SUMMARY AND CONCLUSION

Knowledge of relevant risk factors for hearing impairment in a particular population will have significant clinical relevance, as it can lead to early suspicion and referral for appropriate screening. It also helps in counseling the family about the possible cause of the hearing disorder. It prepares them to prevent the risk of recurrence in subsequent pregnancy. Available International guidelines (JCIH, 2007) on risk factors are based on literature available from Western countries such as US, UK and Australia (Olusanya & Newton, 2007). It is consistently reported in the literature that relative importance of risk factors varies with different countries (table 24). Thus there is a great need to investigate the association of various risk factors with childhood hearing impairment in a country like India.

It should be possible to reduce preventable hearing impairment by minimizing the relevant risk factors. However, it is important to know the association of individual and combined risk factors in India before developing indigenous policies and programs that aim to control the incidence of hearing impairment. Hence this study was undertaken.

This study focused on ascertaining the significance and strength with respect to the association of following categories of risk factors with permanent hearing impairment:

1) Individual hereditary risk factors
2) Combined hereditary risk factor
3) Individual acquired risk factors
4) Combined acquired risk factors

A case-control study with the ratio of 1:1 was designed on 420 infants. The data was collected between 2008 and 2012. The study group consisted of infants with permanent hearing impairment and control group consisted of infants with normal hearing. Each group had 210 infants. Sample size was determined based on the prevalence of risk factors as per Cone- Wesson et al. (2000) for the power of 80%. Alternate sampling method was used for selecting the control group in the age range of 6 months to 2 years from the Department of Pediatrics of Sri Ramachandra Hospital. Age-matched infants with hearing impairment were selected from four hospitals including Sri Ramachandra Hospital and two schools in Chennai, Tamilnadu, India.

Information was collected regarding the risk factors such as family history of hearing impairment, consanguinity, craniofacial anomalies/ syndromes, hyperbilirubinemia, prematurity (< 37 weeks), low Apgar score (< 8 at 5 min), low birth Weight (< 2500 g), post natal infection, intra uterine infection, Seizures (at least one episode), ototoxic drugs, NICU admission (> 5 days). The conclusion on association of individual risk factors was derived from logistic regression analysis based on the significance and adjusted odds ratio. For combined risk factors, the conclusion was based on chi-square analysis and crude (unadjusted) odds ratio.

The conclusions derived from the present study are:

- Among hereditary risk factors, individual and combined factors were significantly associated with permanent hearing impairment. A child with family history of
hearing loss has eight times more chances of having a permanent hearing impairment than a child without this risk factor.

- There are four times more chances for a child with consanguineous parents to have permanent hearing impairment than a child with non-consanguineous parents. The second degree consanguinity has four fold risks and third degree consanguinity has a risk of two and half times. This was well explained by the higher percentage of gene sharing (25%) in the former than the latter (12.5%).

- When the above mentioned hereditary factors were combined, the risk of association with PHI showed a three to five fold increase than its individual risk. A child with the combination of family history and consanguinity has twenty three times more chances of having PHI. This indicated that a defective gene is inherited in many of the families and consanguinity increased the chances of defective gene to have phenotypic expression.

- Among the acquired individual risk factors which were studied, intra uterine infection had highest significant association with permanent hearing impairment. The presence of this factor increased the chances of having the permanent hearing impairment by 17 times. Among the intrauterine infections, rubella was most prevalent.

- The next highest significant association was seen for craniofacial anomaly and low Apgar score. Both had risk estimate of 6.5. This means that there are six and
a half times more chances to get a permanent hearing impairment for a child with any of these factors.

- Next level of significant association was seen for low birth weight and post natal infection. The risk estimate of both the factors was 2.5. Children with these risk factors have two and half times more chances of having permanent hearing impairment than those without these risk factors.

- Other individual acquired risk factors such as seizures, preterm birth, NICU admission, ototoxicity and mechanical ventilation did not have significant association with permanent hearing impairment. An equivalent percentage of these risk factors were also seen in the control group.

- Combined acquired risk factor was also significantly associated with hearing impairment with the risk estimate of two. This means a child with more than one acquired risk factor was having twice the chance of having PHI.

- However, there was no significant association of specific combination of common risk factors such as LBW+ Preterm 2) LBW+ NICU 3) Preterm+ NICU 4) LBW+NICU+ Preterm with hearing impairment.

- The sensitivity of high risk factors to detect PHI was 80.5% in the present study in the age group of 6 months to 2 years. This is in line with other Indian studies
(Ashok Kumar, 1981; Anitha, 2002) indicating a higher efficiency of high risk factors in identifying hearing impairment in India than Western countries.

The following table summarizes the above findings of significant and non-significant risk factors associated with permanent hearing impairment in the present study.
Table 29: Significant and non-significant risk factors associated with hearing impairment.

<table>
<thead>
<tr>
<th>Significant hereditary risk factors</th>
<th>Significant acquired risk factors</th>
<th>Non-significant acquired risk factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Combination of family history and consanguinity</td>
<td>1) Intra-uterine infection</td>
<td>1) NICU admission</td>
</tr>
<tr>
<td>2) Family history</td>
<td>2) Craniofacial anomaly</td>
<td>2) Hyperbilirubinemia</td>
</tr>
<tr>
<td>3) Consanguinity</td>
<td>3) Low Apgar score</td>
<td>3) Seizures</td>
</tr>
<tr>
<td></td>
<td>4) Post natal infection</td>
<td>4) Preterm birth</td>
</tr>
<tr>
<td></td>
<td>5) Combined acquired risk factors (CARF)</td>
<td>5) Ototoxicity and Mechanical ventilation</td>
</tr>
<tr>
<td></td>
<td>6) Low birth weight</td>
<td>6) Specific combinations of CARF such as a) LBW+ Preterm, b) LBW+ NICU, c) Preterm+ NICU, d) LBW+NICU+ Preterm</td>
</tr>
</tbody>
</table>
Recommendations based on the study

- Direct referral for diagnostic hearing evaluation should be done for infants with combined hereditary risk factors and intrauterine infection as they have very high association with PHI.

- Pediatricians, Neonatologists and ENT specialists need to be sensitized regarding the significant risk factors. Close monitoring of hearing abilities of babies with significant risk factors is recommended.

- Risk factor based screening may be adopted in a hospital initially, where universal newborn screening is not in place.

- Since the sensitivity of risk factors in identifying the hearing impairment is high in 6 months – 2 year old children, risk factor based screening can be planned at preschool and school entry level.

Future directions

- The present study is the first systematic attempt in the past two decades to report the association of risk factors with PHI in India. This study was done in hospital based population. A similar study can be planned in the community level i.e. both rural and urban. The children can be chosen from establishments such as primary health center, temples and other public places where periodic immunization programs are held.
• Risk factor association studies may also be planned at school entry level. Risk factor information may be filled by the parents during the school admission and a simple hearing screening technique such as OAE may be performed to detect hearing impairment.

• Since the reliability of the risk factor information is always a challenge, an NHS based study may be an alternative solution. Risk factor study may be planned in a hospital where a universal hearing screening is active. In this way, the data can be directly accessed via inpatient medical records.

Limitations

• Subjects with no reliable medical records were excluded from the study. This might have formed a bias.

• All the subjects in the control group and the study group were not from the same source. This is because of the paucity of normal hearing children in ENT hospitals and clinics where the caseload belonged only to hearing impairment group.