

Abstract

Relationship between the Use of Mobile Phones and  
Hearing Thresholds in Some White-collar Workers

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**Objectives:** The purpose of this study was to investigate the relationship between the use of mobile phones and the levels of hearing thresholds in some clerical workers.

**Methods:** Questionnaires were administered to 450 clerical workers between May and August 2000. The questionnaire included items concerning socio-demographic profile and noise-exposure history as well as use of mobile phone. The number of workers used in the final analysis was 394 (Response rate 87.6%). Males numbered 308 and females 86. Hearing thresholds were measured in both ears using a pure-tone audiometer.

**Results:** In a univariate analysis, the duration and time of mobile phone use per day were significant in regards to hearing threshold at 1000Hz in males ( $p < 0.05$ ). In a linear regression analysis with adjustment for age, education, military service, use of earphone, the group that used mobile phones for more than 49 months was more likely to have low hearing threshold at 1000Hz and 4000Hz in males ( $p < 0.05$ ) as compared to the reference group (30). Use of a mobile phone for more than 60 minutes had a significant relation to hearing thresholds at 1000Hz in males ( $p < 0.05$ ). However, in univariate and adjusted linear regression analyses, none of the mobile phone related variables were significant in females.

**Conclusions:** These results suggested that only certain elements of use of a mobile phone may be associated with hearing thresholds and there is a complex relationship between the use of mobile phone and hearing thresholds that may differ in terms of frequency (1000Hz and 4000Hz) and gender.

**Key Words :** Mobile Phone, Hearing Thresholds

70dB 68dB  
(2001)

가 70dB

가 2001 1  
2,674 56.6%가 가  
( , 2001), 2004 3,100

가 1/3  
(2000)

( , 2000).  
1990 가

(Hermann & Hossmann, 1997; Hocking, 1998; Cox et al, 2000) 가 가

가 (Paredi et al, 2001). Kellenyi et al(1999) ABR(Auditory

800-1800MHz low power radio devices . 20dB

DNA  
(Lai & Singh, 1995; Szmigielski, 1996; Repacholi et al, 1997; Muscat et al, 2000)

가  
가

, EEG  
(Mann & Roschke, 1996; Freude et al, 1998; Borbely et al, 1999; Preece et al, 1999; Hietanen et al, 2000; Koivisco et al, 2000; Krause et al, 2000).

1.

(Braune et al, 1998),  
(Magras & Xenos, 1997),  
(Royal Society of Canada, 1999; IEGMP, 2000)

가 450 가

(Naegeli et al., 1996; Hayes et al, 1997; Darmon et al, 1998; Kompis et al, 2000)

394 87.6%

2.

2000 6 1 2000 10 31 5  
10

가 가 (Violanti and Marshall, 1996; Redelmeier, 1997; Dreyer et al, 1999)

가 ( , )

, )  
 ( Beltone 112, USA)  
 1000 4000Hz  
 3. 21-60 49.8 % ,  
 48.8 % 가 ,  
 51.9 % , 37  
 % , 41.9 % ,  
 39.5 % 가  
 56.7 % , 42.9  
 t-test, % 가 (Table2).  
 ANOVA ,  
 1000 Hz  
 4000 Hz 30 19.59±  
 4.86, 21.7±13.41 가  
 가 1000 Hz  
 가 30 58.8 % , 1000 Hz 20 19.10±4.60  
 가 20 83.7 % 가 , 가 61 17.3±5.55 가  
 67.9 % , 72.1 % 가 , 4000 Hz  
 가 39.3 % 가 가  
 9.7 % . 1000 Hz 4000 Hz  
 74.4 % , 44.2 % (Table 1). 가  
 가  
 31-48 50.2 % , 1000 Hz 4000 Hz  
 30 52.3 % 가 . 19.85±3.9, 21.47±14.82 가

Table 1. General characteristics of the study population by sex

	Males (%) (N=308)	Females (%) (N=86)
Age		
20-29	92 (29.9)	72 (83.7)
30-39	181 (58.8)	14 (16.3)
40-	35 (11.4)	0 ( 0.0)
Educational attainment		
Less than high school	79 (25.6)	23 (26.7)
Graduated junior college	209 (67.9)	62 (72.1)
Graduated university	20 ( 6.5)	1 ( 1.2)
Military services		
Served, infantryman	212 (39.3)	-
Served, others	118 (38.3)	-
Civil defense	39 (12.7)	-
Exempted	30 ( 9.7)	-
Use of an earphone		
Yes	229 (74.4)	38 (44.2)
No	79 (25.6)	48 (55.8)

Table 2. Variables related to mobile phone use by sex

	Males (%) (N=308)	Females (%) (N=86)
Duration (month)		
- 30	73 (23.8)	45 (52.3)
31 - 48	154 (50.2)	33 (38.4)
49 -		
80 (26.1)	8 ( 9.3)	
Time per day (minute)		
- 20	100 (33.4)	18 (22.0)
21 - 60	149 (49.8)	40 (48.8)
61 -	50 (16.7)	24 (29.3)
Level of sound		
1 - 2 (small)	34 (11.0)	16 (18.6)
3	114 (37.0)	36 (41.9)
4 - 5 (loud)	160 (51.9)	34 (39.5)
Places used mostly		
Office	170 (56.7)	25 (29.8)
Car	63 (21.0)	11 (13.1)
House	17 ( 5.7)	36 (42.9)
Street & others	58 (18.8)	14 (16.3)

Table 3. Mean &amp; standard deviation of mean hearing thresholds by use of mobile phone in males

	Mean 1K	P-value	Mean 4K	P-value
Duration (month)				
- 30	19.59 ± 4.86	0.019	21.47 ± 13.41	0.055
31 - 48	19.42 ± 4.42		21.56 ± 13.97	
49 -	17.81 ± 4.45		17.34 ± 11.78	
Time per day (minute)				
- 20	19.10 ± 4.60	0.012	20.75 ± 13.45	0.574
21 - 60	19.52 ± 4.12		20.87 ± 13.79	
61 -	17.30 ± 5.55		18.65 ± 11.50	
Level of sound				
1 - 2 (small)	18.24 ± 5.42	0.515	18.53 ± 13.42	0.119
3	19.07 ± 4.53		18.90 ± 11.32	
4 - 5 (large)	19.23 ± 4.44		21.95 ± 14.54	
Places used mostly				
Office	19.07 ± 4.78	0.894	21.24 ± 13.46	0.627
Car	18.89 ± 4.53		19.21 ± 12.24	
House	19.85 ± 3.90		21.47 ± 14.82	
Street & others	18.98 ± 4.32		19.18 ± 13.963)	

Table 4. Mean & standard deviation of mean hearing thresholds by use of mobile phone in females

	Mean 1K	P-value	Mean 4K	P-value
Duration (month)				
- 30	18.56 ± 4.78	0.312	13.50 ± 5.21	0.161
31 - 48	16.82 ± 5.09		11.29 ± 5.66	
49 -	18.13 ± 5.47		14.38 ± 7.41	
Time per day (minute)				
- 20	17.50 ± 4.77	0.940	12.78 ± 6.91	0.991
21 - 60	18.00 ± 4.81		12.63 ± 5.46	
61 -	17.92 ± 5.65		12.81 ± 5.58	
Level of sound				
1 - 2 (small)	19.22 ± 2.85	0.458	14.06 ± 4.46	0.479
3	17.36 ± 5.38		12.85 ± 6.19	
4 - 5 (large)	17.72 ± 5.31		11.99 ± 5.60	
Places used mostly				
Office	17.90 ± 4.82	0.861	12.90 ± 4.55	0.798
Car	16.82 ± 7.42		11.82 ± 5.93	
House	17.85 ± 4.52		12.43 ± 6.28	
Street & others	18.57 ± 4.46		13.93 ± 5.94	

(Table 3).

	Mean 1K	P-value	Mean 4K	P-value	
1000Hz 4000Hz 31-48	16.82±	0.386	1000Hz 4000Hz 21-60	0.354	
5.09, 11.29±5.66	가 , 4000Hz		0.386, 0354		61
49 14.38±7.41	가		-1.682, -1.679		1000Hz
1000Hz 4000Hz			가		
4000Hz	1000Hz	4.043	1000Hz 4000Hz	0.857,	
4000Hz	19.22	가	가		
±2.85, 14.06±4.46	가	1000Hz 4000Hz	가	가	
	가	가	1.645, 2.484		

(Table5).

	Mean 1K	P-value	Mean 4K	P-value	
5.94 가	18.57±4.46, 13.93±	0.087	1000Hz 4000Hz 31-48	0.412, 49	
(Table4).	가		1000Hz 4000Hz 31-48		가 -0.179
	가		1000Hz 4000Hz 31-48		가 -0.179
	가	1.097	가		
	가	-0.087, -0.412	20		

Table 5. Multiple linear regression of mean hearing threshold (1K and 4K) after adjusting for age, educational attainments, military services and use of earphone in males

	1K			4K		
	*	SE( ) <sup>†</sup>	P-value	SE( )	P-value	
Duration (month)						
31 - 48 vs - 30	-0.087	0.641	0.892	-0.412	1.878	0.826
49 - vs - 30	-1.821	0.740	0.014	-5.318	2.168	0.015
Time per day (minute)						
21 - 60 vs - 20	0.386	0.586	0.510	0.354	1.720	0.837
61 - vs - 20	-1.682	0.790	0.034	-1.679	2.318	0.469
Level of sound						
3 vs 1 - 2	0.743	0.885	0.402	0.891	2.565	0.729
4 - 5 vs 1 - 2	0.857	0.857	0.318	4.043	2.485	0.105
Places used mostly						
Car vs Office	-0.003	0.672	0.997	-2.692	1.958	0.170
House vs Office	1.645	1.189	0.168	2.484	3.464	0.474
Street & others vs Office	-0.235	0.694	0.735	-2.069	2.022	0.307

\*regression coefficients, <sup>†</sup>standard errors of coefficients

Table 6. Multiple linear regression of mean hearing threshold (1K and 4K) after adjusting for age, educational attainments and use of earphone in females

	1K			4K		
	*	SE( ) <sup>†</sup>	P-value	SE( )	P-value	
Duration (month)						
31 - 48 vs - 30	-1.704	1.171	0.150	-2.166	1.319	0.105
49 - vs - 30	-0.179	1.983	0.928	1.097	2.234	0.625
Time per day (minute)						
21 - 60 vs - 20	0.544	1.467	0.712	0.029	1.684	0.986
61 - vs - 20	0.481	1.636	0.769	0.292	1.879	0.877
Level of sound						
3 vs 1 - 2	-1.840	1.533	0.234	-1.225	1.742	0.484
4 - 5 vs 1 - 2	-1.493	1.537	0.334	-2.032	1.746	0.248
Places used mostly						
Car vs Office	-0.844	1.897	0.658	-0.787	2.151	0.715
House vs Office	0.129	1.410	0.927	-0.076	1.598	0.962
Street & others vs Office	0.840	1.745	0.632	1.359	1.979	0.494

1000Hz 4000Hz 21-60 가 0.840, 1.359 ,  
 0.544, 0.029, 61 1000Hz 4000Hz,  
 0.481, 0.292 4000Hz  
 . 가 1000Hz  
 4000Hz -1.840, -1.225, (Table6).  
 -1.493, -2.032 .  
 1000Hz 4000Hz

. Kellenyi et al(1999) 가 8  
 ABR V 가  
 (pulsed high-frequency EMF) V 가  
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