





## Factors Of Hearing Impairment Among Saudi Children: A Comparative Epidemiological Study

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### Abstract

**Objective:** To determine and compare the various risk factors for hearing impairment in the four major regions of Saudi Arabia.

**Materials and Methods:** Nine thousand five hundred forty children below the age of 15 were surveyed from the four major provinces of Saudi Arabia. A questionnaire was filled and an ENT examination with audiological assesment were carried out for each child. The various risk factors were studied.

**Results:** Nine thousand, five hundred and forty children were screened. Out of these 13% were hearing impaired and 8% were at risk of hearing impairment. Consanguinous marriages, failure to attend antenatal clinics, abnormal pregnancy and labour, prematurity, lack of immunization, xenthematous diseases and jaundice were the risk factors for hearing impairment, The Western and Southern regions of Saudi Arabia were found to have the highest rate of some of these risk factors.

**Conclusions:** Consanguinous marriages should be discouraged . Attendance of antenatal clinics and immunization should be encouraged through proper health education and counseling programmes.

### Introduction

Hearing impairment (HI) in children is a handicap which should be prevented at all costs. Prelingual deafness usually results in mutism and the child will be living in his own sad world. Congenital deafness have been well investigated, whether occurring during pregnancy, labour or in the neonatal period.[1,2,3,4] On the other hand deafness occurring in early childhood is usually of the conductive type resulting from acute otitis media or otitis media with effusion.[5,6,7]

The most vital need in the management of the deaf child is early diagnosis.

The other important point is to recognize the risk factors and the children who are at risk of hearing impairment.

The objective of this study was to compare and throw more light on the presumable risk factors leading to hearing impairment in children in the four major regions of the Kingdom of Saudi Arabia.

### Material and Methods

A survey of 9540 children of various age group below 15 years of age was carried out primarily to study the prevalence of hearing impairment in children during the period Sept. 1997 to May 2000.

The sample selection was randomly designed, with representation of the children from all the socio-economic and demographic groups. A questionnaire modified from WHO/PDH was prepared and filled by social workers and parents as part of the team comprising an otolaryngologist, audiologist and a nurse. The questionnaire included age, sex consanguinity of parents, pregnancy, labour, exposure to risk factors and immunization. ENT examination and audiological assesment were carried out. Those children with positive family history of hearing loss, abnormal pregnancy, preterm labour , low birth weight, incomplete vaccination, jaundice, meningitis, mumps or measles infection were recorded.

This report is mainly to compare the various risk factors between the four provinces ( Central, Southern, Eastern, and Western) of Saudi Arabia. A random survey of 9540 children representing all socio economic and demographic group were studied. A questionnaire was designed, ENT examination and audiological assesment were done.

### Results

The total number of children screened was 9540 out of which 44% were boys and 56% were girls of variable age. They were divided into four age

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groups; up to 4 years (2054), between 4-8 (3431), >8-12 (3615) and only 440 children were between 12-15 years of age. The male to female distribution is shown in Table I.

The number of children exposed to various prenatal, perinatal and post-natal risk factors is shown in Table II. While Table III and Fig. I show the effect of various risk factors and the association with hearing impairment.

Out of 9540, 1241(13%) were found with hearing impairment and 782 (8%) were at risk of hearing impairment. The prevalence of H.I. was higher in males (13.84%) as compared to females (12.35%), and the rate of at risk is slightly higher in females (8.52%) as compared to males (7.78%). The distribution of H.I. and at risk from the different four provinces are seen on Figures 1,2. The effect of consanguinity of parents and the sex of the children are given in Figures 3,4. The association of various risk factors with hearing impairment and the risk of hearing impairment is shown in Figure 5.

### Discussion

Saudi Arabia is administratively divided into four provinces (Eastern, Central, Southern, and Western).

The western region of Saudi Arabia stretches almost along the entire length of the red sea coast. This region is densely populated and serves a wide catchment area. Its inhabitants are probably mixed races with different consanguinity. As this region is geographically larger than the Eastern region it is expected that its towns and villages are more widely scattered. This may discourage females to attend early and regularly for antenatal care. Such delays may result in proportionately higher numbers of low birth weight neonates who are more susceptible to neonatal jaundice and more liable to contract infectious diseases like measles, mumps, and meningitis as seen in Figure 4. Sensorineural deafness is a well known complication of these xentematous diseases [8,9]. The risk factors of these diseases in compounded by the fact that the majority of hearing impaired children in the Western region did not complete their scheduled vaccination against such diseases, as may be recalled by reference to Figure 4.

The maximum age range of deaf children recorded in this study was 4-12 years. It is noted that the consanguinity was more prevalent in the Eastern and Southern regions. It is interesting to observe that almost one third of the hearing impaired in this part of the Kingdom are siblings of cousin parents. It has been more interesting to observe other congenital syndromes associated with deafness detected in these children. i.e 2 children with distal renal

tubular acidosis (RTA), which is inherited as an autosomal recessive syndrome, two with rubella syndrome congenital cataract, heart and hearing loss and one with albinism and sensorineural hearing loss. The risk factor of consanguineous marriage as a cause of deafness has been repeatedly reported by other workers [10]. Such consanguineous marriages in the Eastern and Southern regions have resulted not only in a higher proportion of deaf children, but also in a higher percentage of children with allergic rhinitis as compared to those from the Western and Central regions. Nasal allergy has been claimed as a predisposing factor in the formation of otitis media with effusion [11]. This fact is well illustrated in the present study where we noticed that otitis media with effusion as well as suppurative otitis media are more prevalent in hearing impaired children in the Eastern region. This is in agreement with Ashoor [12] who reported similar observations from the same region of Saudi Arabia. Moreover, nasal allergy predisposes to tubotympanic type of chronic suppurative otitis media (C.S.O.M.) resulting in higher percentage of children with drum perforations and hearing loss. Our study showed the following risk factors.

### Abnormal Pregnancy

Abnormal pregnancy of mothers e.g. toxemia, infection with TORCH, Diabetes etc. was found to be an important risk factor for hearing impairment with the odd ratio of 2.41 for hearing impairment (Table II). The frequency of hearing impairment was significantly higher (21.13%) in the children whose mothers were exposed to this risk factor as compared to children whose mothers were not exposed (7.65%) Figure 5.

There were 2.26% male children as compared to 4.14% female children whose mothers faced abnormal pregnancy (Figure 4). The frequency of abnormal pregnancy was maximum in the Western province (5.69%) followed by the Southern province (2.70%). The number of abnormal pregnancies was comparatively less in Central (1.34%) and Eastern province (1.08%). However, the consanguinity of parents was not found to have any significant effect on abnormal pregnancy. (Figure 3)

### Antenatal care attendance

The children whose mothers did not attend antenatal care showed significantly higher incidence of hearing impairment (19.62% vs. 12.14%) and the risk of hearing impairment (9.5% vs. 7.9%) as compared to the children whose mothers received due antenatal care (Figure 5). The odd ratios for hearing impaired and at risk children were 1.82 and 1.34 respectively.

Table - I

Detail of subjects about their sex, age category, region the consanguinity of parents

TOTAL SUBJECTS			
Subjects	MALE Number (%)	FEMALE Number (%)	TOTAL
Total Number	4189 (43.91)	5351 (56.09)	9540
AGE CATEGORY			
Up to 4 Years	1108 (53.94)	956 (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	811 (8.41)	359 (81.59)	440
REGION (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

Table - II

Effect of various risk factor on the outcome of hearing impairment

RISK FACTOR	EXPOSED		UNEXPOSED		X <sup>2</sup>	ODD RATIO	P VALUE
	Normal	Hearing Impairment	Normal	Hearing Impairment			
HI in Parents	74	240	8051	851	1293.23	30	****
HI in Family	152	73	7963	1116	78.20	3.43	****
No Antenatal care	254	62	7783	1076	15.01	1.77	***
Abnormal Pregnancy	250	67	8049	1174	18.40	1.84	***
Abnormal Lomber	180	44	8119	1197	8.33	1.66	**
Preterm Birth	106	24	1538	212	3.88	1.64	*
Low Birth Weight	349	61	3631	394	9.92	1.61	**
Incomplete Vaccination	206	48	8093	1193	7.47	1.58	**
Speech Abnormality	40	66	8257	1175	225.37	11.59	****
Jaundice	256	51	8043	1190	3.32	1.35	*
Meningitis	16	7	8283	1234	4.74	2.94	**
Mumps	45	8	8254	1233	0.06	1.19	NS
Measles	71	12	8228	1229	0.05	1.13	NS

\* p<0.05, \*\* p<0.001, \*\*\* p<0.0001 and \*\*\*\* p<0.00001  
using X<sup>2</sup> test, NS = Not Significant, HI= Hearing Impairment.

Table - III

Association between various risk factors and the number of children  
at risk of hearing impairment

RISK FAKTOR	EXPOSED		UNEXPOSED		ODD RATIO	P VALUE
	NORMAL	AT RISK	NORMAL	AT RISK		
Abnomal Pregnancy	174	76	7343	706	4.54	**
Not Attend	224	30	7075	708	1.34	NS
Abnormal Laboue	130	50	7387	732	3.88	**
Hearing Impairment	62	12	7310	741	1.91	*
High in Family	95	57	7254	709	6.14	**
Speech Abnormality	22	18	7493	764	8.02	**
Premature	34	72	1431	107	28.32	**
Low Birth Weight	121	228	3349	282	22.38	***
Jaundice	180	76	7337	706	4.39	**
Meningitis	13	3	7504	779	2.22	NS
Mumps	13	32	7504	750	24.63	**
Measles	26	45	7491	737	17.59	**
Vaccination not Completed	182	24	7335	758	1.24	NS

\*  $p < 0.05$  and \*\*  $p < 0.00001$  using X2 test, NS = Not Significant

A large number of children (9.66%) whose mothers were lacking the antenatal care for their children were from the Southern province (Figure 2). From the Western province 3.13% of children did not receive due antenatal care whereas for central and Eastern provinces this figure was 2.26% and 0.46% respectively. The children whose parents were first cousins faced maximum neglect in antenatal care (5.19%) as compared to the children whose parents were relatives (3.18%) or not related (2.81%). There was high frequency of female children (8.83%) as compared to male children (4.96%) whose mothers did not attend antenatal care. (Figure 4)

#### Abnormal Labour

Abnormal labour e.g. malpresentation, prolonged labour, prolapsed cord, ventore delivery etc. was found as a risk factor. The odd ratios of abnormal labour for hearing impairment and the risk of hearing impairment were found to be 2.09 and 3.88 respectively (Tables II & III). There was significantly high incidence of hearing impairment (19.64% vs. 12.84%) and the risk of hearing impairment (22.32% vs. 7.85%) in the children whose mothers were exposed to this risk factor (Figure 5).

The frequency of abnormal labour from different provinces were as follows, Western (3.32%), central (1.92%), Southern (1.06%), and Eastern (0.77%) as shown in Figure 2. The children with first cousin parents (1.49%) relatives (1.64%) faced comparatively less incidence of abnormal labour than the couples who were not related earlier (2.59%). There were 2.87% female children and 1.67% male children whose mothers faced abnormal labour (Figure 4).

#### Prematurity

There was significantly higher incidence of hearing impairment (18.46%) as well as the risk of hearing impairment (55.38%) in the children born premature as compared to the children who were not exposed to this risk factor. The hearing impairment and the risk of hearing impairment were 12.11% and 6.11% respectively in the children born full term (Figure 5). The odd ratios for hearing impairment and at risk of impairment in the children exposed to premature birth were found to be 4.76% and 28.32 respectively (Tables II & III). The maximum number of premature births were reported from the Western province (1.75%) whereas only 0.15% of children born premature in the Eastern province. The percentage of pre-term births from Central and Southern provinces were found to be 1.25% and 0.96% respectively (Figure 2). The frequency of pre-term births were slightly

higher in the cases whose parents were not related (59%) as compared to the children whose parents were either cousins (1.38%) or relatives (0.78%). There was no difference in the number of male and female children born pre-term (Figure 4).

#### Low birth weight

The children with low birth weight (<2500g) had comparatively higher frequency of hearing impairment (14.87% vs. 9.78%) and they were at high risk of hearing impairment (55.60% vs. 7.00%) as compared to the children with birth weight of >2500 g (Figure 6). The odd ratios for hearing impairment and at risk children exposed to low birth weight were 4.29 and 22.38 respectively (Tables II & III).

There were 4% low birth weight children and 42% normal birth weight children, whereas 54% cases were undecided.

#### Jaundice

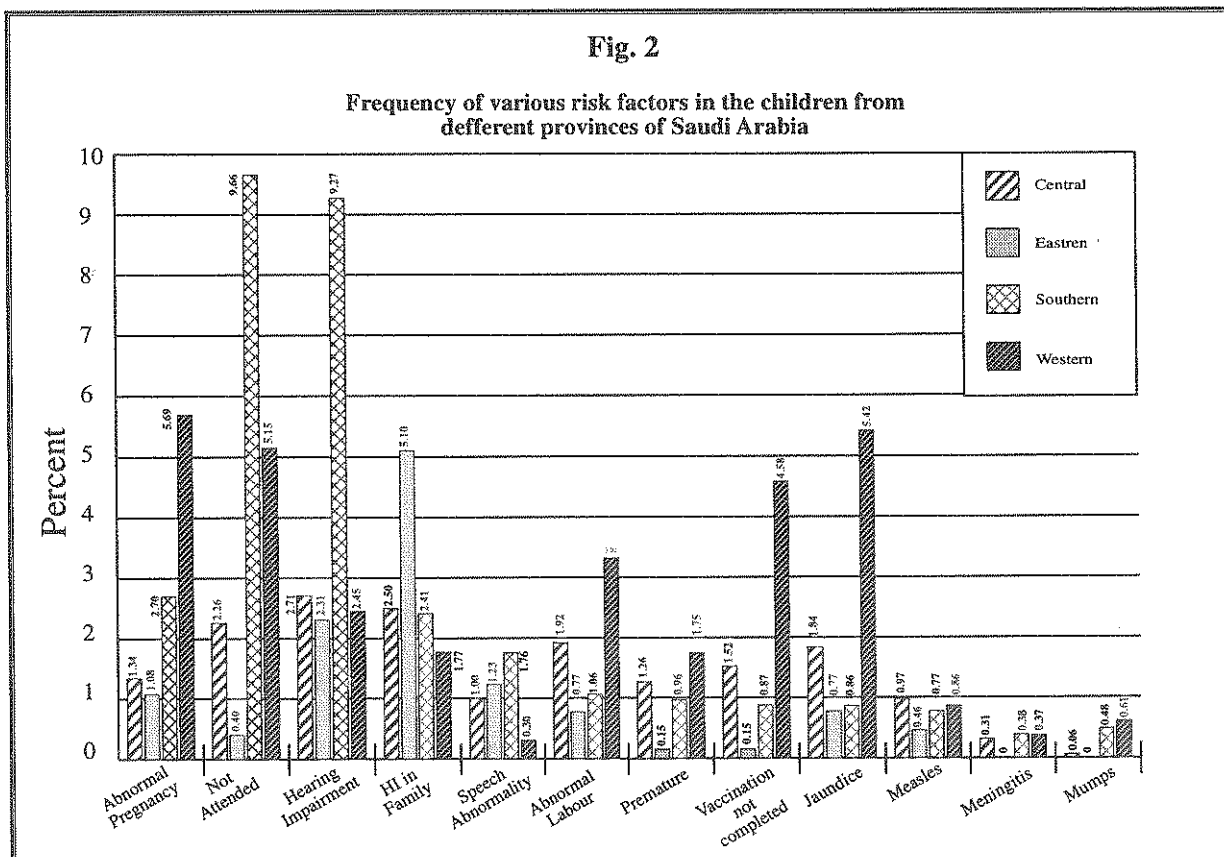
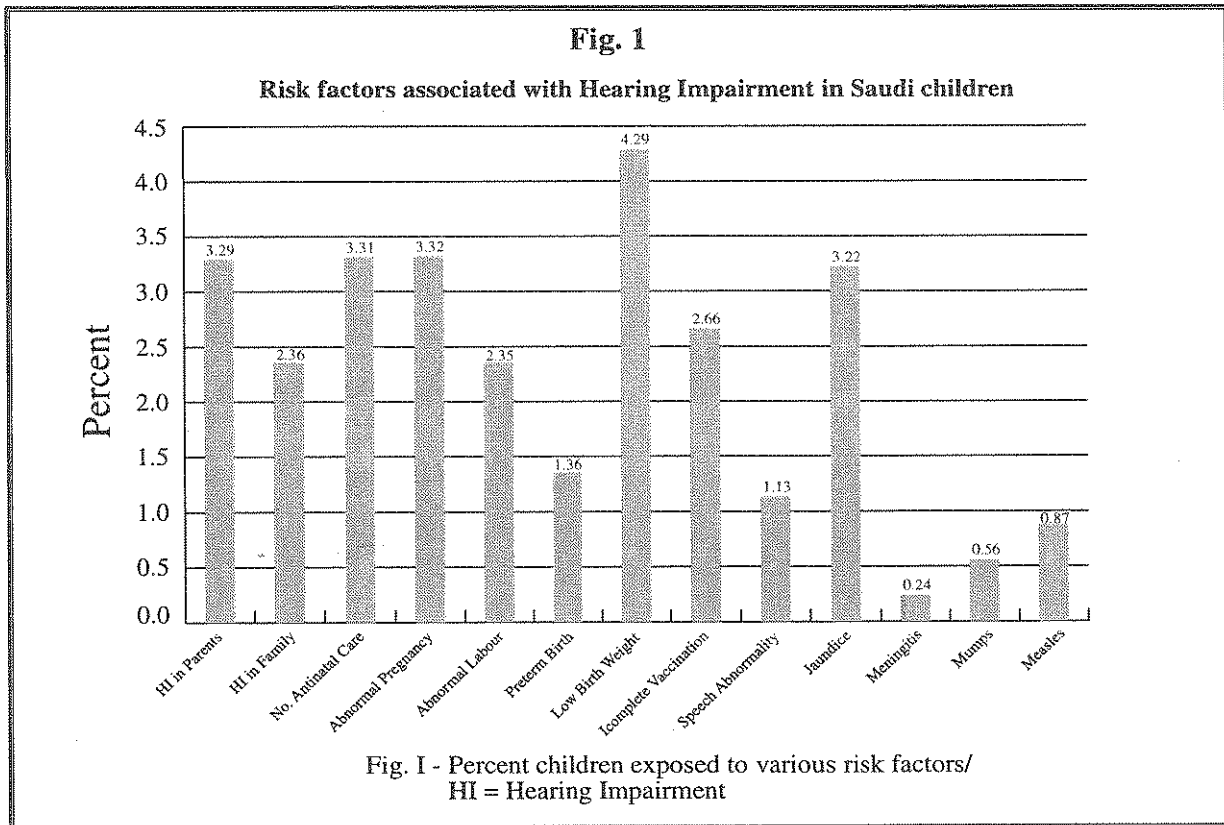
A total of 16.6% of the children suffered with hearing impairment following exposure to jaundice as compared to 12.88% of the children who had hearing impairment without exposure to jaundice (odd ratio, 1.75). The frequency of at risk children with exposure to jaundice was also significantly higher (24.75%) as compared to unexposed children (7.64%) with the odd ration of 4.39.

A large number of children from the Western province (5.49%) suffered from jaundice as compared to the children from other provinces, Central (1.84%), Eastern (0.77%) and Southern (0.86%). The frequency of jaundice was also found to be higher in the children whose parents were not related (3.94%) as compared to the children whose parents were either cousins (1.88%) or relatives (2.69%). Moreover, female children had comparatively higher frequency of jaundice (3.75%) than male children (2.53%).

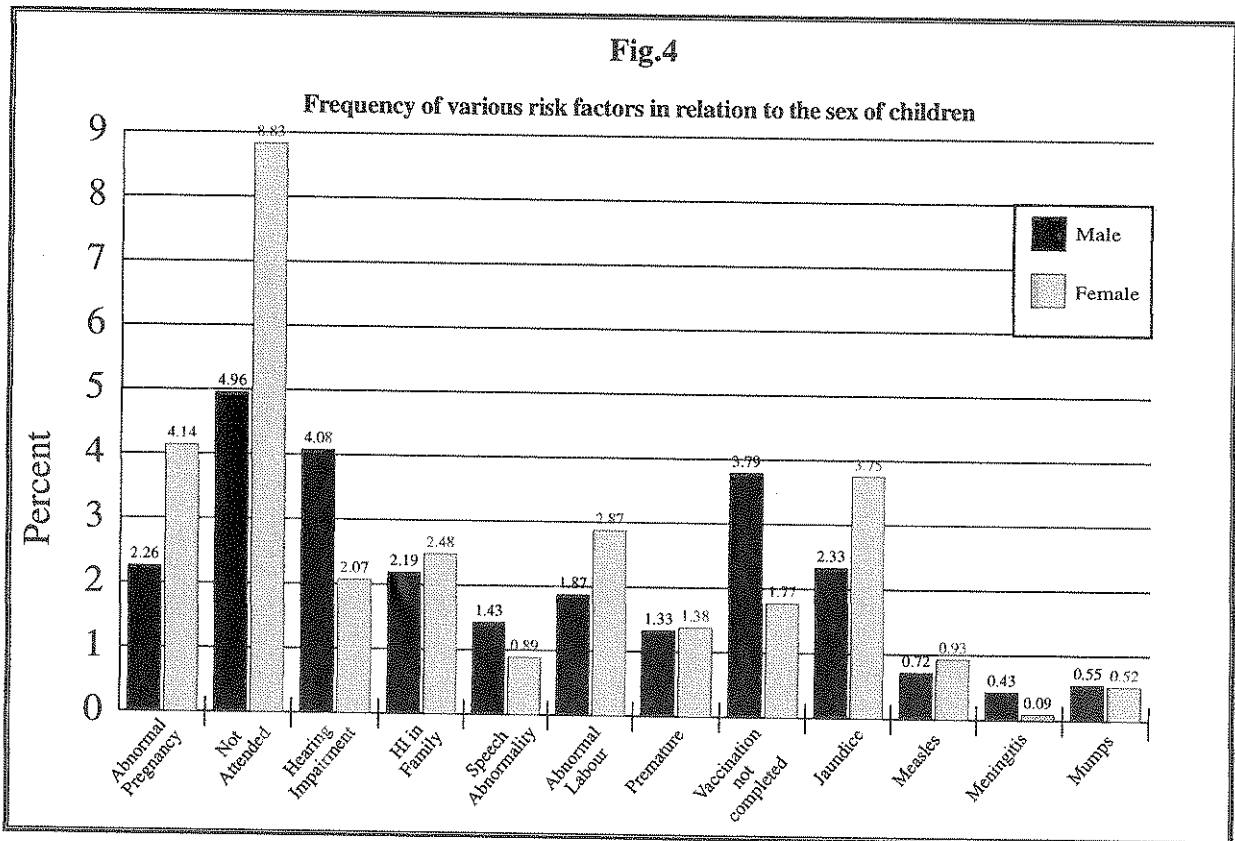
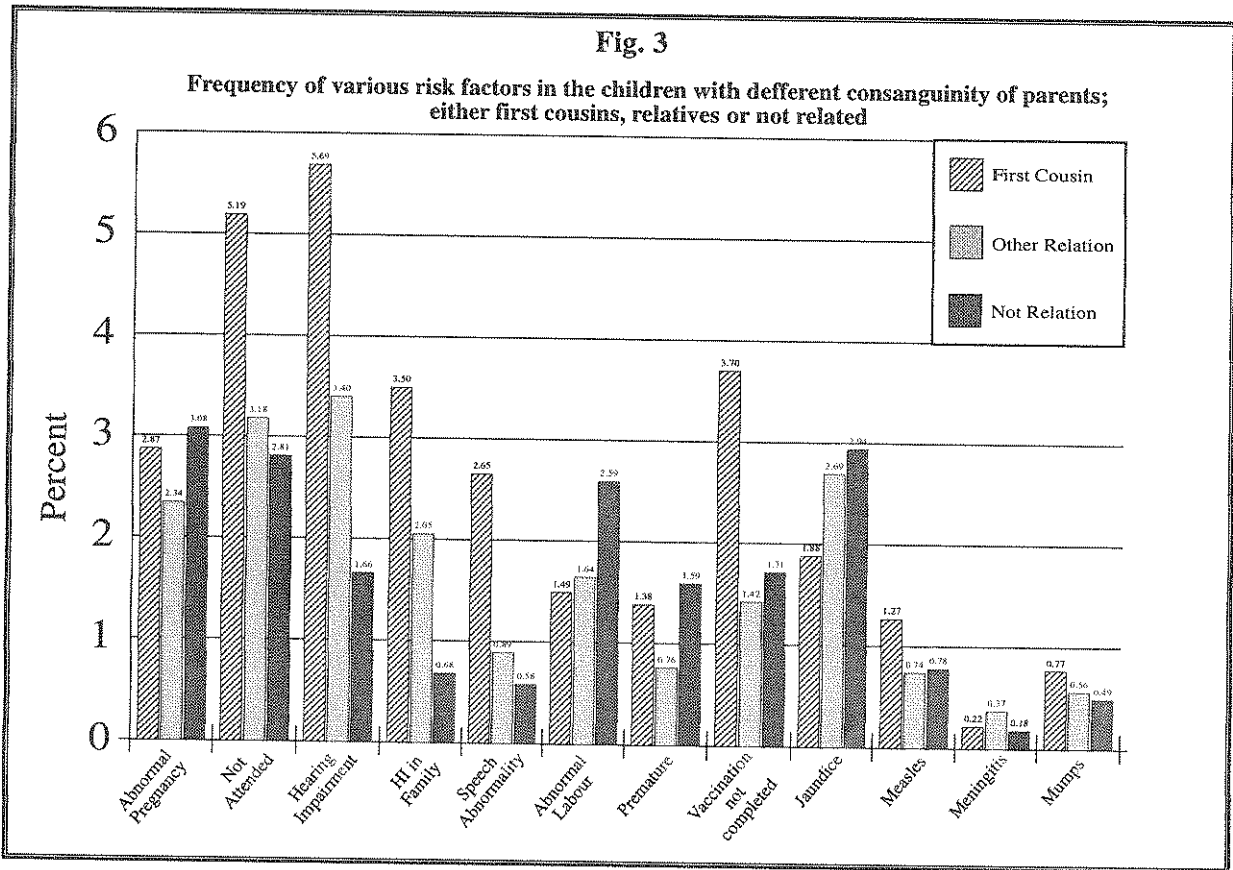
#### Meningitis

There was significantly higher incidence of hearing impairment in the children exposed to meningitis (30.43%) as compared to the hearing impairment in unexposed children (12.96%) with the odd ratio of 3.27 (Table II, Figure 5). In at risk group, 13.04% children were exposed to meningitis as compared to 8.18% at risk children without exposure to meningitis (odd ratio, 2.22).

There were only 23 cases of meningitis in this study. The prevalence of meningitis in the children from the Southern province (0.38%) was comparatively higher than the Central (0.31%) and Western province (0.17%), whereas none of the children had meningitis from the Eastern province (Figure 2). The frequency of meningitis was 0.37% in the







children whose parents were relatives, followed by the children whose parents were cousins (0.22%) or not related (0.18%). Male subjects were more susceptible to meningitis (0.42%) than females (0.093%).

### Mumps

The children who were exposed to mumps had significantly higher incidence of hearing impairment (15.09%) as well as were at high risk of hearing impairment (60.37%) as compared to unexposed children who had a frequency of 12.9% of hearing impairment and 7.90% of at risk of impairment (Figure 5). The odd ratios for hearing impaired and at risk groups exposed to mumps were found to be 3.75 and 24.63 respectively (Tables II & III).

There was no case of mumps from the Eastern province, whereas in other provinces the prevalence of mumps was as follows: central (0.6%), Southern (0.48%) and Western (0.61%). The prevalence of mumps was higher in the children whose parents were cousins (0.77%) as compared to the children whose parents were relatives (0.56%) followed by the children whose parents were not related (0.49%). There were only slight differences between the prevalence of mumps in males (0.596%) and females (0.523%).

### Measles

The hearing impairment was significantly higher in the children exposed to measles (14.45%) as compared to hearing impairment in unexposed children (12.9%) with odd ratio of 2.81% (figure 5, table 2). The exposure to measles was also significantly associated with the risk of hearing impairment in the children, as 54.21% of a risk children had exposure to measles as compared to 7.76% at risk children without exposure of this risk factor (odd ratio 17.59, Table III).

The prevalence of measles in the children from different provinces was as follows: central (0.97%), eastern (0.46%), southern (0.77%), and western (0.86%). Moreover the children whose parent were relatives (0.74%) or not related (0.78%). Female children had slightly higher (0.93%) prevalence of measles than male subjects (0.78%).

### Hearing Impairment History

A significantly higher number (76.43%) of the children with history of hearing impairment were found to be hearing impaired as compared to the percentage of hearing impaired children without earlier history of hearing impairment (9.55%) with the odd ratio of 33.25 (table 2). The risk of hearing impairment was also significantly higher in the children with earlier exposure of hearing impair-

ment (odd ratio 1.91, Table III).

The maximum number of cases with earlier history of hearing impairment were from the Southern province (9.27%) as compared to the children with history of hearing impairment from other provinces (ranging 2.31-2.71%). The history of hearing impairment was markedly higher in the children whose parents were not related (1.66%). The number of cases with hearing impairment history were higher in male group (4.08%) as compared to female children (2.67%) as shown in Figure 4.

### Family History of Hearing impairment

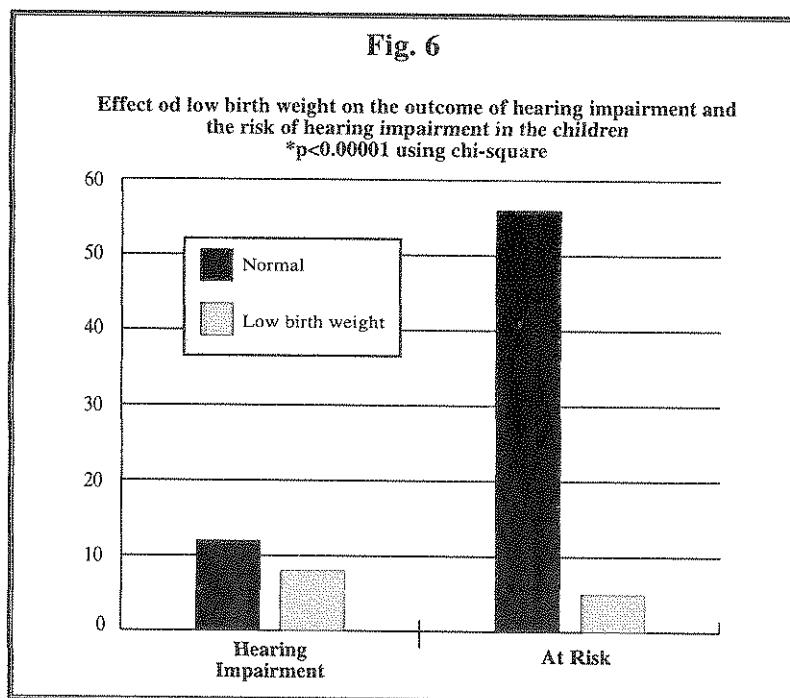
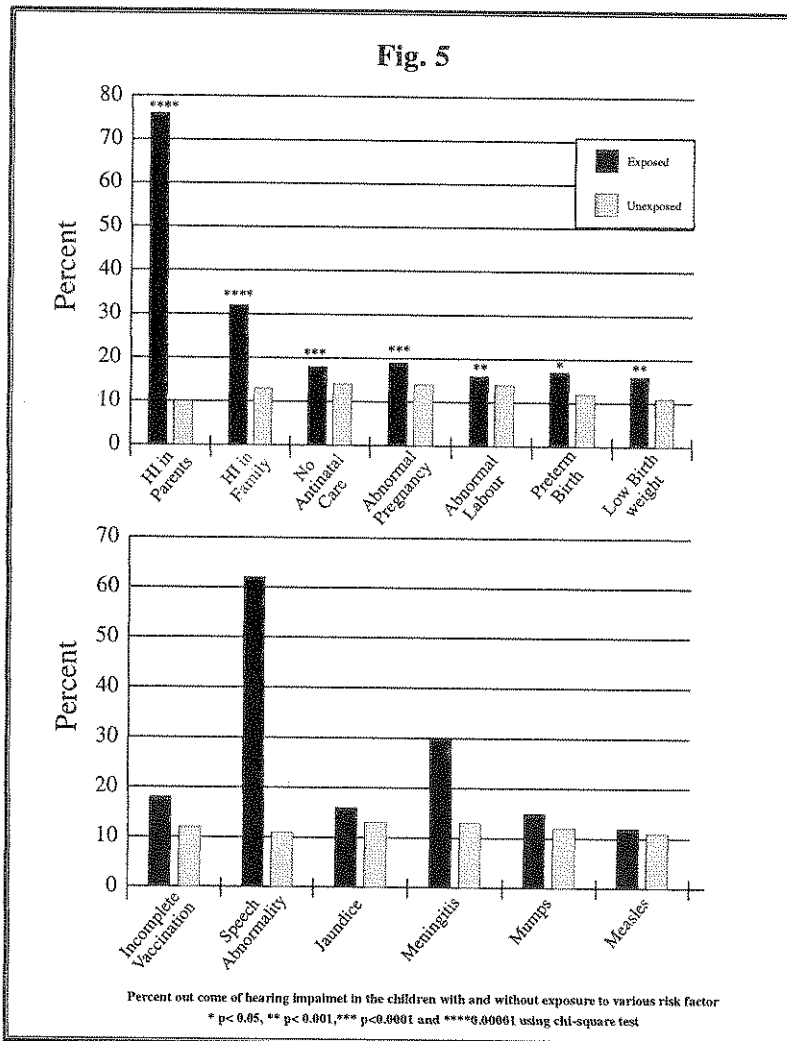
There was significantly higher incidence of hearing impairment (32.44%) in the children whose family had a history of hearing impairment compared to the children whose family has a history of hearing impairment compared to the children whose family had no history of hearing impairment (12.29%). The risk of hearing impairment was also significantly higher (25.33% vs. 7.80%) in the children exposed to this risk factor (Figure 5). The odd ratios for hearing impairment and at risk condition were found to be 4.99 and 6.14 respectively (Tables II & III).

The percentage of children from different provinces whose family had a history of high hearing impairment were as follows: Central (2.5%), Eastern (5.1%), Southern (2.41%) and Western (1.77%). The children whose parents were first cousins were found to have high rate of hearing impairment history in the family (3.59%) as compared to the children whose parents were relatives (2.05%) or not related (1.68%). There were 2.48% females from high in family group as compared to 2.19% male children (Figure 4).

### Speech abnormality

Speech abnormality was found to be significantly associated with hearing impairment, as the incidence of hearing impairment was 61.11% and 12.45% in exposed and unexposed children respectively (Figure 5). The risk of hearing impairment was also significantly higher in the children exposed to this risk factor (16.66%) as compared to unexposed children (8.10%). The odd ratios for hearing impairment and the risk of impairment in relation to speech abnormality were found to be 19.13 and 8.02 respectively (Tables II & III).

Speech abnormality was much higher in the children from the Southern province (3.76%) as compared to Central (1%), Eastern (1.23%) and Western (0.56%) provinces. The children whose parents were cousins had a high incidence of speech abnormality (2.65%) as compared to the children whose parents were relatives (0.89%) or



not related (0.58%). Speech abnormality was higher in male children (1.43%) than female children (0.89%).

### Conclusions

Consanguineous marriage is a social problem in the Kingdom of Saudi Arabia. Although its consequences are well known to people, but still over 40% of the population are practicing it. Health education, counseling before marriage and education through media may help in reducing this customs.

Antenatal care attendance and delivery in hospitals will reduce pregnancy and labour complications and hence hearing loss of the infants.

Immunization of all children should be stressed upon and health services should reach the rural area and encourage parents to follow up this.

Failure to attend antenatal care, incomplete immunization with the susceptibility to infection that cause hearing impairment are seen more in the Western region while consanguineous marriage are more practiced in the Eastern and Eouthern provinces. Female gender are more affected in the Western region. Proper antenatal care, immunization and health education etc. can minimize the effect and prevent hearing impairment.

### Acknowledgment

Our thanks to King Abdulaziz City for Science & Technology (KCAST) for financing the main part of this work. We also thank all the doctors, nurses, technicians and social workers who took part in this project. Our special thanks go to the children and parents for their cooperation and help.

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