

Study on prevalence of hearing loss among the adult population in the Audiologic Centers of Reggio Emilia, Ravenna and Forlì in 2018.

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Abstract

Objective. This study try to found the prevalence and the characteristics of hearing loss in the adult population of the province of Reggio Emilia, Ravenna and Forlì area of the province of Forlì-Cesena in 2018.

Methods. This is a retrospective multicentre research, conducted by the UOC of ENT of Arcispedale Santa Maria Nuova in Reggio Emilia, Santa Maria delle Croci Hospital in Ravenna and Morgagni Pierantoni Hospital in Forlì. All the pure tone audiometric tests performed in 2018 related to the adult population resident in these areas were considered for this study. Patients were divided in three groups based on type and severity of hearing loss. The prevalence of hearing loss was calculated as the proportion of the general adult population (ISTAT datas).

Results. The result is an average value of the prevalence of stable, disabling hearing loss in the population equal to 6.4 ‰ (2431 individuals). The data is substantially uniform: 6.9 ‰ in Romagna, 5.3 ‰ in the province of Reggio Emilia.

Conclusion. The results of this study suggest that the prevalence of moderate, severe and profound hearing loss in Italian population is very high.

Unfortunately, there are no other Italian studies to have a term of comparison with the past.

Keywords: Hearing loss, prevalence, epidemiology, incidence of deafness.

Introduction

Hearing loss is known to be highly prevalent disease in the adult population (Reuben DB, 1998; Moscicki EK, 1985; Cruickshanks KJ, 1998; Helzner EP 2005).

The prevalence of hearing loss increases with aging (Wallhagen MI, 1997).

Acquired causes of hearing loss in adult are exposure to noise (Daniel E, 2007; . Morata TC, 2007; Palmer KT, 2002), some systemic diseases such as cardiovascular and metabolic diseases (diabetes mellitus type II, hyper-

cholesterolemia)(Dalton DS, 2001), the use of ototoxic drugs (Dalton DS, 1998)etc.

Depending on the extent and type of the pathology, hearing loss can be minimally disabling or, if of greater extent, compromise the understanding of the verbal message and therefore the social communication of the individual, negatively affecting the working skills, cognitive status and emotional.

Scientific literature on the incidence of deafness in the adult population is poor There is a critical issue on the methods to improve data

collection that we have not resolved: there is no effective method to recruit an entire population to this type of study.

Invitations by letter or telephone solicitations or press releases always have the result to involve less than 30% of the candidates.

We have tried to represent, as far as possible, the prevalence and characteristics of deafness in the adult population of the administrative district of Reggio Emilia, Ravenna and Forlì (in the administrative district of Forlì-Cesena) in 2018 (before the pandemic crisis which drastically changed the methods with which people access the Hearing Centers) through the description of the population that has turned to the main audiological centers of these three areas.

People with milder forms tend to underestimate the problem by not attending Audiological Centres. So we have limited the search to the most serious forms of deafness: the data relating to the mild and medium forms would have been underestimated

Material and methods

This is a retrospective multicentre study, conducted by the UOC of ENT of Arcispedale Santa Maria Nuova in Reggio Emilia, Santa Maria delle Croci Hospital in Ravenna and Morgagni Pierantoni Hospital in Forlì.

All the pure tone audiometric tests related to the adult population (aged 18 years old and over) from the administrative district of Reggio Emilia, Ravenna and the area of Forlì, for the administrative district of Forlì - Cesena, conducted in 2018 were extracted from the databases in these facilities, and were considered for this study.

The instrumentation used, included audiometers (Otometrics Madsen Astera, Otometrics Massen Zodiac, Natus Resonance) (AD226; Interacoustics AS, Assens, Denmark) with standard headphones (TDH-39; Telephonics Corporation, Farmingdale, New York). The audiometers were calibrated according to the American National Standards Institute-ards standard (S3.6-1996). Hearing thresholds for pure tone were obtained by headphones for the frequencies 250, 500, 1,000, 2,000, 4,000 and 8,000 hertz (Hz) for each ear. If there was no response at a given frequency, the response threshold was test-

ed for intensities above the limits of the audiometer, which were 95 dB for the 250 Hz and 8 KHz frequencies and higher than 115 dB for the frequencies from 500 Hz to 8 KHz. Bone conduction thresholds at 500, 1,000, 2,000 and 4,000 hertz (Hz) for each ear.

Patients were divided in three groups: the patients with neurosensorial hearing loss, the patient with conductive hearing loss and those with mixed hearing loss.

Pure tone averages (PTA) were calculated for speech frequency (0,5, 1, 2 and 4 kHz) in ear with the better thresholds.

Categories of hearing loss severity were based on American Speech - Language - Hearing Association guidelines: the patients were divided into those with moderately severe hearing loss (PTA average tone loss between 56 and 70 dB), severe hearing loss (PTA average tone loss between 71- 90 dB) and profound hearing loss (PTA average tone loss over 91 dB).

If a patient had undergone several audiometric tests, only the last examination conducted in 2018 was considered.

Finally, the prevalence of hearing loss was calculated as the proportion of the general adult population (from 18 years old) (ISTAT demo January 2019) in the administrative district of Reggio Emilia, Ravenna and Forlì area (in the administrative district of Forlì Cesena) who have moderate, severe or profound hearing loss in 2018.

Results

Results of Reggio Emilia Audiologic Center

In 2018, 774 adult individuals (416 male, 358 female) aged between 18 and 99 years old (median age 78 yo) were identified for the administrative district of Reggio Emilia. Of these patients, 656 had sensorineural hearing loss in the best ear, 114 had mixed hearing loss and 4 patients had pure conductive hearing loss. (Table 1). Of the 656 patients with sensorineural hearing loss, 622 had medium grade hearing loss, 24 severe hearing loss and 10 profound hearing loss. Only 114 patients had mixed-type hearing loss: 88 patients with a moderate form, 16 with a severe form and 10 with a profound form. The last 4 patients had a pure, medium-sized conductive form.

Table 1. Numbers of Individuals With Hearing Loss, by gender, degree, and age identified for the administrative district of Reggio Emilia

Male									
	neurosensorial			mixed			neurosensorial		
	PTA mode.	PTA severe	PTA profound	PTA mode.	PTA severe	PTA profound	PTA moder.	PTA severe	PTA profound
18-50	16	0	2	6	0	0	0	0	0
50-60	36	0	0	4	0	2	2	0	0
61-70	52	2	0	14	4	0	0	0	0
71-80	144	4	0	6	2	0	0	0	0
81-90	94	6	0	4	0	2	0	0	0
> 90	12	2	0	0	0	0	0	0	0
	354	14	2	34	6	4	2	0	0

Female									
	neurosensorial			mixed			neurosensorial		
	PTA mode.	PTA severe	PTA profound	PTA mode.	PTA severe	PTA profound	PTA moder.	PTA severe	PTA profound
18-50	10	0	4	4	0	0	0	0	0
50-60	14	0	0	8	2	2	0	0	0
61-70	30	0	2	12	0	0	0	0	0
71-80	88	4	2	18	2	0	2	0	0
81-90	108	4	0	8	4	4	0	0	0
> 90	18	2	0	4	2	0	0	0	0
	268	10	8	54	10	6	2	0	0

Results of Ravenna Audiologic Center

In the same period, 953 adult individuals (500 males, 453 women) aged between 18 and 92 years (median age 80 years) were identified for the administrative district of

Ravenna. 789 of these patients had sensorineural hearing loss in the best ear, 164 had mixed hearing loss and 1 patient had pure conductive hearing loss. (table 2)

Table 2. Numbers of Individuals With Hearing Loss, by gender, degree, and age identified for the administrative district of Ravenna

	Male								
	neurosensorial			mixed			neurosensorial		
	PTA mode.	PTA severe	PTA profound	PTA mode.	PTA severe	PTA profound	PTA moder.	PTA severe	PTA profound
18-50	9	1	3	1	2	4	0	0	0
50-60	6	1	10	1	0	0	0	0	0
61-70	26	1	0	7	3	2	0	0	0
71-80	92	7	1	16	7	1	0	0	0
81-90	198	7	3	20	7	2	0	0	0
> 90	52	1	1	3	5	0	0	0	0
	383	18	18	48	24	9	0	0	0

	Female								
	neurosensorial			mixed			neurosensorial		
	PTA mode.	PTA severe	PTA profound	PTA mode.	PTA severe	PTA profound	PTA moder.	PTA severe	PTA profound
18-50	7	3	3	1	0	3	1	0	0
50-60	12	8	1	2	0	0	0	0	0
61-70	21	2	0	7	0	0	0	0	0
71-80	46	8	2	17	4	0	0	0	0
81-90	152	7	2	26	7	2	0	0	0
> 90	87	8	1	8	4	2	0	0	0
	325	36	9	61	15	7	1	0	0

Of the 789 patients with sensorineural hearing loss, 708 had moderate hearing loss, 54 severe hearing loss and 27 profound hearing loss. Only 164 patients had mixed hearing loss. 109 patients with mixed hearing loss had a moderate form, 39 had a severe form and 16 a profound form. The patient with pure conductive hearing loss presented a moderate hearing loss.

Results of Forlì Audiologic Center

For the administrative district of Forlì-Cesena, in the Forlì area, 704 adult individuals (351 males, 353 women) aged between 18 and 92 years (median age 80 years) were identified. 556 had sensorineural hearing loss in the best ear, and 82 had mixed hearing loss and 5 patients had pure conductive hearing loss. (table 3)

TABLE 3. Numbers of Individuals With Hearing Loss, by sex, degree, and age identified for the administrative district in the Forlì area (administrative district of Forlì - Cesena).

	Male								
	neurosensorial			mixed			neurosensorial		
	PTA mode.	PTA severe	PTA profound	PTA mode.	PTA severe	PTA profound	PTA moder.	PTA severe	PTA profound
18-50	3	3	3	5		2	1	0	0
50-60	17	3	1	3	1	0	0	0	0
61-70	52	3	1	10	1	0	0	0	0
71-80	100	21	2	5	2	1	0	0	0
81-90	84	5	1	7	1	0	0	0	0
> 90	11	0	0	0	1	1	0	0	0
	267	35	8	30	6	4	1	0	0

	Female								
	neurosensorial			mixed			neurosensorial		
	PTA mode.	PTA severe	PTA profound	PTA mode.	PTA severe	PTA profound	PTA moder.	PTA severe	PTA profound
18-50	3	2	1	0	0	0	4	0	0
50-60	6	1	0	5	3	0	0	0	0
61-70	26	1	0	8	0	0	0	0	0
71-80	103	2	1	8	6	0	0	0	0
81-90	121	5	1	5	3	1	0	0	0
> 90	30	4	0	3	0	0	0	0	0
	289	15	3	29	12	1	4	0	0

Of the 617 patients with sensorineural hearing loss, 556 had moderate grade hearing loss, 50 severe hearing loss and 11 profound hearing loss. 82 patients had mixed hearing loss. 59 patients with mixed hearing loss had a moderate form, 18 had a severe form and

5 a profound hearing loss. All patients with pure conductive hearing loss (Wallhagen, 1997) had a moderate hearing loss.

For the County of Forlì Cesena were considered only data relating to the municipalities close to the Hospital of Forlì.

In an adult population of 386522 individuals (ISTAT data January 1, 2019), 2431 individuals were identified with moderate, severe and profound hearing loss. The prevalence findings in this study is 6.4 ‰ of the adult population. The data is substantially uniform. Higher in the Romagna area (6.9 ‰), compared to the administrative district of Emilia (5.3 ‰).

The gender distribution is quite uniform (49% of women and 51% of males). (Fig. 1)

Fig. 1 - distribution by sex of patients

Sex distribution



The most common forms of stable hearing loss encountered are those of the sensorineural type (87.6%), followed by mixed forms (9.2%). The transmissive forms have rarely been found. (Fig. 2)

It was interesting to note the large numbers of the elderly population (between 70 and 90 years) who fall within moderate to profound group (Fig. 3).

Fig. 2 - distribution by type of hearing loss

Type of hearing loss

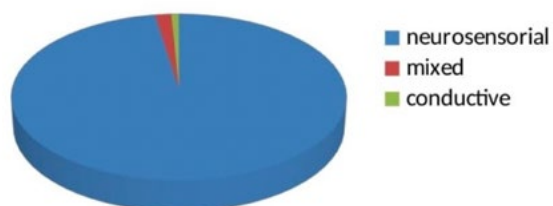


Fig. 3 - distribution by age of patients with hearing loss

Distribution by age



According to the PTA distribution, most of the individuals (88.9 %) had a moderate hearing impairment in the best ear, 8.2% had a severe hearing impairment and only 2.9% had a profound hearing loss (Fig. 4)

Fig. 4 - distribution by PTA of patients with hearing loss

Distribution by PTA

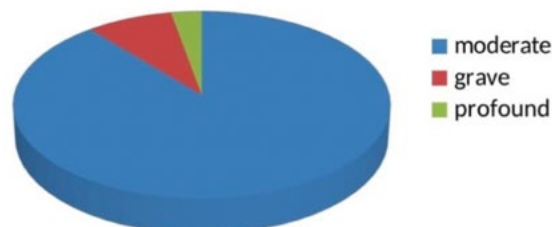


Table 4 shows the odds ratios from the additive main effects for the prevalence of average hearing impairment. Two variables, known to contribute to hearing impairment in other studies, were used in these analyses. These were: age and sex.

Factor		neurisensorial	mixed	conductive
age group 18-50	moderate	ODDS 0.01 p value <0.01**	ODDS 0.60 p value <0.21	ODDS 1.44 p value 0.86
	severe	ODDS 4.61 p value <0.01**	ODDS 0.34 p value <0.15	ODDS 21.00 p value 0.21
	profound	ODDS 14.86 p value <0.01**	ODDS 4.61 p value <0.01**	ODDS 0.69 p value 0.86
age group 50-60	moderate	ODDS 0.29 p value <0.01**	ODDS 0.92 p value <0.85	ODDS 0.29 p value 0.56
	severe	ODDS 1.85 p value <0.05*	ODDS 1.05 p value <0.91	
	profound	ODDS 6.12 p value <0.01**	ODDS 1.53 p value 0.45	
age group 61-70	moderate	ODDS 1.68 p value 0.09	ODDS 3.39 p value <0.01**	
	severe	ODDS 1.62 p value 0.17	ODDS 0.50 p value 0.08	
	profound	ODDS 0.55 p value 0.32	ODDS 0.16 p value >0.01*	
age group 71-80	moderate	ODDS 0.99 p value 0.93	ODDS 1.49 p value 0.13	
	severe	ODDS 1.30 p value 0.16	ODDS 1.50 p value 0.15	
	profound	ODDS 0.38 p value 0.01*	ODDS 0.10 p value <0.01**	
age group 81-90	moderate	ODDS 2.20 p value 0.01**	ODDS 1.03 p value 0.88	
	severe	ODDS 0.55 p value 0.04*	ODDS 1.20 p value 0.51	
	profound	ODDS 0.26 p value 0.01**	ODDS 0.70 p value 0.34	
age group >90	moderate	ODDS 1.03 p value 0.09	ODDS 0.54 p value 0.10	
	severe	ODDS 1.24 p value 0.41	ODDS 2.67 p value >0.01*	
	profound	ODDS 0.55 p value 0.99	ODDS 1.01 p value 0.97	
sex group		neurisensorial	mixed	conductive
male	moderate	ODDS 0.97 p value 0.85	ODDS 0.75 p value 0.21	nv
	grave	ODDS 0.96 p value 0.81	ODDS 1.19 p value 0.50	nv
	profound	ODDS 1.02 p value 0.95	ODDS 1.49 p value 0.29	nv
female	moderate	ODDS 1.03 p value 0.85	ODDS 1.34 p value 0.25	nv
	grave	ODDS 1.11 p value 0.56	ODDS 0.84 p value 0.50	nv
	profound	ODDS 0.76 p value 0.38	ODDS 0.67 p value 0.29	nv

*Significant at $P = 0.05$ level, **significant at the $P = 0.01$ level.

Discussion

It is important to recognize the following limitation of this study, all of which may have led to an under estimate of the prevalence:

It was considered the Hearing thresholds (PTA) obtained by means of pure tone audiometry measuring octave frequencies from 0,5 to 4 kHz; high frequency PTA hearing loss patients were not included. This may have had the effect of including fewer patients.

It was considered the Hearing thresholds (PTA) obtained by means of pure tone audiometry in ear with the better thresholds; unilateral hearing loss patients were not included.

There will be some patients who only accessed other hearing services (not participating to this study): they represent missing data.

Patients were divided into those with moderately severe hearing loss PTA (average tone loss between 56 and 70 dB), severe hearing loss (PTA average tone loss between 71- 90 dB) and profound hearing loss (PTA average tone loss over 91 dB). Although considering the increased awareness of the role of mild HL and correlation between cognitive tests measuring auditory attention and working memory (especially verbal working memory) with mild HL, we decided not to report mild hearing loss prevalence that, considering our survey method, could have been underestimated.

Unlike other previous experience (Quaranta A,1991), who corroborate self reported hearing loss audiometrically, we estimates prevalence of hearing loss on instrumental data (tonal audiometric examination). Estimates based on self report may be inaccurate given the observed tendency of some individuals to deny or minimize their hearing loss.

Audiometric screening is critical to capture the true prevalence of hearing loss at an early stage among adult.

The results of our study suggest, as in previous experience, that neurosensorial hearing loss increases progressively with aging (also demonstrated by the high statistical significance of the data).

We have not noticed the same evidence in the mixed and transmissive forms.

The same trend is confirmed by other international studies (Turton L,2013; Davis A,

1989; MRC Institute of Hearing Research,198; Löfvenberg C. 2022; GBD 2019 Diseases and Injuries Collaborators,2019; Borchgrevink H.M, 2005; Wilson D.H,1999).

The prevalence of impairment is the same in both gender: there isn't any statistical significant difference.

In the previous experience, the prevalence of impairment is consistently higher for male compared with females.

Extensive population-based studies, conducted in differing geographical areas in the World, show higher prevalence estimate: 27% in Norway (Borchgrevink H.M, 2005), 35% in UK (Davis A,1989) and 22% in Australia (Borchgrevink H.M, 2005; Wilson D.H,1999) and 16,1 % in US (based only on adults aged 20 - 69 yo).

The difference in prevalence estimates may result from differences in the age distributions of the populations surveyed, in method of enrolling survey and in the grade of hearing loss considered.

If we consider the prevalence of more severe hearing loss (moderata, severe and profound) the data are very homogeneous.

A population-based study conducted by Turton et al (Turton L,2013) in UK identified 2199 (0,7%) clinical adult patients with 70 dB Hearing level in better ear at frequencies 0,5 and 2 Khz. A recent South Korean study on patients by Korean National Health Insurance Services which cover the entire population, reported that 0,27% of the patients had a bilateral hearing level ≥ 70 dB (Im, G.J.,2018). The Swedish registry for adult patients with bilateral profound hearing loss (≥ 70 dB) reported an estimated prevalence of $\geq 0,2\%$. (Hannula S, 2010)

The last three studies used audiogram data accumulated over 5 or more years from an entire country, we only consider only audiogram data in 2018.

Conclusion

Deafness is widespread in the population but there isn't adequate literature to support statistical quantification. The results of this study suggest that the prevalence of more severe hearing loss (the tip of the iceberg of whole hearing loss), in the Italian adult population is relatively high. It is possible, how-

ever, an increase in this value over the years, due to the aging of the population, the greater exposure to damage noise that civilization, economic development and habits.

It is important for all operators in the field of hearing disease must raise awareness with the Institutions responsible for developing and deciding on health policy guidelines.

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