

# A survey of childhood hearing impairment

Siraj M. Zakzouk, MD, FRCS, Kamal J. Daghistani, MD, FRCS, Tarek S. Jamal, MD, FRCS,  
Abdulmonem A. Al-Shaikh, MD, FA, Metwakil F. Hajjaj, MD.

## ABSTRACT

**Objectives:** To study the current status of hearing impairment among children in the different provinces of Saudi Arabia, and to compare the findings with previous studies carried out in the Kingdom and abroad. To study the various risk factors related to hearing impairment.

**Methods:** A randomly selected sample of 9540 children were examined. A field work was carried out to enumerate and number the various areas of the different provinces of the Kingdom. A survey team performed clinical examination and completed the questionnaire form. The hearing was tested using free sound, speech, tuning forks, pure tone and tympanometry. The data was analyzed by  $\chi^2$  test using EPI. INFO Computer software.

**Results:** A total of 9500 children below the age of 15 years were selected. The prevalence of hearing impairment was found to be 13.09% while 8.15% were at risk of hearing impairment. The children from Southern

(20.67%) and Western (14.68%) provinces showed significantly higher prevalence. The prevalence of hearing impairment was significantly higher in children whose parents were first cousin (16.4%) or a relative (12.42%) as compared to non related (10.38%).

**Conclusion:** High prevalence of hearing impairment in the children from Southern Provinces may be attributed to hereditary factors. The Western province does not show high consanguinity and males are less than female in these 2 provinces. Several pre, peri and post natal risk factors play an important part in pathogenesis of hearing impairment. Further investigations are warranted to identify potential risk factors associated with childhood hearing impairment in Saudi Arabia.

**Keywords:** Hearing impairment, risk factor, consanguinity.

Saudi Medical Journal 1999; Vol. 20 (10): 783 - 787

Hearing impairment is a serious disabling condition for the population of any age, however, its impact on childhood population is quite crucial. Hearing impairment of even the mildest degree can result in long lasting communicative, social and academic deficits. It is well documented that presence of hearing loss will interfere with the acquisition, development and the use of language.<sup>1</sup> The greater the degree of hearing loss, the more difficult it will be for the child to readily acquire language through the auditory channel. The children with hearing impairment are also found to have poorer self-perceptions than the children of the same

age with normal hearing.<sup>2</sup> The most vital need in the management of deaf child is early diagnosis, which unfortunately does not often happen. A child diagnosed before 6 months of age has a huge advantage over one in whom diagnosis is delayed until 18 months, therefore every effort should be made to identify the child with hearing loss as early as possible. The prevalence of childhood hearing impairment varies widely in the children from different populations. Naeem and Newton<sup>3</sup> reported that Asian children were at high risk of sensorineural hearing loss (SNHL) as compared to non-Asian children. Recent screening of the

From the ENT Division, Security Forces Hospital, Riyadh, Kingdom of Saudi Arabia.

Received 25 April 1999. Accepted for publication in final form 20 June 1999.

Address correspondence and reprint request to: Prof. S. Zakzouk, Senior ENT Consultant and Head of ENT Division, Security Forces Hospital, PO Box 3643, Riyadh 11481, Kingdom of Saudi Arabia. Tel. (009661) 4911374. Fax. (009661) 4913634.

Jamaican children showed the prevalence of hearing impairment to be 4.9%,<sup>4</sup> whereas it was higher (8.7%) in the children from Tanzania.<sup>5</sup> Jacob et al<sup>6</sup> found the prevalence of hearing impairment in rural primary school children from south India to be 11.9%. Davis et al<sup>7</sup> reported the prevalence of hearing impairment in British children to be 1.2 per 1000 whereas in Swedish children it was 2 per 1000.<sup>8</sup> Parving and Christensen<sup>9</sup> observed that the prevalence of hearing impairment increased with increasing age and it was found to be 5.32 per 1000 in Danish children. The prevalence of hearing loss in the French children was reported to be comparatively less; 0.54 per 1000 children under 9 years old.<sup>10</sup> Studies on the epidemiology and etiology of hearing impairment in the children from Saudi Arabia started only recently.<sup>11,12,13</sup> Considering the high prevalence of hearing impairment in Saudi children reported in earlier studies, this investigation was aimed to determine the current status of hearing impairment in the children from different provinces of Saudi Arabia.

**Methods.** A comprehensive survey of 9,540 Saudi infants, pre-school and school age children below 15 years of age was carried out from January 1998 to December 1998. The subjects were selected from Central, Eastern, Southern and Western provinces of Saudi Arabia. The sample selection was randomly designed, with representation of children from all the socio-economic and demographic groups. Fieldwork was carried out to enumerate and number the administrative, industrial, trading, residential, recreational and road areas of different provinces of Saudi Arabia. Within each block selected, a random starting point was chosen and the survey team followed the predetermined route. Each survey team included an Ear, Nose and Throat (ENT) specialist, a nurse, a social worker and a field supervisor. After obtaining permission from the family, the team performed the clinical examination of the child and completed a questionnaire with the help of parents. The hearing impairment in the children was tested using free field speech testing and tuning fork tests. Pure tone audiometry and tympanometry were used for further confirmation of hearing status of the children. The children 'at-risk' of hearing impairment were detected using the methods reported earlier.<sup>7</sup> The data was analyzed by  $\chi^2$  test using EPI-INFO computer software.

**Results. Total subjects.** A total of 9540 Saudi children were included in the study. There were 4189 (44%) male and 5351 (56%) female children (Figure 1a). The complete distribution of total subjects with male:female ratio is given in Table 1.

**Age category.** The subjects were categorized in 4 age groups. The maximum number of children were

in the age group >8 to 12 years (3615) followed by >4 to 8 years (3431). There were 2054 children below 4 years, whereas only 440 children were more than 12 years of age (Figure 1b). The male:female ratio was nearly the same in the age category of >4 to 8 years, whereas the number of female subjects were greater in the age categories >8 to 12 years and >12 years. However, in the age group of >4 years, there were more male subjects than females as shown in Table 1.

**Provincial status.** The maximum number of children were from the Western province (4058) and the minimum from the Eastern province (647). From the Central province, a total of 3800 children were surveyed and from the Southern province 1035 children were included (Figure 1c). There were more male children from the Central and Eastern provinces, whereas there were more females from the Southern and Western provinces (Table 1).

**Consanguinity of parents.** There were 1809 children whose parents were first cousins whereas the parents of 2672 children were relatives. The parents of 4439 children were not consanguineous (Table 1, Figure 1d). The number of children whose parents were first cousins was comparatively higher from Southern (39.51%) and Eastern (37.55%) provinces as compared to Central (15.23%) and Western (14.24%) provinces. There was also a high percentage of children from the Southern province (43.76%) whose parents were relatives, whereas the percentage of such children from Central, Eastern and Western provinces was 29.92%, 17.61% and 23.85% (Figure 2).

**Hearing impaired and at risk children.** Out of 9540 children surveyed, 1241 (13.09%) were found to be hearing impaired and 782 (8.15%) were at risk of hearing impairment (Figure 3). The prevalence of hearing impairment was significantly higher in males (13.84%) as compared to females (12.35%). Although females were slightly at higher (8.52%) risk of hearing impairment as compared to males (7.78%), this difference was not statistically significant (Figure 3). The hearing impairment was significantly higher in the children from Southern (20.67%) and Western (14.68%) provinces as compared to the children from Central (9.65%) and Eastern (9.89%) provinces (Figure 4). However, a large number (36.47%) of children from the Eastern province were found to be at risk of hearing impairment. The at-risk children from Western, Central and Southern provinces were 7.02%, 5.97% and 3.28% (Figure 5). The prevalence of hearing impairment was significantly higher in the children whose parents were first cousins (16.14%) or relatives (12.42%) as compared to the children whose parents were not related (10.38%, Figure 4). The risk of hearing impairment was also significantly higher in the children whose parents were cousins (17.74%)

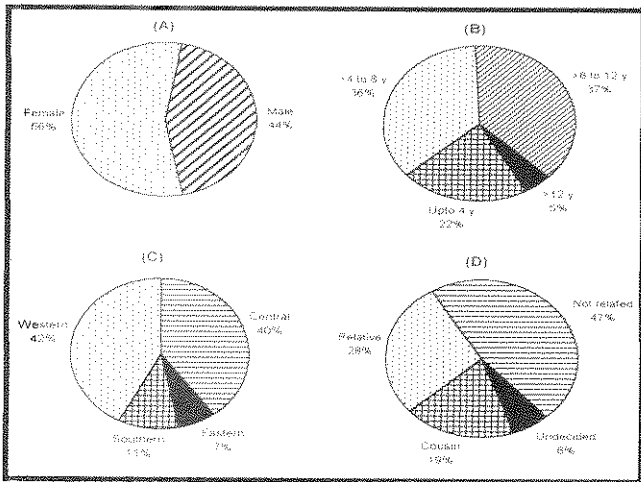


Figure 1 - Percentage frequency distribution of total subjects according to (A) sex, (B) age category, (C) provincial status and (D) consanguinity of parents.

Table 1 - Details of subjects sex, age category, region and the consanguinity of parents.

Subjects	Male Number (%)	Female Number (%)	Total
Total number	4189 43.94	5341 56.09	9540
Age category:			
Upto 4 years	1108 53.94	946 46.06	2054
>4 to 8 years	1749 50.97	1682 49.03	3431
>8 to 12 years	1251 34.60	2364 65.40	3615
>12 years	81 18.41	359 81.59	440
Province:			
Central	2067 54.39	1733 45.61	3800
Eastern	330 51.00	317 49.00	647
Southern	360 34.78	675 65.22	1035
Western	1432 35.29	2626 64.71	4058
Consanguinity of Parents:			
Cousin	815 45.05	994 54.95	1809
Relative	1211 45.32	1461 54.68	2672
Not related	1890 43.58	2549 57.42	4439
Unknown	273 44.03	347 55.97	620

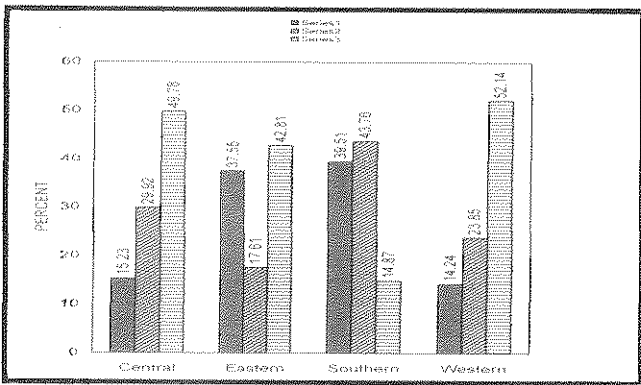


Figure 2 - Consanguinity of parents, of the children from different provinces of Saudi Arabia.

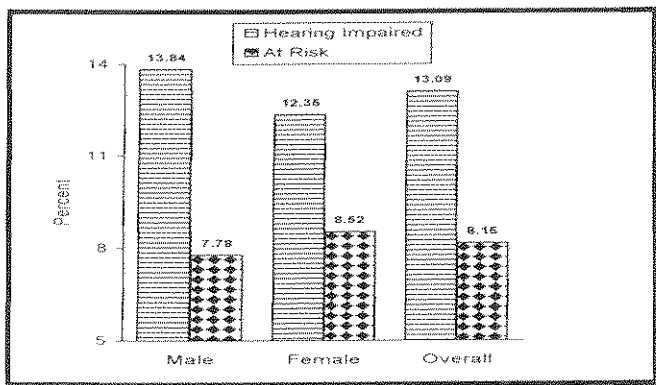


Figure 3 - Prevalence of childhood hearing impairment and the childhood population at risk of hearing impairment.

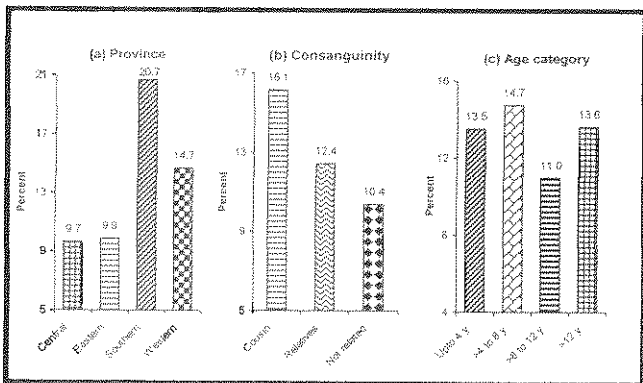


Figure 4 - Prevalence of hearing impairment in the children from (a) different provinces (b) with different consanguinity of parents and (c) of different age group.

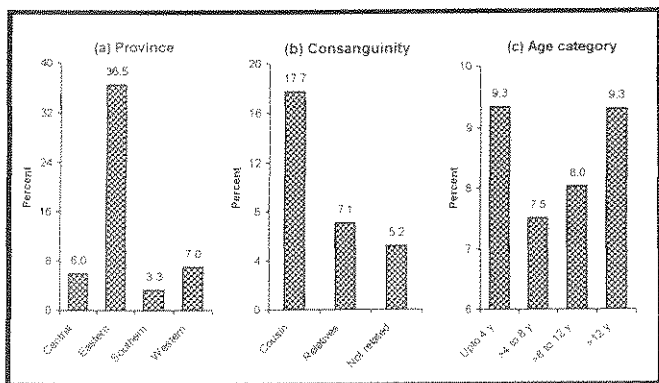


Figure 5 - Percentage of children at risk of hearing impairment, from (a) different provinces (b) with different consanguinity of parents and (c) of different age group.

or relatives (7.11%) as compared to the children whose parents were not consanguineous (5.2%, Figure 5). The prevalence of hearing impairment was higher in the children of the age group >4 to 8 years (14.74%) followed by the children >12 years (13.63%) and below 4 years (13.53%). The children in the age group >8 to 12 years showed significantly less hearing impairment (10.94%, Figure 4). The children below 4 years (9.34%) and above 12 years (9.31%) of age showed a higher risk of hearing impairment whereas the risk of hearing impairment in >4 to 8 years and >8 to 12 years groups was found to be 7.51% and 8.04%. (Figure 5).

**Discussion.** The prevalence of hearing impairment observed in the present investigation is comparatively higher than reported by earlier investigators from Saudi Arabia.<sup>11,12,13</sup> Male children showed a higher rate of hearing impairment, this concurs with earlier studies which suggests that male children may have a higher incidence of some of the risk factors associated with hearing impairment.<sup>14,15,16</sup> The higher incidence of hearing impairment shown from the Southern and Western provinces is probably due to several socioeconomic and demographic factors. Lee et al<sup>17</sup> reported a greater risk of bilateral hearing loss in the children living in crowded housing conditions as well as in those whose parents had low educational attainments. The higher incidence of hearing impairment found in the children whose parents were first cousins or relatives may be due to the fact that there is a close association between consanguinity and the incidence of hearing loss as has been reported earlier.<sup>16,18,19</sup> Recently several investigators have suggested the role of inheritance in the development of childhood hearing impairment. Darin et al<sup>8</sup> reported that in 33% of the hearing impaired children the causative factor was hereditary. A hereditary origin was observed in 21% of the children with severe to profound hearing loss.<sup>10</sup> Another recent study also suggested the etiology of hearing loss to be genetic in 40% of the children. Parving and Christensen<sup>9</sup> found that the major factor for permanent hearing loss in Danish children was inheritance. They also observed an increase in inheritance-induced hearing loss from 20% in 1977-1981 to 37% in 1982-1986. The high prevalence of hearing impairment in the children from the Southern province may be attributed to hereditary factors. However, the high prevalence of hearing impairment in children from the Western province may not be explained by consanguinity of parents alone. Moreover the percentage of male children was also less in these 2 provinces, hence male sex alone is not responsible as a sole risk factor for the hearing impairment.

In conclusion, there are several prenatal, perinatal and postnatal risk factors which play an important role in the pathogenesis of hearing impairment.<sup>2,19,22</sup>

<sup>23,24</sup> Further investigations are warranted to identify potential risk factors associated with childhood hearing impairment in Saudi Arabia.

**Acknowledgments.** Thanks to King Abdulaziz City for Science & Technology (KCAST) for financing the main part of this work and the team that worked hard with me, and all of the nurses, technicians, and social workers. Special thanks to the children and parents for their cooperation during the conduct of this work.

## References

- Ross M, Brackett D, Maxon AB. Assessment and management of hearing impaired children: Principles and practices. Austin, TX: Pro-Ed; 1991.
- Leslie GI, Kalaw MB, Bowen JR, Arnold JD. Risk factors for sensorineural hearing loss in extremely premature infants. *J Paediatr Child Health* 1995; 31 (4): 312-316.
- Naeem Z, Newton V. Prevalence of sensorineural hearing loss in Asian children. *Br J Audiol* 1996; 30 (5): 332-339.
- Lyn C, Jadusingh WA, Ashman H, Chen D, Abramson A, Soutar I. Hearing screening in Jamaica: prevalence of otitis media with effusion. *Laryngoscope* 1998; 108 (2): 288-290.
- Minja BM, Machelamba A. Prevalence of otitis media, hearing impairment and cerumen impaction among school children in rural and urban Dar es Salaam, Tanzania. *Int J Pediatr Otorhinolaryngol* 1996; 37 (1): 29-34.
- Jacob A, Rupa V, Job A, Joseph A. Hearing impairment and otitis media in a rural primary school in South India. *Int J Pediatr Otorhinolaryngol* 1997; 39 (2): 133-138.
- Davis A, Wood S, Healy R, Webb H, Rowe S. Risk factors for hearing disorders: epidemiologic evidence of change over time in the UK. *J Am Acad Audiol* 1995; 6(5): 365-370.
- Darin N, Hanner P, Thiringer K. Changes in prevalence, etiology, age at detection and associated disabilities in preschool children with hearing impairment born in Goteborg. *Dev Med Child Neurol* 1997; 39 (12): 797-802.
- Parving A, Christensen B. Epidemiology of permanent hearing impairment in children in relation to costs of a hearing health surveillance program. *Int J Pediatr Otorhinolaryngol* 1996; 34 (1-2): 9-23.
- Baille MF, Arnaud C, Cans C, Grandjean H, du Mazaubrun C, Rumeau-Rouquette C. Prevalence, aetiology, and care of severe and profound hearing loss. *Arch Dis Child* 1996; 75 (2): 129-132.
- Bafaqeeh SA, Zakzouk S, Al Muhaimid H, Essa A. Relevant demographic factors and hearing impairment in Saudi children: epidemiological study. *J Laryngol Otol* 1994; 108: 294-298.
- Zakzouk S, El Sayed Y, Bafaqeeh SA. Consanguinity and hereditary hearing impairment among Saudi population. *Annals of Saudi Medicine* 1993; 13 (5): 447-450.
- Zakzouk S, Hossain A. Hearing impairment among children in Saudi Arabia: familial incidence and potential risk factors. *Int J Pediatr Otorhinolaryngol* 1994; 29: 111-120.
- Ferber-Viart C, Morlet T, Maison S, Duclaux R, Putet G, Dubreuil C. Type of initial brain stem auditory evoked potentials (BAEP) impairment and risk factors in premature infants. *Brain Dev* 1996; 18 (4): 287-293.
- Froom J, Culpepper L, Bridges-Webb C, Bowers P, Stroobant A, Lion J et al. Effect of patient characteristics and disease manifestations on the outcome of acute otitis media at 2 months. *Arch Fam Med* 1993; 2 (8): 841-846. infants. *Brain Dev* 1996; 18 (4): 287-293.
- Zakzouk SM. Epidemiology and etiology of hearing impairment among infants and children in a developing country. Part I. *J Otolaryngol* 1997; 26 (5): 335-344.
- Lee DJ, Gomez-Marin O, Lee HM. Sociodemographic and

- educational correlates of hearing loss in Hispanic children. *Paediatr Perinat Epidemiol* 1997; 11 (3): 333-344.
18. El Sayeed Y, Zakzouk S. Prevalence and etiology of childhood sensorineural hearing loss in Riyadh. *Annals of Saudi Medicine* 1996; 16 (3): 262-265.
  19. Feinmesser M, Tell L, Levi H. Consanguinity among parents of hearing impaired children in relation to ethnic groups in the Jewish population of Jerusalem. *Audiology* 1989; 28 (5): 268-271.
  20. Maxon AB, Bracket D. *The hearing-impaired child: infancy through high school years*. Andover Medical Publishers; USA: 1992.
  21. Sassen ML, Veen S, Schreuder AM, Ens-Dokkum MH, Verloove-Vanhorick SP, Brand R et al. Otitis media, respiratory tract infections and hearing loss in pre-term and low birth weight infants. *Clin Otolaryngol* 1994; 19 (3): 179-184.
  22. Weisglas-Kuperus N, Baerts W, de Graaf MA, van Zanten GA, Sauer PJ. Hearing and language in preschool very low birth weight children. *Int J Pediatr Otorhinolaryngol* 1993; 26 (2): 129-140.
  23. Al Serhani A, Kabiraj M, Al Muhaimid H, Al Essa A, Zakzouk S. Screening of hearing in delayed speech development by auditory brain stem response (A useful sorting test). *Saudi Medical Journal* 1997; 18 (6): 551-553.
  24. Borradori C, Fawer CL, Buclin T, Calame A. Risk factors for sensorineural hearing loss in preterm infants. *Biol Neonate* 1997; 71 (1): 1-10.