessary. The neonates were all tested while in natural sleep or a quiet state. All the infants were screened in the first 7 days of life. Both of the ears were tested for each neonate and the test was started with the ear which was easier to be accessed. Randomization was arranged for the TEOAE and the 1 kHz TBOAE measurements in each ear.
**Pattern of OAE results showing the risks for SIDS**

According to Rubens et al. (2007), the pattern of TEOAE results which suggested that infants were at risk for SIDS was:

1. The three test frequency bands at 2000, 3000, and 4000 Hz had signal to noise ratios (SNR) > 4 dB in the right ear (Ruben et al., 2007);

2. There is a significant decline in right ear TEOAE signal to noise ratios across the three frequencies, 2000, 3000, and 4000 Hz (Rubens et al., 2007)—compared to the left ear and compared to the normative data.

Thus, in this study, the following criteria for the TEOAE results were used for identifying infants who were at risk for SIDS:

1. The signal to noise ratios (SNRs) at 2000, 3000, and 4000 Hz should be above 4 dB in the right ear

2. The mean SNRs at 2000, 3000, and 4000 Hz of the infant’s left ear should be at least 4 dB greater than that of the right ear.

As mentioned previously, the OAEs screening results of infants who died of SIDS showed a significant decrease in SNRs at 2000, 3000 and 4000 Hz in the right ear, when compared to healthy controls (Ruben et al., 2007). In the present study, the suspected cases would be identified by comparing their SNRs in the left and right ears. This method resembled Ruben et al.’s (2007) study but the left ears of all the infants participated in this
study was taken as reference ears—the normal healthy ears.

Since TBOAE recordings were also made during data collection, the results obtained were also used to analyze and identify the infants who were at risk for SIDS. The criteria for identifying at risk infants from TBOAE recordings were:

1. The SNRs at 1000, 1500, and 2000 Hz should be above 4 dB in the right ear.

2. The mean SNRs at the three frequencies of the infant’s left ear should be at least 4 dB greater than that of the left ear.

According to Zhang, McPherson, & Zhang (2008), tone-burst stimuli might probably be better than click stimuli at eliciting responses in the low frequency range and it might improve the SNRs and make it more possible to detect a response at these frequencies. Thus, in the present study, 1000, 1500 and 2000 Hz were chosen for analysis with TBOAEs, which were different frequencies from those selected for TEOAE analysis.

Statistical analyses

All the TEOAE and TBOAE results collected were analyzed with reference to the abovementioned pattern and the percentage of neonates who showed such results was calculated. Statistical significance between the prevalence of abnormal TEOAE results and that of SIDS in Hong Kong in 2006 was then evaluated using the binomial test (George & Mallery, 2009). This is a statistical test for evaluating whether the distribution of observed values is significantly different from the expected distribution (George & Mallery, 2009). In
addition, factors including birth weight and gestation were analyzed using a Multivariate Analysis of Variance (MANOVA) and a Mann-Whitney U test was used to analyze whether the two groups of infants differed in their gender distributions. Any significance between the results for TEOAE and TBOAE in showing the number of cases at risk for SIDS was evaluated by Wilcoxon Signed Rank Test. Statistical analyses were done using SPSS for Windows, version 16.0 software. The statistical significance was set at p<.05.

Results

Number of suspected SIDS cases

According to the results of the TEOAE and TBOAE analyses, total number of suspected SIDS cases was 59 and 9, respectively, among the 521 cases. The prevalence of suspected SIDS using these two measures was therefore 11.32% and 1.73%, respectively. Figure 1 shows the number of suspected SIDS cases according to the results for TEOAE recordings. Totally, 84 cases had both ears’ SNRs greater than or equal to 4 dB at 2000, 3000 and 4000 Hz, which was a criterion for getting a pass for hearing screening, and had mean SNRs greater in the left ear at these frequencies. Further analyses found that only 59 cases fitted the criteria as mentioned in the Method, which specified that the mean SNRs in the left ear were 4 dB or greater than those on the right ear. As shown in Figure 1, the cases on the right side of the dotted line were the cases which showed SNRs in the left ear being at least 4 dB greater than that on the right ear.
Figure 1 Number of cases which passed the TEOAE screening and showed mean SNRs at 2000, 3000 and 4000 Hz in the left ear greater than that in the right ear. The dotted line separated the OAE classified cases from the normal ones. Totally 84 cases showed greater SNRs in the left ear than the right one but only cases of the mean dB difference with greater or equal to 4 dB would be identified as suspected cases, which were the cases on the right side of the dotted line. There were totally 59 cases.
Figure 2 Number of cases which passed the TBOAE screening and showed mean SNRs at 1000, 1500 and 2000 Hz in the left ear greater than that in the right ear. The dotted line separated the OAE classified cases from the normal ones. Totally 16 cases showed greater SNRs in the left ear than the right one but only cases of the mean dB difference with greater or equal to 4 dB would be identified as suspected cases, which were the cases on the right side of the dotted line. There were totally 9 cases.

Figure 2 shows the number of cases at risk for SIDS according to the results of TBOAE recordings. Similarly, 16 cases passed the TBOAE and had mean SNRs greater on the left ear at 1000, 1500 and 2000 Hz. Finally, 9 cases, shown on the right side of the dotted line, were found to have a SNR greater than or equal to 4 dB in the left ear compared to the right ear.
Comparing prevalence of SIDS in Hong Kong with OAEs results

To compare the prevalence of SIDS in Hong Kong, 0.015/1000, with the prevalence of suspected SIDS cases using TEOAE (11.32%) and TBOAE (1.73%), it was found that there was significant difference between the known population prevalence rate and the OAE classified suspected rate—as shown in Table 1.

<table>
<thead>
<tr>
<th>Types of OAE</th>
<th>No. of cases</th>
<th>Observed proportion</th>
<th>Known proportion</th>
<th>p</th>
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<tbody>
<tr>
<td>TEOAE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspected</td>
<td>59</td>
<td>.113</td>
<td>.001</td>
<td>&lt;.000</td>
</tr>
<tr>
<td>Normal</td>
<td>462</td>
<td>.887</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TBOAE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspected</td>
<td>9</td>
<td>.017</td>
<td>.001</td>
<td>&lt;.000</td>
</tr>
<tr>
<td>Normal</td>
<td>412</td>
<td>.983</td>
<td></td>
<td></td>
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p<.05
With reference to the results calculated by using TEOAE and TBOAE recordings, it was found that the prevalence differed by 9.59%. In order to determine whether this difference was significant or not, a Wilcoxon Signed Rank Test was used for evaluation. It was shown there was a significant difference ($Z=-6.155$, $p<.000$) between the two measurements in their proportions of suspected cases.

**Risk factors for SIDS**

MANOVA was used to analyze whether the two groups of infants (the suspected SIDS group and the normal group) differed significantly in two congenital factors that have been related to increased risk of SIDS. According to Coakes & Steed (2003), a number of assumptions should be met under the use of MANOVA including sample size, normality, linearity, homogeneity of regression, homogeneity of variance-covariance matrices and multicollinearity and singularity. The data was checked with the use of SPSS and met the above assumptions.

As shown in Table 2, overall analysis was not significant, $F(2, 521)=1.337$, $p=.264$, and further tests showed that both groups did not differ significantly for both birth weight, $F(1, 521)=2.678$, $p=.102$, and gestation, $F(1, 521)=0.176$, $p=.675$. Post hoc tests were not performed since there were fewer than three groups from the set of data. A Mann-Whitney U test was used to analyze whether the two groups of infants differed in their gender distributions. Results showed that there was no significant difference ($Z=-0.316$, $p=.752$) in
the proportion of males and females between the two groups.

Table 2 MANOVA for the comparison between the suspected SIDS group and normal group in terms of gestation and birth weight

<table>
<thead>
<tr>
<th></th>
<th>df</th>
<th>F</th>
<th>η</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gestation</td>
<td>1</td>
<td>0.176</td>
<td>0.201</td>
<td>.675</td>
</tr>
<tr>
<td>Birth weight</td>
<td>1</td>
<td>2.678</td>
<td>0.326</td>
<td>.102</td>
</tr>
<tr>
<td>Gestation*Birth weight</td>
<td>2</td>
<td>1.337</td>
<td>0.005</td>
<td>.264</td>
</tr>
</tbody>
</table>

Note. η represents mean square; p<.05

Discussion

False alarms in the TEOAE/TBOAE screening for SIDS

According to Driscoll and McPherson (in press), a screening test’s functionality, which is the test’s ability to identify people who are at risk for certain disorders or diseases from those who are not, can be shown by various test performance measures including sensitivity and specificity.

If the screening test can have entirely the same results as a gold standard test, it should show only true positives and true negatives, meaning that the truly diseased/disordered
persons can be identified in the screening as positive cases and the truly normal persons can be identified as negative cases in the screening respectively. On the other hand, if the screening does not agree with the standard test, false positives and false negatives will be shown. False positives are defined as those normal persons who are wrongly screened to have the disease/disorder and false negatives are the persons who do have the disease/disorder but they are not identified in the screening. Specificity, which is the proportion of normal cases that are correctly rejected by a screening test (Driscoll & McPherson, in press), is highly related to the proportion of false positive cases as the more false positive cases appear, the lower the specificity the screening has.

In this study, the TEOAE and TBOAE classified rates for cases which were at risk for SIDS were 11.32% and 1.73%, respectively. These OAEs classified rates were significantly larger than the prevalence of SIDS, 0.015/1000, in the Hong Kong paediatric population, as shown in Table 1. These significantly large rates will mean there are a large number of false positives derived from this screening procedure.

Using the number of live births of Hong Kong in 2006 as a reference, there was only 1 case of SIDS reported from over 65,625 newborn babies. If TEOAE or TBOAE were used to screen these live births, 7429 and 1135 newborns, respectively, would be labeled to be at risk for SIDS after screening. At a minimum, there would be over one thousand false positive cases. In other words, the specificity of using OAEs to screen for SIDS would be very low
since the ability of the screening test to exclude normal cases was low.

There would be a number of drawbacks for a screening test with such low specificity. First of all, since over one thousand families would be informed of the risk of their infants having SIDS, these false alarms would cause psychological burden to the families and hence normal family function could be adversely affected (Driscoll & McPherson, in press). Consistent with this idea, Farquhar and Jennings (2008) also suggested that if the accuracy of such hearing screening for SIDS could not be validated, many parents would be warned unnecessarily about potential SIDS risk. Second, according to Driscoll and McPherson (in press), these families might often seek unnecessary referrals to medical doctors to check on their infants even if they appeared healthy and this might lead to high financial costs from excessive consultation. Third, when there are excessive referrals for professional resources for preventive measures of SIDS, this can, in turn, lead to the delay for such services for the true positive cases (Driscoll & McPherson, in press).

*A lack of a diagnostic test*

According to Driscoll and McPherson (in press), the use of a screening test assumes there is a gold standard test which will be able to confirm the diagnosis. As mentioned in the Introduction, SIDS is confirmed through a thorough investigation including a postmortem examination (Krous et al., 2004), meaning that the diagnosis can only be performed when the infant is dead. When an infant is indicated to be at risk for SIDS, the family will not be able to
confirm such risk through a diagnostic test. This means that the OAE screening method for SIDS-susceptible cases cannot be verified. It is thus worth considering whether such OAE screening would be ethical, when there is no diagnostic test for infants with SIDS.

**Risk factors**

Hunt and Hauck (2006) suggested that some pregnancy-related factors like prematurity and low birth weight were found to have association with the incidence of SIDS. In the study of Øyen et al. (1997), the combined effects of sleeping position and prenatal risk factors were investigated and it was found that risk increased when low birth weight or preterm infants were placed non-supine. Hauck (2001) also suggested that, generally, SIDS affected about 30% to 50% more males than females. All these suggested that prematurity, low birth weight and males sex increase the risk for SIDS.

However, in present study, gestational age, gender and birth weight were not found to differ significantly between the suspected SIDS group and the normal group. This phenomenon is actually expected since, with reference to the results presented, the use of OAEs to determine susceptible SIDS cases was not found to be plausible. Since the OAE results gave a large proportion of false alarms, the OAE classified “at risk for SIDS” group could not possibly represent the main characteristics of the SIDS population.

**Difference between the OAEs**

A significant difference was found between the TEOAE and TBOAE results. One of the
possible reasons for this is that different frequencies were used for analysis of screening response in the two tests. For TEOAE, frequency levels of 2000, 3000 and 4000 Hz were chosen as the screening criteria while those of 1000, 1500 and 2000 Hz were chosen for TBOAE. It is hypothesized that the use of different frequencies as criteria led to such differences since the two procedures covered different frequency ranges and hence tested different regions of the cochlea.

According to Prieve, Gorga, & Neely (1996, as cited in McPherson, Li, Shi, Tang, & Wong, 2006), tone burst stimuli used in OAEs can generate a greater response and better SNRs than clicks. It is hypothesized that the lower SIDS suspected prevalence rate of TBOAE may be due to its better ability in triggering a response and thus the discrepancy between the left and right ear did not differ as much as for the TEOAE results. Besides, the TBOAE recordings were made using a 1 kHz tone burst stimulus and that this gave a different OAE response range to the TEOAE response and this might also cause a difference in the results. However, it should be noted that although the TBOAE classified rates (1.73%) were much lower than the TEOAE ones (11.32%), the prevalence was still significantly higher than the actual SIDS prevalence in the Hong Kong population. Thus, the use of TBOAE results is still not a sound method to identify infants at risk for SIDS.

**Limitations**

In this study, an indirect method was used to evaluate whether it is practical to use OAE
screening results to identify infants at risk for SIDS. The calculated prevalence of suspected cases (by OAE measures) was compared to the actual SIDS prevalence rate in Hong Kong. A better modification would involve following these 521 infants over at least a six-month period to see if the cohort had unexpected deaths. However, it was not practical as the previous researchers did not have access to longitudinal data on these infants. Besides, the tested infant population was highly mobile, since many expatriates used the services of the hospital, and this makes longitudinal follow-up difficult. So it is suggested that a future study using a longitudinal method could be implemented.

Besides, TBOAE results were also used to identify cases at risk. However, no previous study has analyzed the pattern of TBOAE results an infant with SIDS should have, and the criteria chosen in the present study were based solely on work with TEOAE recordings. Thus, the use of the TBOAE results for analyses still requires further research. Finally, this study as well as Rubens et al. (2007)’s study looked at OAE data for screening only. It may be possible to combine OAE data with other newborn screening data or infants’ case history to derive more effective and valid screening criteria for infants at increased likelihood of developing SIDS.

Conclusion

In summary, the use of OAEs screening results to determine suspected SIDS cases would cause a very large number of false alarms. These false alarms would create a mental burden
for many families as well as great financial cost to referral systems. Besides, since the OAE findings identified too many infants at risk for SIDS, in which most could not be true positive cases, the risk factors, male sex, low birth weight and prematurity, were not found to differ significantly between the suspected and normal groups. This, again, showed that OAEs results might not be a valid measure to identify infants who are prone to SIDS.

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*Paediatrics*, 100, 613-621.


