

# Deafness in Italy: an epidemiological and socio-demographic study

G. ALTISSIMI<sup>1</sup>, P. GIACOMELLO<sup>2</sup>, F. MAZZEI<sup>3</sup>, R. TURCHETTA<sup>1</sup>, L. CARCHIOLO<sup>3</sup>, M.P. ORLANDO<sup>1</sup>, V. TESTUGINI<sup>1</sup>, F. CIANFRONE<sup>4</sup>, M.G. CAMMERESI<sup>1</sup>, G. CIANFRONE<sup>1</sup>

<sup>1</sup>Department of Sensory Organs, Umberto I Polyclinic, Sapienza University of Rome, Rome, Italy

<sup>2</sup>Department of Economic and Social Analysis, Sapienza University of Rome, Rome, Italy

<sup>3</sup>A.I.R.S., Italian Association for Research on Deafness, Rome, Italy

<sup>4</sup>San Camillo Forlanini Hospital, Rome, Italy

**Abstract. – OBJECTIVES:** Hearing loss is very common in our society, but epidemiological data on deafness in Italy is lacking. A.I.R.S. onlus (Italian Association for Research on Deafness) yearly launches the National Day for the Fight Against Deafness (NDFAD).

During this events, that are held every year, it is possible to perform a free hearing test in all the facilities that have joined the initiative throughout Italy (240 hospitals joined in 2011).

**AIM:** to report data collected throughout the “A.I.R.S. National Day for the Fight against Deafness” of the last years, focusing in particular but not only on audiometric outcomes.

**METHODS:** demographic and social data, as well as audiometric outcomes, was collected on forms that have been subsequently stored in a on-line database and analyzed with MySQL and Microsoft Excel.

**CONCLUSIONS:** This data are important in order to describe the “hearing health” of the Italian population, and is a first step towards creating a database with epidemiological and preventive aims, a strongly felt need both at national and at regional level.

*Key Words:*

Hearing loss, Hearing epidemiology, Prevention campaign.

## Introduction

In recent years, the World Health Organization (WHO) has repeatedly focused the attention on the problem of hearing loss (HL). According to a WHO estimate<sup>1</sup> 360 million people worldwide are suffering from disabling HL (5.3% of the world's population). This number is growing due to increasing global population and extended life expectancies, and WHO projections estimate that as many as 750 million people are going to be hear-

ing impaired in 2015. At present, about one third of people over the age of 65 have hearing disability, and 50% of HL could be avoided through prevention and early diagnosis<sup>1</sup>. WHO also insists on the costs related to non-treated deafness, which are estimated at 2200 Euros per year for each case of mild deafness, up to 13200 Euros per year for each case of severe HL<sup>2</sup>.

About 8 million Italians (12% of the whole population) suffer from hearing disorders, more than half a million of whom are adults with severe deafness and subsequent social handicap; more than a thousand newborns in our country are born every year with congenital deafness that seriously hinder the development and use of speech, the integration in school and in society<sup>3</sup>.

In Italy the Italian Association for Research on Deafness (AIRS) yearly launches the National Day for the Fight Against Deafness (NDFAD). This type of initiative is fully in line with WHO programs. During this Events it has been possible to perform a free hearing test in all the facilities that have joined the initiative. In hospitals, physicians and paramedical staff have also offered free information to users, aimed at improving knowledge of deafness. In 2003, 120 hospitals took part in the initiative, and this number has been increasingly growing through the years. In 2011, 240 hospitals were involved (75% of the total number of the ORL departments of the Italian hospitals), all over the national territory.

The latest five editions of the AIRS National Day, from 2007 to 2011, were also an opportunity to experiment a data collection protocol with epidemiological aims and patients survey. Various past initiatives attempted to collect data on incidence and prevalence of deafness in Italy, but were sporadic and incomplete. The most complete review is a multicenter study performed in the late

nineties on hearing loss etiology in our country, coordinated by the University of Bari with the Universities of Milan, Padua, Florence and Palermo<sup>4</sup>. In such paper a large sample of subjects (over 2000), with bilateral or monolateral HL, underwent a general clinical/history examination, hearing tests and an audiological study; data regarding the etiology of the various types of HL were collected, and presbycusis was found to be the most common cause of hearing loss, along noise trauma.

The methodology for collecting and processing data during AIRS National Days differs substantially from other surveys and epidemiological polling and has been improved in the latest editions, to reach a largely satisfactory level of quality in the 2011 edition.

The aim of this paper is to disclose and discuss the data collected in the National Days in recent years.

## Methods

All individuals who spontaneously attended the NDFAD were visited and then subjected to a hearing threshold test. Based on the results, they were subsequently informed and advised by a specialist regarding the possible clinical, diagnostic and therapeutic follow-up.

NDFAD incorporates a multicenter epidemiological study, and for each subject we have designed a form. In Part A of the form the physician records:

- Social and demographic characteristics such as age (classified into four age groups: <12 years, 13 to 45 years, 46 to 60 years, >60 years), sex and occupation (executive, professional, office worker/craftsman/workman, retired, housewife, student, unemployed, other);
- Whether the subject was having its first hearing test or not;
- Questions about the reasons for the visit (suspects a HL, suffers from tinnitus and/or dizziness, suspects hereditary deafness, believes to have no problem and only wants to check his/her hearing);
- Global perceived knowledge of hearing problems (inadequate, sufficient or good);
- Opinion on the usefulness of the initiative to improve information and raise awareness on the problem of deafness (positive or negative).

In Part B of the form the results of the audiological examinations are noted. Degrees of HL have been classified according to the International

al Bureau for Audiophonology (BIAP)<sup>5</sup>, which is based on hearing threshold average at 0.5, 1, 2 and 4 KHz, resulting in normal hearing ( $\leq 20$  dB), mild (between 21 and 40 dB), moderate (between 41 and 70 dB), severe (between 71 and 90 dB) and profound HL (between 91 and 119 dB), or complete deafness (values  $\geq 120$  dB).

## Statistical Analysis

Data from 2007 to 2011 were stored in a on-line database. The software used, MySQL, a Relational Database Management System (RDBMS), has the dual characteristic function to perform input and output, i.e. the ENT in charge, after uploading data from his hospital on the AIRS website, can view the statistical analyses from data that has already been processed in graphical form. Such data are also accessible by the public. This optimizes both the amount of time needed to input data and to statistically analyze it (Figure 1). Data were processed with software XLSTAT. We use describing function and parametric tests on proportions as Z test and  $\chi^2$  test, with significance level of 5%, to assess the randomness or less of the differences in time and between the modes for 2011 data ( $H_0$ : proportions are equal;  $H_1$ : at least one proportion is significantly different from another).

We have to point out that the collection of data was not homogeneous over the years. For 2007 and 2008 the information is less detailed compared to that of 2009, 2010 and 2011 and for this reason we will focus on the latest years (2009-2011), with only a few hints to previous years.

## Results

The data analyzed are those of individual records entered on-line: 4876 forms in 2009, 2961 in 2010 and 4783 in 2011 (total number of participants: 12620; 38,6% in 2009, 23,5% in 2010, 37,9% in 2011). The number of participants is certainly higher, considering that in 2011 as much as 40% of participating hospitals did not input their data in the database.

Results are classified in: (1) Social and demographic characteristics; (2) Reasons for participation and global knowledge of hearing problems; (3) Results of the audiological tests; (4) Hints to regional data.

In each paragraph, we will provide a list of the main specific characteristics/variables.

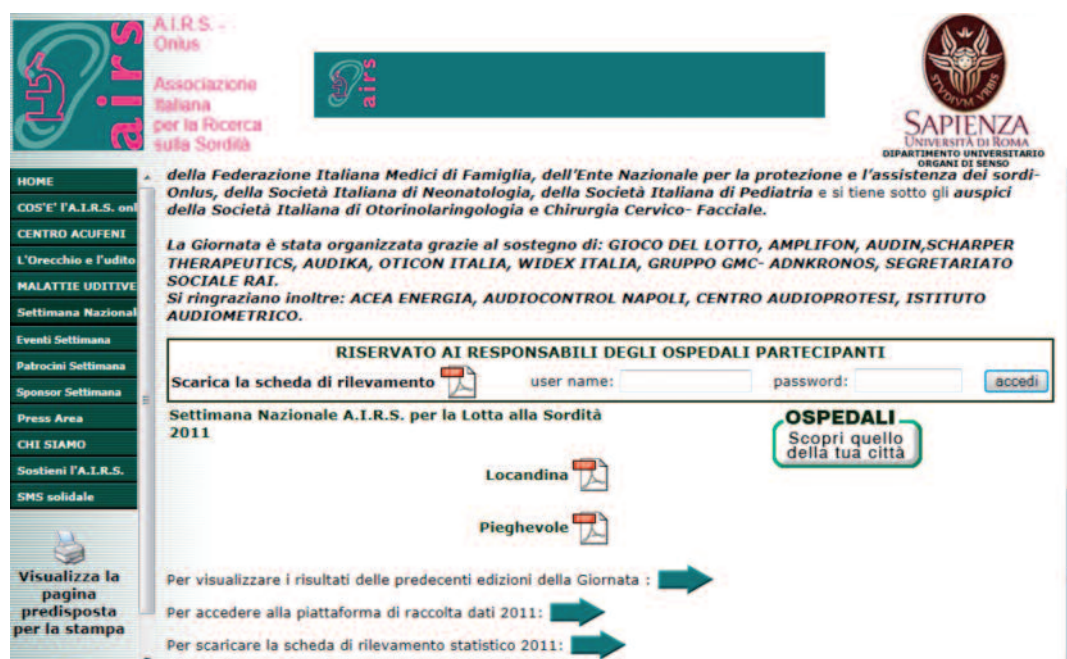


Figure 1. A.I.R.S. web homepage.

## 1. Social and demographic characteristics

**Age:** adults and elderly represent the greatest majority of people who participated in the Event, being 83% in 2011, 5% more than previous years

**Table I.** Distribution for Gender and Age. Years 2009, 2010, 2011.

Age	Percent values			Males ratio	
	M	F	Tot	M/F %	Total
<b>Year 2009</b>					
< 12	2.8	2.1	2.5	130.8	120
13-45	15.8	24.3	20.1	62.3	982
46-60	24.6	32.9	28.9	71.3	1408
> 60	56.8	40.7	48.5	133.1	2366
Total	2382	2494	4876	95.5	4876
<b>Year 2010</b>					
< 12	2.7	1.8	2.2	140.7	65
13-45	16.7	23.2	20.1	67.3	594
46-60	25.9	33.6	29.8	72.0	884
> 60	54.7	41.4	47.9	123.7	1418
Total	1431	1530	2961	93.5	2961
<b>Year 2011</b>					
< 12	2.1	1.9	2.0	104.3	96
13-45	13.0	17.7	15.4	70.0	738
46-60	22.3	30.7	26.6	69.4	1272
> 60	62.6	49.7	56.0	120.0	2677
Total	2334	2449	4783	95.3	4783

(Table I). Mean age was 59 years in 2011, while in 2009 and 2010 it was 56 years and 55 years in 2007. Attendance of people over 60 is slightly lower in 2007 than in 2008, 2009 and 2010 (46% compared to 48% in 2009 and 2010). In 2011 people over 60 were the vast majority (56.0%).

**Gender:** in 2009-2011 male ratio was 93.5-95.5% (Table I). Gender data are not available for 2007 and 2008; the percentage distributions relating to age are consistent with those of 2009 and 2010.

**Occupation:** retired people are the most numerous participants in the years 2009-2011 (42.1% in 2009, 41.1% in 2010 and 47.9% in 2011; Table II). Office employees/craftsmen/workers were the second most common group (25.7% in 2009, 27.8% in 2010 and 23.2% in 2011). We have no data concerning occupation for 2007 and 2008.

## 2. Reasons for participating and knowledge of the problem

Almost all participants gave, in each edition, a positive judgment on the initiative as an action aimed at improving awareness on deafness issues (for example in 2011 only 1.6% of people answered with a negative judgment).

**Reasons for participation:** a suspect of HL was the main reason to attend the event (71% in 2011, 70% in 2009 and 72% in 2010). In 2011 23% of

**Table II.** Distribution according the type of occupation. Years 2009, 2010 e 2011. a.v.: absolute value.

Occupation	Year 2009		Year 2010		Year 2011	
	a.v.	%	a.v.	%	a.v.	%
Executives	67	1.4	37	1.2	51	1.1
Professionals	335	6.9	191	6.5	245	5.1
Empl./craft./workers	1252	25.7	822	27.8	1108	23.2
Unemployed	100	2.1	60	2.0	117	2.4
Housewives	563	11.5	339	11.4	588	12.3
Retired	2056	42.1	1214	41.1	2293	47.9
Student	264	5.4	173	5.8	210	4.4
Others	239	4.9	125	4.2	171	3.6
Total	4876	100.0	2961	100.0	4783	100.0

participants believed to have no problem and only wanted to check their hearing as a preventive measure (the values in the other editions were higher: 32% in 2009 and 29% in 2010); as many as 54% had already undergone an earlier audiometric test (50% in 2009 and 53% in 2010).

*Presence of tinnitus and/or vertigo:* in 2011 about 34% of the participants reported tinnitus (30% in 2010 and 2009) and 13% suffered from vertigo (18% in 2010 and 2009) as the cause for participating to the NDFAD (observed  $\chi^2$  test = 20.9; critical value = 6.0). The presence of ver-

tigo has not been investigated in 2007 and 2008, while tinnitus incidence was 32% in 2007 and 29% in 2008.

*General knowledge of hearing problems:* in 2011 only 33% of the surveyed people stated that they had inadequate knowledge of the problem, while the remaining 67% thought they had a sufficient or good knowledge of it. This percentage is higher than that of 2010 (34.2%) and of 2009 (36.8%), a significant difference with  $p$ -value < 0.04% (observed  $\chi^2$  test = 15.9 critical value = 6.0) (Table III).

**Table III.** Distribution according to the level of problem knowledge and motivation Percentage values. Years 2009, 2010 and 2011. a.v.: absolute value.

Knowledge of problem	Total	First time test		Suspect of HL		Prevention visit		Suspect hereditary Deafness	
		Yes	No	Yes	No	Yes	No	Yes	No
<b>Year 2009</b>									
Good	14.8	12.5	17.1	13.0	19.0	19.0	12.9	14.4	14.9
Sufficient	48.4	46.3	50.6	48.3	48.7	45.0	50.0	46.1	48.7
Inadequate	36.8	41.2	34.3	38.7	32.3	36.0	37.1	39.5	36.4
Total (a.v.)	4876	2449	2427	3412	1464	1551	3325	612	4264
(% on total)		50.2	49.8	69.9	30.1	31.8	68.2	12.6	87.4
<b>Year 2010</b>									
Good	15.7	12.0	19.0	13.7	20.8	21.1	13.6	22.4	15.1
Sufficient	50.1	46.4	53.3	50.9	48.2	45.9	51.8	41.5	50.9
Inadequate	34.2	41.6	27.7	35.4	31.0	33.0	34.6	36.1	34.0
Total (a.v.)	2961	1379	1582	2139	822	845	2116	241	2720
(% on total)		46.6	53.4	72.2	27.8	28.5	71.5	8.1	91.9
<b>Year 2011</b>									
Good	15.5	14.2	16.6	14.1	18.9	17.3	15.0	17.2	15.4
Sufficient	51.5	47.2	55.1	52.0	50.2	50.0	51.9	49.9	51.7
Inadequate	33.0	38.5	28.3	33.8	30.9	32.7	33.1	33.0	32.9
Total (a.v.)	4783	2190	2593	3409	1374	1098	3685	367	4416
(% on total)		45.8	54.2	71.3	28.7	23.0	77.0	7.7	92.3

### 3. Results of the audiometric tests

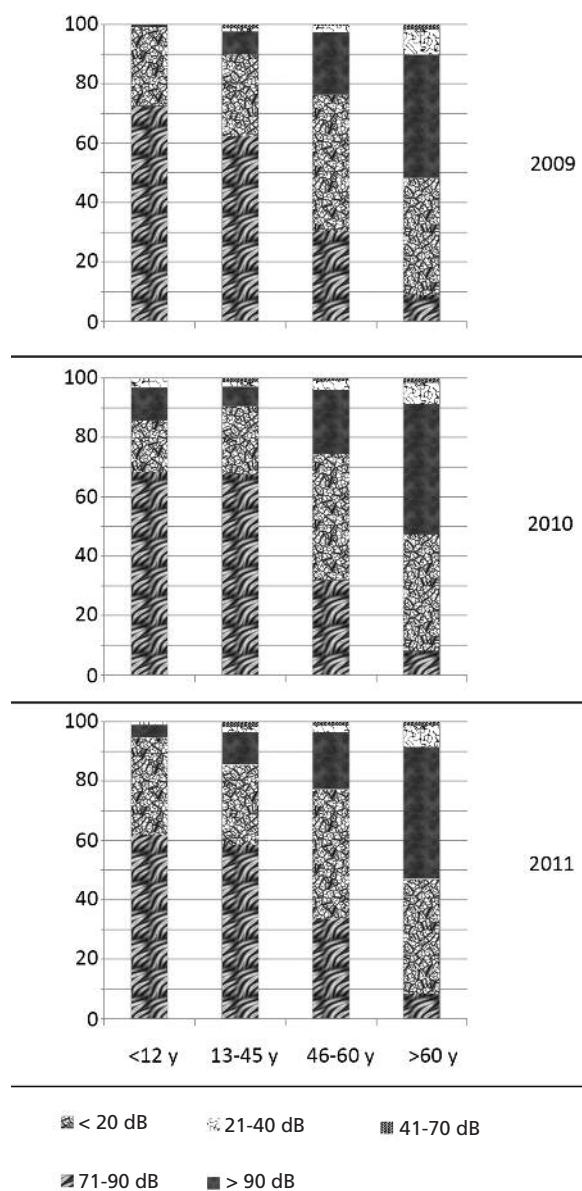
Only pure-tone audiometry data has been collected, even if some hospitals have performed other audiometric surveys. In all years under review (2007-2011) all hearing losses greater than 90 dB, not being a large enough sample, were combined, to give greater statistical significance to the data.

In 2011, 23.5% of subjects had normal hearing, 37.3% had mild HL, 31% had moderate HL, 4.8% had severe HL, 1.3% had profound HL or complete deafness. In 2009 and 2010 the percentage of normal hearing subjects was slightly higher than in 2011 and that of medium HL participants was lower, while severe hearing losses have remained practically the same number, as well as the mild HL and complete deafness percentage (Table IV). In 2007 and 2008 the subjects who underwent audiometric tests were found in 28% of cases to have normal hearing, 35% had mild HL, 30% had moderate HL, 5% (2007) and 6% (2008) had severe HL, while 2% (2007) and 1% (2008) had profound HL or complete deafness (Figure 2).

### 4. A hint to regional data

We briefly compared the territorial data collected in 2011 in three different regions: we chose Lombardy, Lazio and Sicily, because in these regions there is the higher number of hospitals involved (Figure 3); also, these regions well represent the macro-areas of northern, central and southern Italy; a more detailed study will be performed at a later time, but we would like to mention some significant data.

Lazio is the region that is closer to the national *mean age*, while participants aged 46-60 years are more common in Sicily, and those over 60 in Lombardy.



**Figure 2.** Results of the audiometric tests according to age. Percentage distribution. Years 2009, 2010 and 2011 (see text for details).

**Table IV.** Results of the audiometric tests, according to gender. Years 2009, 2012 and 2011. a.v.: absolute value.

Threshold in dB	Year 2009				Year 2010				Year 2011			
	M %	F %	Total a.v.	%	M %	F %	Total a.v.	%	M %	F %	Total a.v.	%
< 20 dB	19.7	34.6	1333	27.3	21.0	35.1	837	28.3	16.4	30.3	1124	23.5
21-40 dB	39.7	36.8	1863	38.2	36.5	35.9	1071	36.2	37.6	37.1	1786	37.3
41-70 dB	32.0	23.3	1342	27.6	34.2	23.6	851	28.7	36.8	25.4	1483	31.0
71-90 dB	6.7	3.3	241	4.9	6.1	3.3	138	4.7	5.6	4.1	231	4.8
> 90 dB	1.7	1.8	86	1.8	1.3	1.2	37	1.2	1.5	1.2	63	1.3
(not stated)	0.2	0.2	11	0.2	0.9	0.9	27	0.9	2.1	1.9	96	2.0
Total	100.0	100.0	4876	100.0	100.0	100.0	2961	100.0	100.0	100.0	4783	100.0

In Lombardy, the *gender* percentages are similar to the national data; there were more female participants in Lazio (81 males, 100 females) and equal participation in Sicily (100 males for every 100 females).

With reference to the *working activity*, retired people are the most frequently found in all three regions, although with very different percentages: in Lombardy they were 10% more than the national percentage (47.9%), 5% fewer in Lazio and 13% fewer in Sicily.

As to the *reasons for participating in the event*, the percentage of those who carried out the tests for the first time is higher than the national average (45.8%) both in Lombardy (6% more) and in Sicily (8% more), while Lazio behaves in the opposite way (6% less); the same is true for those who had the visit as a preventive measure, although differences in the percentages are smaller (26% in Lombardy, 25% in Lazio, 18% in Sicily, 23% in all Italy); the percentage of those who participate because they suspect a HL is higher in Lombardy (75%) and lower in Sicily (70%) compared to the national percentage (71%), which is the same as in Lazio.

In Lombardy, nearly 75% of 2011 participants who had audiometric tests have a mild or moderate HL (68% in all Italy) and 60% are sensorineural. These percentages are lower than in the other two regions, while normal hearing was

present in 21% of the subjects in Lombardy, 29% in Lazio, 25% in Sicily (24% in all Italy).

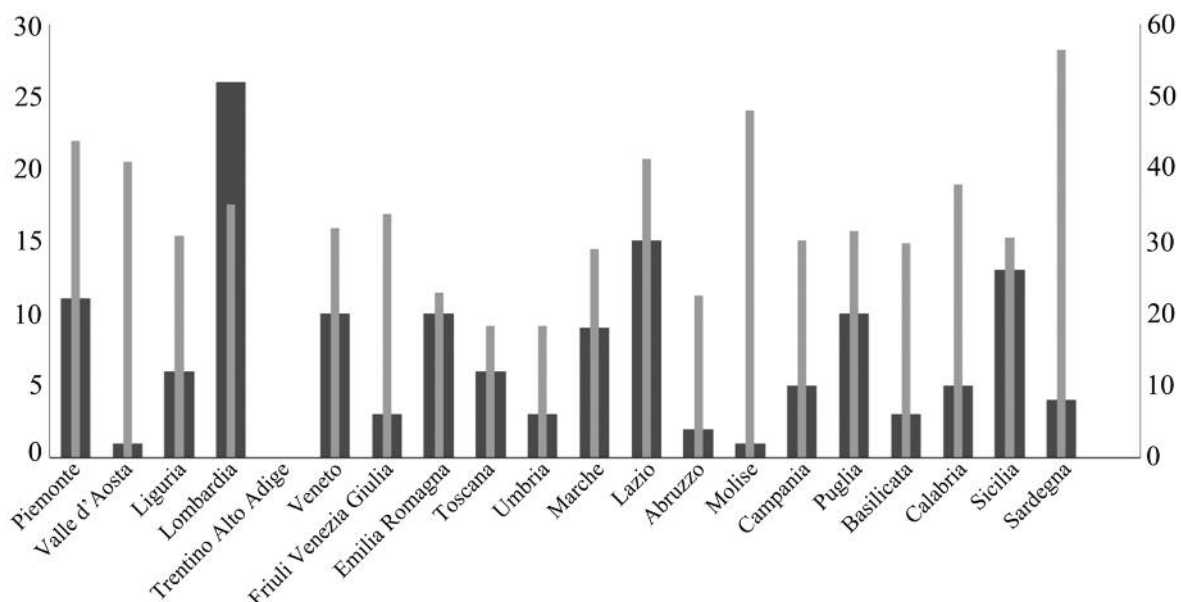
The attendants in Sicily and Lazio complain of *tinnitus* with significantly higher percentages than the national average (respectively 45% and 41%, national percentage is 34%), whereas the opposite is true for those in Lombardy (27%).

With regards to the *subjective knowledge of the hearing problem* the percentage of subjects who report a good knowledge is 18% in Lombardy, 14% in Lazio, 12% in Sicily; the national percentage is 16%.

## Discussion

In order to better discuss our findings, we will follow the same classification we used in the results section.

*Gender and Age:* age distribution shows on one hand the increasing interest of the aging population in hearing problems, and on the other hand how much those problems are neglected by the younger working generations. Correlating gender and age shows that in 2009 and 2010 there was a prevalence of males for individuals under 12 years of age (whose total number, though, was rather limited, around 2% of the total) and for those aged 60 and over, while the opposite was true for the remaining age classes (Table I).



**Figure 3.** Regions according to the number of hospitals and respective forms filled in. Note: this graph has a double scale: the larger blocks represent the number of Hospitals involved (right side axis); the narrower green lines represent the number of forms filled in for each Hospital (left side axis).

**Table V.** Distribution for gender and motivation percentage values. Years 2009, 2010 and 2011. a.v.: absolute value.

Gender	First time test		Suspect of HL		Prevention visit		Suspect hereditary Deafness	
	Yes	No	Yes	No	Yes	No	Yes	No
<b>Year 2009</b>								
Males	47.6	52.4	72.3	27.7	29.9	70.1	11.0	89.0
Females	52.7	47.3	67.7	62.3	33.6	66.4	14.1	85.9
Total (a.v.)	2449	2427	3412	1464	1551	3325	612	4264
(% on total)	50.2	49.8	69.9	30.1	31.8	68.2	12.6	87.4
<b>Year 2010</b>								
Males	43.6	56.4	74.8	25.2	26.1	73.9	7.0	93.0
Females	49.3	50.7	69.8	30.2	30.8	69.2	9.7	90.3
Total (a.v.)	1379	1582	2139	822	845	2116	241	2720
(% on total)	46.6	53.4	72.2	27.8	28.5	71.5	8.1	91.9
<b>Year 2011</b>								
Males	44.3	55.7	73.9	26.1	20.9	79.1	5.8	94.2
Females	47.2	52.8	68.8	31.2	24.9	75.1	9.5	90.5
Total (a.v.)	2190	2593	3409	1374	1098	3685	367	4416
(% on total)	45.8	54.2	71.3	28.7	23.0	77.0	7.7	92.3

*Occupation:* retired people participated the most to the events. This was expected, given the fact that adults and the elderly were the most numerous participants. This, apart from the greater availability of time for people who no longer work, might indicate an increased attention to hearing in ageing populations. The second most frequent occupation group includes office employees/craftsmen/workers, who, together with retired people account for about 70% of the sampled population, testifying the importance of hearing problems in at-risk populations, such as workers and craftsmen (Table II).

*Reason for participating to the events:* most attendees believed they had a HL (71%): this suggests that, if on the one hand the awareness in population is already high (more than half had already had an audiometric test), on the other hand prevention should be increased (only 23% of the attendants had prevention aims). The percentage of people who suspect a HL has grown from 68% in 2007 to 71% in 2011. This reveals a high self-evaluation in relation to incipient hearing problems. Among the participants who suspected a HL, males were more numerous than females in the last three years. For those who did not suspect any hearing problem, but participated for prevention purposes or had already had a hearing test, females were more numerous, revealing a greater attention to this problem: in 2011, 25% of women

and 21% of males took the event opportunity for prevention; 47% of women against 44% of men underwent their first hearing test (Table V). In both cases differences are significant (at the 5% level) with  $p$ -value  $<0.01\%$  (opportunity for prevention) and  $p$ -value  $<3.82\%$  (first hearing test).

Tinnitus and vertigo are a common cause for participating to the Event. Data from 2009 to 2011 show that sex correlates much less to tinnitus than vertigo: this fact can be explained by the particular hormonal function in women<sup>6-11</sup>. The age variable, on the contrary, presents a predictable positive correlation both in the presence of tinnitus and of vertigo, possibly as a consequence of oxidative processes connected to the cochlear-labyrinthine district aging, and with pathologies to which elderly people are subjected and their consequent pharmacological therapies<sup>12-15</sup> ( $p$ -value  $<0.01\%$  in both cases).

The decreasing trend in the percentage of people who report that they have inadequate information on the problem is confirmed when we consider the data for 2007 (39%), and this probably derives from A.I.R.S. awareness campaigns, where deafness topics have been repeatedly described and discussed, and from the fact that there is a greater willingness to learn about health issues of social relevance. If we relate the reason for participating to the knowledge of the hearing problems, it is evident how “inadequate knowledge” has a fairly high percentage when

the hearing test is performed for the first time (years 2009-2011), while “good knowledge” is more frequent in people participating for preventive reasons or because they suspect a hereditary HL ( $p$ -value < 0.01% in all cases) (Table V). This further confirms that hard work is needed in order to raise awareness of hearing related issues in the general population. We expected a correlation between degree of knowledge of hearing problems and work activity of the participants (proxy variable for the level of education). The  $\chi^2$  test with a  $p$ -value < 0.01% confirmed, for 2011, a dependency between the two variables, but the  $\nu$  Cramer coefficient is very low (0,13 in a range between 0 - maximum independence - and 1 - maximum dependence), which we did not expect. This is probably due to an excessive synthesis of the individual data form: employment groups are too vague, making the form faster to compile, but not providing enough information to perform statistical analysis of relational type.

*Hearing correlation with other variables:* In 2009-2011 the gender variable underlined that males had worse hearing than females (for exam-

ple in 2011 the moderate hearing losses were 36.8% in males, but only 25.4% in females,  $p$ -value < 0.01%). These data, combined with the higher number of females attending the event (25% vs. 20% for men in 2011) hints to a stronger attention for the HL problem on the part of women. There might be a higher resistance of female hearing compared to male's, for different endocrine, genetic and immunological characteristics<sup>16</sup>.

There is a high percentage of normal hearing subjects who attended as a preventive measure (47%); this is also observed in the previous two years, although with significantly different percentages ( $p$ -value < 0.01) (45% in 2009 and 50.4% in 2010). Also, percentages of moderate hearing losses increase over time for those who suspect a decline in hearing (36.9% in 2011, 34.6% in 2010 and 33.9% in 2009) while the percentages in the population with severe hearing losses remain steady over the years (5.7%). (Table VI). In 2009-2011 hearing losses were sensorineural in more than 83% of the cases (same percentage of 2007 and 2008). Mixed hearing loss values, even

**Table VI.** Results of the audiometric tests according to motivation to participate in the event. Years 2009, 2012 and 2011. Percentage values.

Threshold (dB)	First timetest		Suspects hearing loss		Preventive visit		Suspect hereditary deafness	
	Yes	No	Yes	No	Yes	No	Yes	No
< 20 dB	36.1	18.5	16.8	51.9	45.0	19.1	20.9	28.3
21-40 dB	39.2	37.2	41.1	31.5	33.6	40.3	40.7	37.9
41-70 dB	20.7	34.4	33.9	12.7	17.1	32.4	31.7	26.9
71-90 dB	2.8	7.1	5.8	2.9	3.0	5.9	4.4	5.0
> 90 dB	0.4	1.9	1.5	0.5	0.5	1.5	1.8	1.1
(not stated)	0.8	0.8	0.9	0.5	0.8	0.8	0.5	0.8
Total	2449	2427	3412	1464	1551	3325	612	4264
<b>Year 2010</b>								
< 20 dB	40.1	18.0	17.8	55.5	50.4	19.4	28.2	28.3
21-40 dB	35.3	37.0	39.1	28.5	30.8	38.4	31.9	36.5
41-70 dB	20.6	35.8	34.6	13.7	16.1	33.8	31.5	28.5
71-90 dB	2.7	6.4	5.8	1.6	2.0	5.7	5.0	4.6
> 90 dB	0.4	2.0	1.6	0.4	0.1	1.7	1.7	1.2
(not stated)	0.9	0.8	1.1	0.4	0.6	1.0	1.7	0.8
Total	1379	1582	2139	822	845	2116	241	2720
<b>Year 2011</b>								
< 20 dB	33.5	15.1	15.3	43.8	47.0	16.5	21.5	23.7
21-40 dB	39.0	35.9	38.3	35.1	35.0	38.0	35.1	37.5
41-70 dB	22.7	38.0	36.9	16.3	15.1	35.7	33.0	30.8
71-90 dB	2.7	6.6	5.7	2.5	1.4	5.9	4.4	4.9
> 90 dB	0.4	2.1	1.6	0.7	0.2	1.7	2.5	1.2
(not stated)	1.6	2.3	2.2	1.6	1.4	2.2	3.5	1.9
Total	2190	2593	3409	1374	1098	3685	367	4416



**Table VII.** Results of the audiometric tests according to the type of HL. Years 2009, 2010 and 2011. a.v.: absolute value.

Threshold (dB)	Conductive		Sensorineural		Mixed	
	a.v.	%	a.v.	%	a.v.	%
<b>Year 2009</b>						
21-40 dB	153	71.4	1420	53.5	114	35.0
41-70 dB	53	24.8	1018	38.3	171	52.5
71-90 dB	4	1.9	177	6.7	35	10.7
> 90 dB	3	1.4	37	1.4	4	1.2
(not stated)	1	0.5	4	0.1	2	0.6
Total	214	100.0	2656	100.0	326	100.0
(% on total)	6.7		83.1		10.2	
<b>Year 2010</b>						
21-40 dB	93	66.9	799	49.9	74	39.8
41-70 dB	37	26.6	671	41.8	81	43.6
71-90 dB	9	6.5	98	6.1	24	12.9
> 90 dB			32	2.0	6	3.2
(not stated)			4	0.2	1	0.5
Total	139	100.0	1604	100.0	186	100.0
(% on total)	7.2		83.2		9.6	
<b>Year 2011</b>						
21-40 dB	107	65.7	1398	50.9	120	32.5
41-70 dB	46	28.2	1158	42.1	193	52.4
71-90 dB	6	3.7	150	5.5	44	11.9
> 90 dB	2	1.2	36	1.3	10	2.7
(not stated)	2	1.2	7	0.2	2	0.5
Total	163	100.0	2749	100.0	369	100.0
(% on total)	5.0		83.8		11.2	

though not very significant (in 2011 they were 9.6% of the total), had a swinging trend, while conductive hearing losses (5.0% in 2011), show a decrease in prevalence over time (Table VII). With regard to the type of HL in relation to age, the data from 2009-2011 show that the sensorineural type of loss is directly proportional to the age variable, with rates ranging between 63% and 69%, for the subjects over 60 years of age; the same behavior is observed for the mixed type, while more than half of conductive hearing losses are in people aged 13 to 60 (Table VIII). Data from 2011, with a  $p$ -value  $< 0.01\%$  and  $< 2.01\%$  for the mixed type, confirm a physiological process of aging of the auditory organ which tends to involve the sensory and perceptual apparatus more than the transmission one. Italy is the European country with the second longest life expectancy after Sweden, with more than 12 million people aged over 65 (as of January 2011), a rate of old age of 114%, second place after Germany (153% and 111% for the European Union in 2011), and an average age of 43 years (the old age rate is the result of the relationship between the population over 65 and the population between 0-14 years); according to the

current forecast from the Italian National Institute for Statistics (ISTAT) these values in 2050 will rise to 21 million elders and an average age of 49 years<sup>17</sup>. In Italy, deafness is the second leading cause of disability, with 16.7‰ affected<sup>18</sup>, only preceded by motor disabilities (29.6‰). A recent report from the Italian National Institute for Insurances and Work Accidents (INAIL) issued in 2011 shows that among the occupational diseases the most common is HL, with over 6000 new reports each year<sup>19</sup>.

The data regarding *differences between regions*, despite showing some statistically significant differences, are difficult to interpret, since they could be related to cultural and social factors. This could also be the result of increased industrialization in some regions, which subsequently resulted in a better healthcare policy and a higher concern from the people living in those regions.

In recent years, the promotion of the NDFAD was mainly carried out by advertising campaigns on television, radio, and on the major national newspapers, achieving a high diffusion: it is estimated to have reached more than 20 million people. However, the number of participants who

**Table VIII.** Type of hearing loss according to age. Years 2009, 2010 and 2011.

Age	Conductive	Sensorineural	Mixed
<b>Year 2009</b>			
< 12	9.9	0.6	0.3
13-45	36.8	9.4	9.7
46-60	29.1	27.4	25.8
> 60	24.2	62.6	64.1
Total	223	2767	329
<b>Year 2010</b>			
< 12	8.9	0.5	1.6
13-45	30.8	7.9	15.3
46-60	35.6	26.7	31.6
> 60	24.7	64.8	51.6
Total	146	1668	190
<b>Year 2010</b>			
< 12	16.5	0.1	0.3
13-45	27.1	7.7	12.7
46-60	31.7	22.8	26.2
> 60	24.7	69.4	60.8
Total	170	2870	371

have been registered in the database is very low compared to 61 million people leaving in our Country: in 2011, only 0.08% of the Italian population participated in the Event.

Despite the broad information given through the media there is still a very low sensibility to hearing problems and there are no adequate health policies and early interventions campaigns, which should be fundamental to reduce the damage deriving from HL, both at an individual and a social level.

Our data confirm that hearing disability already begins in adulthood (the Event attendants aged 45-60 years had normal hearing only in 34% of cases), and high degrees of HL affect more than half of the elderly (53% of participants over 60 had hearing losses of 41 dB or more).

## Conclusions

The most important outcomes emerged from our initiative can be summarized as follows, and can be a useful suggestions for future actions:

- Awareness should be raised at a younger age;
- We should make people participate in the NDFAD not only when they suspect a HL, but also as a preventive measure (only 23% of the participants had this intention);
- We should improve our efforts with the aim to have a better understanding of hearing loss related problems (33% of participants who had

an audiometric test reported an inadequate knowledge and only 16% a good knowledge of hearing problems): higher knowledge could in fact help reduce the percentage of those who attend the NDFAD as prevention, not suspecting of having a HL while actually being hearing impaired (as much as 38% have mild or moderate HL);

- This experience suggests that we should make some improvements to the survey form, for example with a greater breakdown of age groups and of work classes, and a better wording of the questions on the motivation of participation in the Event;
- A greater effort must be made by the personnel working in the hospitals who join the initiative in performing the tests, and in communicating the results, especially using the platform and protocol designed for the data entry (only 60% of forms has been submitted).

## Acknowledgements

We thank all participating Physicians, Audiometrists, Hospitals, Departments and General Managers for their cooperation and willingness. We want to emphasize the availability of all medical staff (doctors and audiometrists) involved, who often spontaneously and freely stay at work longer than their time of service, as well as the effort of hospitals, who for one day have renounced to collect the money for the services provided, in particular in such a delicate economical period.

This work was supported by A.I.R.S. onlus (Italian Association for Research on Deafness, non governmental and non profit organization).

## Conflict of Interest

The Authors declare that there are no conflicts of interest.

## References

- 1) WHO fact sheet n°300, updated February 2013. (<http://www.who.int/mediacentre/factsheets/fs300/en/>)
- 2) <http://www.fnaai.it/anap.index.php>
- 3) [www.associazioneairs.it](http://www.associazioneairs.it)
- 4) QUARANTA A, ASSENNATO G; Società Italiana di Audiologia. Causes of hearing loss in Italy. *Audiologia Newsletter* 1997; 3: 31-33.
- 5) BUREAU INTERNATIONAL D'AUDIOPHONOLOGIE (BIAP). BIAP Recommendation n° 02/1 bis: audiometric classification of hearing impairments, 1996.
- 6) KÖ Ü N, KÖ Ü A, TURHAN NÖ, KURTARAN H. Hearing levels in menopausal women and the effect of ti-

- bolone on audiological functions. *J Obstet Gynaecol* 2012; 32: 294-297.
- 7) KÖ Ü N, KÖ Ü A, TURHAN NÖ. Discrepancy in improvement of hearing loss between left and right ears after postmenopausal hormone therapy. *Med Hypotheses* 2011; 76: 447-449.
  - 8) HORNER KC. The effect of sex hormones on bone metabolism of the otic capsule--an overview. *Hear Res* 2009; 252: 56-60.
  - 9) HEDERSTIERNA C, HULCRANTZ M, ROSENHALL U. Estrogen and hearing from a clinical point of view; characteristics of auditory function in women with Turner syndrome. *Hear Res* 2009; 252: 3-8.
  - 10) MITRE EI, FIGUEIRA AS, ROCHA AB, ALVES SM. Audiometric and vestibular evaluation in women using the hormonal contraceptive method. *Braz J Otorhinolaryngol* 2006; 72: 350-354.
  - 11) GUIMARAES P, FRISINA ST, MAPES F, TADROS SF, FRISINA DR, FRISINA RD. Progesterin negatively affects hearing in aged women. *Proc Natl Acad Sci U S A* 2006; 103: 14246-14249.
  - 12) HUANG Q, TANG J. Age-related hearing loss or presbycusis. *Eur Arch Otorhinolaryngol* 2010; 267: 1179-1191.
  - 13) CASPARY DM. Aging and hearing. *Hear Res* 2010; 264: 1-2.
  - 14) SOUSA CS, CASTRO JÚNIOR N, LARSSON EJ, CHING TH. Risk factors for presbycusis in a socio-economic middle-class sample. *Braz J Otorhinolaryngol* 2009; 75: 530-536.
  - 15) MEGIGHIAN D, SAVASTANO M, SALVADORI L, BOLZAN M, FRIGO A. Clinical and epidemiological aspects of age-related hearing loss in the Veneto region. *Acta Otorhinolaryngol Ital* 2001; 21: 1-16.
  - 16) CANLON B, FRISINA RD. Sex hormones and hearing: a pioneering area of enquiry. *Hear Res* 2009; 252: 1-2.
  - 17) <http://demo.istat.it/>
  - 18) ISTAT, Multipurpose Survey "Health conditions and use of health services", 2006.
  - 19) INAIL, Rapporto Annuale, 2011.