HEARING LOSS IN IRAQI DIVERS

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ABSTRACT

Background: Ear problems, particularly hearing loss, in divers are well known and documented all over the world. Studies showed that they form the most common health problems among divers. However, it seems that this problem has never been investigated in the Iraqi divers population.

Aim: This cross-sectional comparative study is an attempt aims to contribute to the better understanding of the extent and impact of the problem among the local divers and to relate certain risk factors associated with diving.

Subjects & Methods: One hundred and eleven divers and 222 non-divers were interviewed regarding this problem and examined audiometerically.

Results showed that 45% of the studied divers complained of some sort of ear problems. In a considerable number of them the problem is serious. Audiometerically, about 50.5% of divers have some degree of hearing loss. There was a significant difference in the prevalence of hearing loss in divers as compared to non-divers. Furthermore, hearing loss problem among divers was more severe than in non-divers and it was mostly bilateral. High frequencies are the ones affected more.

The role of certain proposed risk factors was studied with few conclusive findings; these are the association between hearing loss and underwater blast, maximum depth, duration of profession and underwater diving accidents.

Further studies and regular check-ups are strongly recommended.

INTRODUCTION

Diving is an occupation in which divers are exposed to physical, chemical, biological, and psychological hazards. Ear problems are the most common of all occupational diseases of diving[1], and deafness is perhaps one of the most common ear problems encountered in diving[2]. Zannini and Marroni reviewed 10 years records of obligatory annual medical check-up of 100 professional divers and reported that hearing problems were encountered in 47% of divers checked[3]. Decrements in auditory function were observed to low and high frequencies[4], and the deafness was related to the length of the occupational career as a diver[5].

Hearing loss encountered in diving is classified into three types:

1. Conductive hearing loss, which results from dysfunction of any component of the sound conduction system such as obstruction of the external auditory canal (2) or the middle ear cleft disorder and/or tympanic membrane perforation such as that associated with middle ear barotrauma[6].
2. Sensorineural or nerve hearing loss results from dysfunction in the inner ear, auditory nerve, or brain stem cochlear nuclei. Such dysfunction can result from exposure to noise[7], occlusion of the cochlear blood supply with ischemia, and mechanical disruption of inner ear or brain stem structures from trauma or bubbles resulting from decompression sickness[8], and inner ear barotrauma[9].
3. Mixed or combined conductive sensorineural hearing losses result from simultaneous dysfunction in the middle and inner ears, such as that occurring in coexisting middle and inner ear barotrauma[10].

It seems that such a problem has not been investigated in the Iraqi divers population. Therefore, this cross-sectional comparative study is a primary attempt to determine the extent and impact of the problem of hearing loss in Iraqi professional divers and to relate hearing loss to certain risk factors associated with diving.

SUBJECTS AND METHODS

Subjects:

The study population included 111 professional divers from the Iraqi Navy as a study group and other 222 military non-divers personnel chosen randomly from the Iraqi Navy too, as a comparative group.

Methods:

Interviewing of the subjects according to a questionnaire form which covers the following

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aspects: sociodemographic characteristics, professional history of the diver, history of risk factors that can influence the auditory system, and the presence of ear complaint, its duration, severity, and the aggravating and relieving factors for divers only.

Audiometry was performed using ***"Diagnostic Audiometer TA 155"***. The examination was performed in a quiet and isolated room. Calibration was carried out according to another audiometer under the supervision of a skilled technician.

RESULTS

Table-1 shows the distribution of divers and comparison group according to age, years of service and residence. Both groups had the same age and years of service distribution reflecting the process of matching which was adopted during sampling. The mean age for both groups was 29.02±6.73 years. The majority (82%) were <34 years of age. Nearly two thirds (67.6%) of both groups were from rural areas, whereas 32.4% were from urban areas.

Table 1. ***Distribution of divers and comparison group according to age & years of service.***

Character	Divers (n=111)			Comparison group (n=222)		
	Mean ±SD	*No.*	*%*	*Mean ±SD*	*No.*	*%*
Age (years)						
19 - 33	29.02	91	82.0	29.02 ±6.73	182	82.0
34 – 53	±6.73	20	18.0	-	40	18.0
Years of service						
≤15		102	91.9	-	204	91.9
16+		9	8.10	-	18	8.10
Residence						
Urban		36	32.4	-	72	32.4
Rural		75	67.6	-	150	67.6

Table-2 shows the distribution of the two groups according to different ear complaints. Of the divers, 45% reported some sort of ear complaints compared to 12.2% of the comparison group with a significant statistical difference (P<0.01). The most frequently reported complaint in divers was earache (50%), followed by fullness sensation (44%) and tinnitus (42%) In the comparison group, tinnitus was the main complaint (48.1%).

Table 2. ***Distribution of divers & comparison group according to the presence of ear complaint and the frequency of complaints.***

Category	Divers (n=111)			Comparison group (n=222)		
	No.	***% out of complaining***	***% out of total***	***No.***	***%out of complaining***	***% out of total***
Non-complaining	**61**	**-**	**55.0**	**195**	**-**	**87.8**
Complaining	**50**	**-**	**45.0**	**27**	**-**	**12.2**
-Earache	**25**	**50.0**	**-**	**12**	**44.4**	**-**
-Fullness	**22**	**44.0**	**-**	**0**	**0**	**-**
-Tinnitus	**21**	**42.0**	**-**	**2**	**48.1**	**-**
-Hearing loss	**16**	**32.0**	**-**	**-**	**7.4**	**-**
-Discharge	**6**	**12.0**	**-**	**-**	**-**	**-**
-Excessive wax	**1**	**2.0**	**-**	**-**	**-**	**-**
-Pain or itching in the external ear	**0**	**0**	**-**	**-**	**-**	**-**
-Vertigo	**0**	**0**	**0**	**0**	**0**	**0**

In Table-3, the extent of hearing loss among the study groups is illustrated. The presence of hearing loss was based on two methods; either as reported by the studied individuals themselves, or as measured by audiometer. Regarding self-reporting, 16(14.41) divers complained of hearing loss compared to 2 (0.9%) of the comparison group. According to

audiometeric assessment, 56 (50.5%) of divers and 24 (10.8%) of the comparison group were found to suffer from some degree of hearing loss. The extent of such hearing loss was significantly higher in divers (P<0.01) than in the comparison group. The table shows clearly that self-reporting was not sensitive in detecting hearing loss but very specific in excluding such problem and had a reasonable predictive power (see underneath table-3).

Table 3. ***Distribution of divers & comparison group according to measured against reported hearing loss.***

Measurement hearing loss / Reported HL	Divers (n=111)			Comparison group (n=222)			Total (n=333)	
	+	-	*Total*	+	-	*Total*	+	-
Present	12	4	16 (14.4%)	2	0	2 (0.9%)	14	4
Absent	44	51	95 (85.6%)	22	198	220 (99.1%)	66	249
Total No.	56	55	111	24	198	222	80	253
%	50.5	49.5	100	10.8	89.2	100	24	76
SND= 7.94	P<0.01							
Sensitivity	21.4%		8.3%		17.5%			
Specificity	92.7%		100%		98.4%			
Predictive value	75%		100%		77.8%			

Table-4 illustrates the distribution of hearing frequencies involved. The results showed that the high frequencies (4000,8000 Hz) and to less extent the low frequency (250 Hz) were more likely to be affected than middle frequencies (500-2000 Hz) in both divers and comparison groups. However, in divers all frequencies were affected as compared to comparison group and the percentage of the affected high frequencies (4000, 8000 Hz) in divers (68.9%) was more than that in the non-divers group (40.5%) with a significant statistical difference (P<0.05). With respect to the site affected, both ears were nearly equally affected in divers while in the comparison group the right ear was more likely to be affected.

Table 4. ***Distribution of frequencies affected in divers and comparison group according to the site.***

Frequency	Divers			Comparison group		
	Lt ear	*Rt ear*	*Total*	*Lt ear*	*Rt ear*	*Total*
250	9	11	20 (11.3%)	6	12	18 (42.8%)
500	7	6	13 (7.3%)	-	7	7 (16.7%)
1000	3	6	9 (5.2%)	-	-	-
2000	7	6	13 (7.3%)	-	-	-
4000	29	25	54 (30.5%)	4	6	10 (23.8%)
8000	32	36	68 (38.4%)	4	3	7 (16.7%)
Total	87 (49.2%)	90 (50.8%)	177 (100%)	14 (33.3%)	28 (66.7%)	42 (100%)

The association of audiometrically determined hearing loss and selected risk factors was examined as shown in Table-5. Underwater blast, maximum depth of diving, and duration of service seem to affect measured hearing loss more clearly than frequency of diving or underwater accident. This effect was quantified by calculating the odds ratio that ranged from 4.154 in underwater blast to 0.769 in case of most frequent time spent underwater/single dive. However, these associations were found to be statistically not significant.

Table 5. ***Relation between hearing loss in divers and selected risk factors.***

Risk factor	Hearing loss		Total
	Present No. %	*Absent* No. %	
Maximum depth (m)			
< *20*	6 (10.7)	12(21.8)	18
20+	50 (89.3)	43 (78.2)	83
Most frequent time(hr)			
≤ 2	52 (92.9)	50 (90.9)	102
2.1+	4 (7.10)	5 (9.1)	9
Underwater blast			
-Absent or rare	52 (92.8)	54 (98.2)	106
-Common	4 (7.20)	1 (1.8)	5
Diving accident	26 (46.4)	30 (54.5)	56
-Absent	30 (53.6)	25 (45.5)	55
-Present			
Duration of service (yr)			
< 10	23(41.1)	28 (50.9)	51
10+	33(58.9)	27 (49.1)	60
Total	56	55	111

*For the maximum depth association: OR=2.326, X^2=1.76712, DF=1, P>0.05
*For the most frequent time association: OR=0.769, X^2=0.001407, DF=1, P>0.05
*For underwater blast association: OR=4.154, SND=1.352359, P>0.05
*For the diving accident association: OR=1.38, X^2=0.4426505.DF=1, P>0.05
*For the duration of service association: OR=1.48, X^2=0.7214423, DF=1, P>0.05

DISCUSSION

Since this study is surveying the relation between diving and hearing loss, it was obligatory to exclude those who gave a history of other risk factors that can contribute to auditory problems (18 divers). The comparison non-divers group had to be individuals selected from a population similar, as much as possible, to the divers population and does not differ from it except in diving practice. Therefore, they were chosen from the same unit with a total number double that of divers. The two groups were matched to age, years of service, and residence. The problems of memory, awareness, and mood of the study individuals could be a source of bias. Blindness in this study was not possible, but the interviewer did his best to remain unbiased throughout interviewing as well as in examining all the subjects in the same way. Calibration of the instrument was done according to another available audiometer under the supervision of a skilled technician. The divers population in Iraqi Navy is mainly composed of young adults (82%) of them were < 34 years of age. This may help in avoiding the effect of age as a confounding factor for hearing loss. The statistically significant difference in the percentage of presence of ear problem complaints with a diver/non diver ratio of 3.7 reflects how common ear problems among divers are, which can be attributed to the diving practice. This goes with the results of other studies[11,12]. This fact is ascertained by the more variability of symptoms among divers as compared to the comparison group. However, the absence of complaining of vertigo may point to a fact that despite the prevalence of ear problems in divers, their vestibular system had remained away from damage. This is not consistent with Reissman et al[13], who reported that vertigo is relatively common after diving which may be the result of changes in pressure or because of the possibility of the involvement of the vestibular system by the damage that may occur due to exposure of the inner ear to diving risk factors. Whereas the literatures mentioned that external ear infection is one of the most common and troublesome infections in divers[10], none of the interviewed divers had complained of symptoms of otitis externa. It is clear that there was a significant statistical difference in the prevalence of hearing loss as reported and that measured audiometerically. This difference may be explained by the fact that reporting hearing loss means problems in copping with the environmental sounds, mainly speech sounds. While in the audiometeric method it refers to any hearing threshold more than 25 DB even in a single frequency[2]. It was

noted that there was a wide distribution of frequencies affected in divers. This goes with the findings of Dembert et al[4] who found that there was a decrement in the auditory function of divers in comparison to non-divers that include both low and high frequencies. Furthermore, high frequencies tended to be affected more in comparison with both low frequencies in the same group and to high frequencies in the comparison group. This is consistent with the results of other studies, which found that diving is associated more with high frequency hearing loss[14,15]. The difference between the affection of left and right ears seen in the comparison group was not seen in divers where both ears were nearly equally affected. This can be explained as that diving exerts an equal stress on both ears. Many risk factors were found to be associated with hearing loss such as the frequent exposure to underwater blast (OR=4.154), maximum depth reached by the divers (OR=2.326), duration of service (OR=1.48), and underwater diving accident (OR=1.38). These results are in agreement with the findings of Zannini and Marroni[3] and Ohgaki[5], et al who reported that deafness is related to the length of the occupational career of diving. However, these associations were found not to be statistically significant, this probably due to the small number of divers. The most frequent underwater time/dive, which points to periods of exposure to underwater noise while carrying out usual tasks, seemed to be not associated with hearing loss. This possibly means that either time is not the suitable indicator of exposure to underwater noise, or Iraqi divers are not being exposed to sufficient underwater noise that can be associated with hearing loss.

In conclusion, there is a clear decrement in hearing in divers that can be attributed to the diving activity and it can arrow to be a permanent damage. A wide spectrum of hearing frequencies are affected, particularly the high frequencies are the more involved. This hearing loss usually tends to be bilateral and it is usually associated with increasing years of diving profession especially if there are underwater blasts or accidents. Since hearing loss associated with diving is not preventable, attempts must focus on reducing its extent and impact. Establishment of annual check-up programs can achieve this. Also, ear complaints by divers must be considered seriously by both the divers and the supervising physician and applying the agreed upon criteria for non-diving.

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