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**PREVALENCE AND DETERMINANTS OF TINNITUS
IN THE ITALIAN ADULT POPULATION**

Silvano GALLUS^a Alessandra LUGO^b Werner GARAVELLO^c
Cristina BOSETTI^a Eugenio SANTORO^a Paolo COLOMBO^d Paola PERIN^e
Carlo LA VECCHIA^b Berthold LANGGUTH^f

^a Department of Epidemiology, IRCCS - Istituto di Ricerche Farmacologiche "Mario Negri",
Milan, Italy

^b Department of Clinical Sciences and Community Health, University of Milan, Milan, Italy

^c Department of Surgery and Translational Medicine, University of Milano–Bicocca, Milan,
Italy

^d Istituto DOXA, Worldwide Independent Network/Gallup International Association
(WIN/GIA), Milan, Italy

^e Department of Brain and Behavioural Sciences, University of Pavia, Pavia, Italy

^f Department of Psychiatry and Psychotherapy, University of Regensburg, Regensburg,
Germany

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Correspondence to:

Silvano Gallus, ScD
Department of Epidemiology
IRCCS - Istituto di Ricerche Farmacologiche "Mario Negri"
Via G. La Masa 19; 20156 Milan, Italy
Tel: +390239014657; Fax: +390233200231
e-mail: silvano.gallus@marionegri.it

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ABSTRACT

Background: Limited, outdated and poor quality data are available on prevalence of tinnitus, particularly in Italy. **Methods:** A face-to-face survey was conducted in 2014 on 2952 individuals, representative of the Italian population aged 18 years or over (50.6 million). Any tinnitus was defined as the presence of ringing or buzzing in the ears lasting for at least 5 minutes within the previous 12 months. **Results:** Any tinnitus was reported by 6.2% of Italian adults, chronic tinnitus (i.e., for more than 3 months) by 4.8%, and severe tinnitus (i.e., big or very big problem) by 1.2%. The corresponding estimates for the population aged ≥ 45 years were 8.7%, 7.4% and 2.0%. Multivariable analysis on population aged ≥ 45 years revealed that higher age (OR=4.49 for ≥ 75 vs. 45-54 years), and obesity (OR=2.14 compared to normal weight) were directly related to any tinnitus, and high monthly family income (OR=0.50) and moderate alcohol consumption (OR=0.59 for < 7 drinks/week vs. non-drinking) were inversely related. **Conclusions:** This is the first study on tinnitus prevalence representative of the general Italian adult population. It suggests that in Italy, tinnitus affects more than 3 million adults and is felt as a (very) big problem by more than 600,000 Italians, mostly aged ≥ 45 years.

INTRODUCTION

Tinnitus, a symptom of various underlying pathologies, is defined as the perception of sound, typically a ringing, buzzing or whistling sound, in the absence of a corresponding acoustic external stimulus [1, 2].

Inadequate and poor-quality data are available on the epidemiology of tinnitus (e.g., prevalence, aetiology and potential treatments). This is, at least in part, a consequence of the subjective nature of tinnitus assessment, the heterogeneity of the question used to define the presence of tinnitus, and the large variety of tinnitus properties [3] and associated disorders [4].

Knowledge on the burden of tinnitus in the general population comes from a few large prospective cohort studies, basically from northern Europe and the USA, providing data on tinnitus incidence in adults [5-7]. With reference to tinnitus prevalence in adults, to our knowledge, only a small number of previous studies (n=20) from a limited number of countries (n=14) were conducted using surveys representative at a national or sub-national level. **Table 1** shows summary results from all those surveys [5, 8-25]. Prevalence of tinnitus in adults ranged between 5 and 30% and that of severe tinnitus from less than 1% to 7%.

In Italy, besides some data on tinnitus provided by a few case series [26-30] or selected professional subgroups [31], all the information on tinnitus prevalence comes from two old surveys. One investigation, conducted in Milan in 1981 on 1473 adults, showed a chronic tinnitus prevalence of 12% and severe tinnitus prevalence of 3% [24, 32]. Another survey, conducted in five Italian provinces in the 1990's on a sample of 2216 adults, reported a prevalence of chronic tinnitus of 14.5% [25, 32]. Both surveys show a relatively high prevalence of tinnitus, but were conducted in specific areas and were therefore not representative of the general Italian population.

In order to update the information on tinnitus in Italy and to determine its socio-demographic and other individual-level correlates, and to compare tinnitus prevalence with the other available prevalence estimates worldwide, we analysed data from a representative survey of Italian adults conducted in 2014.

METHODS

In collaboration with DOXA – the Italian branch of the Worldwide Independent Network/Gallup International Association - during February-April 2014, we conducted a face-to face survey using a standardized methodology [33, 34]. The study sample consisted of 2952 individuals (1413 men and 1539 women) aged ≥ 18 years, representative of the Italian adult population (i.e., 50.6 million adults) in terms of sex, age, geographic area, and socio-economic characteristics. Participants were selected through a representative multistage random sampling. The first stage was used to select municipalities (the smallest Italian administrative division) in all of the 20 Italian regions (the largest Italian administrative division). Thus, taking as criteria two characteristics, region and size, we identified 116 municipalities, representative of the Italian universe of municipalities (method known as proportional stratified sample). In the second stage, in each municipality an adequate number of electoral wards was randomly extracted (each ward corresponding to a given district of the municipalities), so that the various types of more or less affluent areas of the municipality were represented in the right proportions (i.e., central and suburban districts, outskirts and isolated houses). In the third stage, knowing the demographic structure of the Italian population, adequate sex-and-age specific numbers of individuals were randomly sampled from electoral rolls. Unavailable participants were replaced by their neighbours (living in the same floor/building/street) with the same sex and age group. Statistical weights were used to assure representativeness of the Italian population aged 18 years or over.

Ad hoc trained interviewers conducted interviews using a structured questionnaire in the context of a computer-assisted personal interview (CAPI). All interviews were conducted in the houses of the selected individuals who accepted to participate to the study. Besides general information on demographic and socio-economic characteristics, we collected data on anthropometric characteristics, tobacco smoking, and alcohol drinking. The questionnaire also included three direct questions about tinnitus [35]. Participants were asked about the presence of tinnitus as follows: “In the past 12 months, have you been bothered by ringing or buzzing in your ears or head that lasted for 5 minutes or more?” Those who answered “yes” were enquired about their experience with tinnitus with two further questions. The first one (i.e., “How long have you been bothered by this ringing or buzzing in your ears or head?”) was used to detect “chronic tinnitus”, defined as tinnitus duration of 3 months or more. The second one (i.e., “How much of a problem is this ringing or buzzing in one or both ears or in your head?”) was used to assess severity of tinnitus: mild tinnitus was defined as reporting “no problem” or “a small problem”, moderate tinnitus as reporting “a moderate problem”, and severe tinnitus as reporting “a big problem” or “a very big problem”.

Education was categorized into low (no qualification up to middle school diploma), intermediate (high school) and high (university). Geographic area was categorized as northern, central, and southern Italy. Ever smokers (current and ex- smokers) were participants who had smoked 100 or more cigarettes in their lifetime. Ex-smokers were participants who had quit smoking at least one year before the study, and current smokers were individuals continuing smoking or having stopped less than 1 year before the study. Alcohol consumption was computed as the sum of the number of drinks/week (around 12 grams of alcohol) of four different types of alcoholic beverages (i.e., beer, wine, spirits and digestives). This variable was then categorized into no alcohol drinking, consumption of <7 drinks per week (median value) and of ≥ 7 drinks per week. Body mass index (BMI) was

computed as the ratio between self-reported weight (kg) and height (m²), and categorized into: underweight and normal weight (BMI <25.0 kg/m²), overweight (25.0 ≤BMI <30.0 kg/m²) and obese (BMI ≥30.0 kg/m²). Net monthly family income was categorized according to tertiles in the overall population aged ≥45 years (<1160€/month, 1160€-1939€/month, ≥1940€/month).

Statistical analyses

Given the rarity of (severe) tinnitus among younger generations (18-44 years), we limited the multivariate analyses to middle-age and elderly adults. Odds ratios (OR) for any, chronic and severe tinnitus, and corresponding 95% confidence intervals (CI), were estimated using unconditional multiple logistic regression after adjustment for sex, age, level of education, geographic area, smoking status, alcohol consumption and BMI. All the analyses were performed with SAS, version 9.2, statistical package (SAS Institute).

RESULTS

Table 2 shows the prevalence of tinnitus overall and according to its duration and severity. Among 2952 Italian adults, 6.2% reported tinnitus for 5 minutes or more in the past 12 months. Any tinnitus prevalence was 6.0% in men and 6.4% in women, and was 2.7% in individuals aged 18-44 years, 5.9% in 45-64 years and 12.3% in those aged ≥65 years. Among the elderly, any tinnitus prevalence was 10.8% in individuals aged 65-74, 13.2% in those aged 75-84 and 27.4% in those aged ≥85 years. Overall, the prevalence of chronic tinnitus was 4.8%. This prevalence was similar in men (4.9%) and women (4.8%), and increased with increasing age (1.3% in participants aged 18-44 years, 4.6% in 45-64, and 11.1% in participants aged ≥65 years). According to severity, 2.9% of Italian adults reported a mild,

2.1% a moderate, and 1.2% a severe tinnitus (1.0% reported that tinnitus was a “big problem” and 0.3% a “very big problem”). Prevalence of severe tinnitus was 0.8% in men and 1.6% in women, and was 0.1% in 18-44 years participants (i.e., 1 out of 1228), 1.2% in 45-64 years (i.e., 12 out of 981), and 3.2% in ≥ 65 years (i.e., 24 out of 743). Among adults with severe tinnitus, 2.7% (i.e., 1 out of 37) aged 18-44 and 97.3% (i.e., 36 out of 37) aged ≥ 45 years.

Table 3 shows the ORs for any, chronic and severe tinnitus, according to selected socio-demographic characteristics in the Italian population aged ≥ 45 years. Any tinnitus increased with increasing age: as compared to participants aged 45-54 years, OR for those aged ≥ 75 was 4.49 (95% CI: 2.34-8.62). An inverse trend was observed according to family income: as compared to individuals with income $< 1160\text{€}/\text{month}$, the OR for those with income $\geq 1940\text{€}/\text{month}$ was 0.50 (95% CI: 0.29-0.85). A higher prevalence of any tinnitus was observed in widowed (OR: 1.88; 95% CI: 1.15-3.06) and divorced/separated (OR: 2.32; 95% CI: 1.21-4.43) as compared to married participants. No significant relation with any tinnitus was observed according to sex and municipality size. Chronic tinnitus patterns broadly reflected those of any tinnitus. According to severe tinnitus, women more frequently reported it compared to men (OR: 3.26; 95% CI: 1.28-8.31). A significant direct trend was observed in severe tinnitus prevalence according to age: the ORs compared to individuals aged < 55 years were 3.57 for 55-64, 4.21 for 65-74, and 9.59 for participants aged ≥ 75 years (p for trend=0.002). Significant inverse trends were observed with family income ($p=0.011$) and municipality size ($p=0.022$) No specific pattern in any, chronic and severe tinnitus was observed according to level of education and geographic area.

When compared to abstainers, the OR for moderate alcohol drinkers was 0.59 (95% CI: 0.36-0.98) for any tinnitus, but no trend with drinks per week was observed ($p=0.307$; **Table 4**). Compared to non-drinkers of alcoholic beverages, those drinking < 7 drinks per week less frequently reported severe tinnitus (OR: 0.16; 95% CI: 0.04-0.77), while no

difference in severe tinnitus was observed in participants drinking 7 or more drinks per week (OR: 1.59; 95% CI: 0.68-3.68). A significant direct trend was observed according to BMI (p=0.004): as compared to underweight and normal weight subjects, the OR for overweight was 1.49 (95% CI: 0.99-2.25) and the OR for obese 2.14 (95% CI: 1.25-3.67). No significant relation with any, chronic and severe tinnitus has been observed according to smoking status.

DISCUSSION

This is the first national representative study providing data on tinnitus prevalence in the Italian adult population. Self-reported prevalence of tinnitus was 6.2%, and that of severe tinnitus was 1.2%. The corresponding estimates for adults aged ≥ 45 years were 8.7% and 2.0%, and for the elderly (aged ≥ 65 years) 12.3% and 3.2%, respectively. Only two previous studies, conducted more than two decades ago, and representative only of the adult population of selected areas, investigated tinnitus prevalence in Italy, showing substantially higher prevalence estimates among adults [24, 25, 32].

We found no sex differences in any and chronic tinnitus, while severe tinnitus was more frequent in women. Inconsistent results have been reported according to sex differences, with most previous studies, though not all [10, 20], showing higher tinnitus prevalence in men than in women [5, 14, 19, 36].

A direct and steady relationship between age and prevalence of tinnitus has been observed in the present as in other studies [19, 21], suggesting that tinnitus is a symptom peculiar of the elderly. Some studies, however, observed a plateau of tinnitus prevalence around 60-70 years, and a subsequent decline in older age groups [9, 10, 12].

Low socio-economic status was reported as a potential risk factor for tinnitus in various studies [9, 10, 16, 36]. We confirmed this observation, showing a consistent and significant inverse relation with income, whose magnitude was significantly stronger for

severe tinnitus rather than for any tinnitus. Accordingly, our data are compatible with higher (severe) tinnitus rates among residents in municipalities with a relatively small population size. This is in agreement with a survey from China, showing a higher tinnitus prevalence in rural than in urban areas [18], although in Egypt the opposite was observed [22]. A few studies investigated the relationship between marital status and tinnitus, showing no significant difference [21, 36]. We found, however, that divorced or separated participants had more frequently any, and, in particular, severe tinnitus than married ones. Both low income [37] and divorce/loss of partner [38] are likely to be associated with high stress and anxiety, which in turn have been strongly correlated to tinnitus [39]. Lower income could also correlate with different exposure to environmental noise [40] and worse access to health facilities [37] and consequent hearing loss which is thought to be an essential triggering factor in tinnitus onset [4].

We found no significant difference in tinnitus prevalence according to smoking status, confirming findings from most other studies [17, 20, 21, 36]. Only a few surveys reported a higher prevalence of tinnitus in current than in never smokers [9, 10].

As regards alcohol consumption, moderate drinkers showed the lowest tinnitus prevalence. This is consistent with a study from Norway showing a 10 to 15% reduction of tinnitus prevalence in moderate alcohol consumers [9], and a US study showing a substantial reduction of tinnitus prevalence in female alcohol drinkers [41]. The observed relation with alcohol reminds to the well-known J-shaped risk curve between alcohol and risk of myocardial infarction or other cardiovascular diseases [42-44]. Indeed a few studies show that tinnitus and cardiovascular diseases share several risk factors [10, 41], supporting the hypothesis that a healthy microvascular system in the inner ear [41], cochlear nerve [45] or central auditory system (which is responsible for tinnitus chronicization) [4] may reduce the

risk of tinnitus. Other studies, however, did not find any relation between alcohol drinking and risk of tinnitus [17, 20, 21, 36].

Prevalence of any and chronic, but not severe, tinnitus was highest among obese compared to normal weight subjects. High BMI was reported as a possible risk factor for tinnitus [9], but most studies showed no consistent relation between overweight and obesity, and tinnitus [10, 17, 20, 21, 36].

We observed one of the lowest prevalence estimates of tinnitus (either any or severe) worldwide (**Table 1**). Comparisons between different surveys are difficult, due to the heterogeneity in terms of age range of the population studied and the lack of a standard and validated definition of tinnitus [17, 21, 36]. We decided to use the definition of any, chronic and severe tinnitus adopted for the NHANES study [35], which assessed the presence of tinnitus over the past 12 months, and not only at the time of interview. This assessment tool may therefore have led to an overestimation of current tinnitus prevalence. Comparison is also complicated by the difference in the demographic structure of various populations. Our tinnitus prevalence was similar only to those observed in Japan [17], Egypt [22] and Iran [19], but appreciably lower than those found in North America [10], Australia [12], northern Europe [5, 14, 16], and Korea [20, 21]. The large heterogeneity in the prevalence of tinnitus observed worldwide may be related to different lifestyle, including dietary, habits. The typical Mediterranean diet, characterized by a high monounsaturated/saturated fat ratio, a relatively high consumption of cereals, legumes, fruit and vegetables, and fish, a moderate consumption of alcohol, and a low consumption of meat and meat products, and milk and dairy products, has been shown to reduce obesity [46], and prevent cardiovascular [47, 48], cancer [49] and overall mortality and morbidity [50, 51]. In Italy, the level of adherence to the Mediterranean diet is still relatively high [52]. Also usual diets of Egypt, Iran (and Japan, i.e., the other countries with relatively low rates of tinnitus) have been shown to have recently taken on a

Mediterranean-like dietary pattern [53]. It is possible that some aspects of the Mediterranean diet may, at least partially, prevent tinnitus. This hypothesis is corroborated by our findings of a favourable effect of moderate alcohol consumption, and of an unfavourable effect of obesity on tinnitus. These results should however be confirmed by analytical epidemiological studies, including case-control and cohort studies, providing data on incident cases [1, 10]. Differences in genetic protection against age-related hearing loss and in levels of exposure to noise or chemical induced hearing loss [54] may also have a role in the heterogeneity of tinnitus prevalence estimates observed in various countries.

This is the largest study on tinnitus prevalence in Italy, and the first one conducted on a sample representative at a national level. Our sample size is satisfactorily large to derive stable estimates on a relatively frequent condition as any tinnitus, and to assess differences in tinnitus prevalence between various subpopulations using a multivariate analysis, after allowance for several covariates. However, given the rarity of severe tinnitus (1.2%), the statistical power of our sample is inappropriate to observe differences among sufferers of severe tinnitus (n=36) in terms of individual-level characteristics. Moreover, a weakness present in namely all the surveys is that information on tinnitus was self-reported, due to the difficulties to objectively detect/diagnose tinnitus. Other potential limitations are those inherent to the cross-sectional design, where it is not possible to establish the mechanisms by which tinnitus and its identified correlates mutually interact [55, 56].

In conclusion, in Italy tinnitus affects more than 3 million adults, and severely impairs quality of life of more than 600,000 Italian adults, mostly aged ≥ 45 years. Our data also show that socio-economic and anthropometric characteristics, and selected lifestyle habits may have a role on tinnitus prevalence. Our data add relevant knowledge on a disorder for which inappropriate data on aetiologic factors and no treatments are available today [1, 2].

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Table 1. Representative cross-sectional studies providing data on prevalence of either any tinnitus (AT) or chronic/frequent tinnitus (CT) or severe tinnitus (ST) on adults.

Publication (author, yr)	Country	Study period	Study design Assessment of tinnitus	Sample size	Age group; Sex	Percent prevalence		
						AT	CT	ST
Americas								
Cooper, 1994 [8]	USA	1971- 1975	<u>Sample:</u> HANES; multistage stratified probability sampling; nationally representative sample (25-74 yrs) <u>CT:</u> Defined as “frequent, bothersome tinnitus” assessed by the following set of questions: At any time over the past few years, have you ever noticed ringing in your ears, or have you been bothered by other funny noises in your ears? Does it bother you? (just a little OR quite a bit)	6342	25-74 yrs 25-74 yrs; M 25-74 yrs; F		14.9% 12.6% 17.1%	
Hoffman and Reed, 2004 [9]	USA	1990	<u>Sample:</u> NHIS; household multistage probability sampling survey; nationally representative sample (≥ 20 yrs) <u>AT:</u> Have you been bothered by ringing in the ears or other funny noises in the head in the past 12 months? (yes)	59,343	≥ 20 yrs ≥ 50 yrs		8.4% 12.1%	
Hoffman and Reed, 2004 [9]	USA	1994- 1995	<u>Sample:</u> NHIS; household multistage probability sampling survey; nationally representative sample (≥ 20 yrs) <u>CT:</u> Do you have now a ringing, roaring buzzing in the ears that has lasted for at least three months? (yes)	99,435	≥ 20 yrs ≥ 50 yrs			4.4% 7.6%
Shargorodsky, et al., 2010 [10]	USA	1999- 2004	<u>Sample:</u> NHANES; nationally representative sample (≥ 20 yrs) <u>AT:</u> In the past 12 months, have you ever had ringing, roaring, or buzzing in your ears? (yes)	14,178	≥ 20 yrs ≥ 20 yrs; M ≥ 20 yrs; F ≥ 80 yrs		25.3% 26.1% 24.6% 28.1%	7.9% 9.4% 6.5% 12.5%

Publication (author, yr)	Country	Study period	Study design Assessment of tinnitus	Sample size	Age group; Sex	Percent prevalence		
						AT	CT	ST
			<u>CT</u> : How often did this happen? (almost always OR at least once a day)					
Oiticica and Bittar, 2014 [11]	Brazil	2012	<u>Sample</u> : Cluster household sampling, representative of the municipality of Sao Paolo (≥18 yrs) <u>AT</u> : Do you have tinnitus in your ears? (yes) <u>CT</u> : Is this ringing constant, i.e., do you perceive it every day? (yes) <u>ST</u> : Does your tinnitus bother you? (from mildly to severely annoying)	1960	≥18 yrs ≥18 yrs; M ≥18 yrs; F >65 yrs	22% 17% 26% 36%	7% 6% 7% -	14% 9% 19% -
Australia								
Sindhusake et al., 2003 [12]	Australia	1997-1999	<u>Sample</u> : BMHS; representative sample of West of Sidney area (≥55 yrs) <u>AT</u> : Have you experienced any prolonged ringing buzzing or other sounds in your ears or head within the past year that is, lasting for five minutes or longer? (yes)	2015	≥55 yrs ≥55 yrs; M ≥55 yrs; F ≥80 yrs	30.3% 32.2% 28.6% 25.4%		
Europe								
Davis, 1989 [13]	UK	1982	<u>Sample</u> : NSH; nationally representative household sample (17-80 yrs) <u>CT</u> : “prolonged spontaneous tinnitus” defined as tinnitus that lasts for more than five minutes and occurs not only after loud sounds	10,778	17-80 yrs		7.1%	
McCormack et al., 2014 [14]	UK	2006-2010	<u>Sample</u> : Likely representative sample (40-69 yrs) <u>AT</u> : Do you get or have you had noises (such as ringing or buzzing) in your head or in one or both ears that lasts for more than five minutes at a time? (yes from some to all of time) <u>ST</u> : How much do these noises worry, annoy or upset you when they are at their worst?	172,621	40-69 yrs 40-69 yrs; M 40-69 yrs; F	16.2% 18.4% 14.1%		3.8% 4.1% 3.5%

Publication (author, yr)	Country	Study period	Study design Assessment of tinnitus (moderately OR severely)	Sample size	Age group; Sex	Percent prevalence		
						AT	CT	ST
Ottaviani et al., 1983 [24]	Italy	1981	<u>Sample:</u> Sample representative of the municipality of Milan (≥ 18 yrs) <u>AT:</u> current or previous self-reported tinnitus <u>CT:</u> tinnitus every day <u>ST:</u> tinnitus which causes severe annoyance	1473	≥ 18 yrs ^a ≥ 18 yrs; M ≥ 18 yrs; F	29.6% 36.0% 23.2%	11.8% 12.0% 11.6%	3.4% 4.2% 2.7%
Quaranta et al., 1996 [25]	Italy	1989-1991	<u>Sample:</u> Sample representative of 5 Italian provinces (≥ 18 yrs) <u>CT:</u> Do you have a sensation of sounds in the ear or in the head without any relevant external stimulus? (every day)	2216	≥ 18 yrs		14.5%	
Gallus et al., 2015 (present study)	Italy	2014	DOXA survey: CAPI; multistage-random sampling; nationally representative sample (≥ 18 yrs) <u>AT:</u> In the past 12 months, have you been bothered by ringing or buzzing in your ears or head that lasted for 5 minutes or more? (yes) <u>CT:</u> How long have you been bothered by this ringing or buzzing in your ears or head? (3 months or more) <u>ST:</u> How much of a problem is this ringing or buzzing in one or both ears or in your head? (a big problem OR a very big problem)	2952	≥ 18 yrs ≥ 18 yrs; M ≥ 18 yrs; F ≥ 45 yrs ≥ 65 yrs	6.2% 6.0% 6.4% 8.7% 12.3%	4.8% 4.9% 4.8% 7.4% 11.1%	1.2% 0.8% 1.6% 2.0% 3.2%
Pilgramm et al., 1999 [15]	Germany	1998-1999	<u>Sample:</u> Random sampling; nationally representative sample (≥ 10 yrs) <u>AT:</u> noise in the ear at the time of the study <u>CT:</u> Ear noise lasting longer than one month	3049	≥ 10 yrs	3.9%	3.6%	
Hasson et al., 2010 [16]	Sweden	2008	<u>Sample:</u> Sample representative of the working and non-working population (16-64 yrs) <u>AT:</u> Have you during the most recent time	11,441	16-64 yrs ^a 16-64 yrs; M ^a 16-64 yrs; F ^a	26.1% 31.5% 21.8%		1.5% - -

Publication (author, yr)	Country	Study period	Study design	Sample size	Age group; Sex	Percent prevalence		
			Assessment of tinnitus			AT	CT	ST
			experienced sound in any of the ears, without there being an external source (so-called tinnitus) lasting more than 5 min? (yes) <u>ST</u> : How much do you feel that tinnitus sounds worry, bother or upset you? (severely)					
Engdahl et al., 2012 [5]	Norway	1996-1998	<u>Sample</u> : HUNT; population-based cohort study; representative of the general working population (≥ 20 yrs) <u>AT</u> : Are you bothered by ringing in ears? (yes)	49,948	≥ 20 yrs ^a ≥ 20 yrs; M ≥ 20 yrs; F ≥ 65 yrs ^a	14.1% 16.4% 12.1% 20.7%		
Asia								
Michikawa et al., 2010 [17]	Japan	2006	<u>Sample</u> : Karabuchi Study: face-to-face survey; nationally representative sample (≥ 65 yrs) <u>AT</u> : In the past year have you experienced any ringing, buzzing, or other sounds (tinnitus) in your ears? (yes) <u>ST</u> : Have these sounds interfered with your concentration or ability to sleep? (yes)	1320	≥ 65 yrs ≥ 65 yrs; M ≥ 65 yrs; F	18.6% 18.0% 19.0%		3.0% 2.6% 3.4%
Xu et al., 2011 [18]	China	2005-2006	<u>Sample</u> : Participants from Jiangsu Province using a probability proportional to size method (≥ 10 yrs). Age-standardized rates are provided <u>AT</u> : In the past year have you had noises in your ears or head which lasted longer than 5 minutes? (yes)	6333	≥ 10 yrs	12.4%		
Jallesi et al., 2013 [19]	Iran	2009	<u>Sample</u> : Sample likely representative of the Tehran province population (≥ 7 yrs) <u>AT</u> : Participants who had sound perceptions without external source which was lasting more than five minutes <u>ST</u> : Tinnitus with severe and intolerable annoyance	3207	≥ 7 yrs ≥ 7 yrs; M ≥ 7 yrs; F	4.6% 5.6% 3.7%		1.2% - -

Publication (author, yr)	Country	Study period	Study design Assessment of tinnitus	Sample size	Age group; Sex	Percent prevalence		
						AT	CT	ST
Park and Moon, 2014 [20]	Korea	2010- 2011	<u>Sample</u> : KNHANES; face-to-face survey; stratified multistage clustered probability design; nationally representative sample (≥ 20 yrs) <u>AT</u> : In the past year have you ever had ringing, roaring, or buzzing in your ears? (yes) <u>ST</u> : How much these sounds cause annoyance in your life? (annoyed and bothered OR have problems getting to sleep)	10,061	≥ 20 yrs	21.4%		7.3%
					≥ 20 yrs; M	19.5%		6.8%
					≥ 20 yrs; F	22.8%		7.7%
					≥ 40 yrs ^a	23.3%		8.9%
					≥ 60 yrs ^a	30.0%		13.8%
Park et al., 2014 [21]	Korea	2009- 2011	<u>Sample</u> : KNHANES; face-to-face survey; stratified multistage clustered probability design; nationally representative sample (≥ 12 yrs) <u>AT</u> : Within the past year, did you ever hear a sound (buzzing, hissing, ringing, humming, roaring, machinery noise) originating in your ear? (yes) <u>ST</u> : How severe is this noise in daily life? (annoying OR severely annoying)	21,893	≥ 12 yrs	19.7%		5.8%
					≥ 12 yrs; M	17.7%		5.0%
					≥ 12 yrs; F	21.7%		6.5%
					≥ 40 yrs ^a	23.5%		9.2%
					≥ 70 yrs	32.1%		16.6%
Africa								
Khedr et al., 2010 [22]	Egypt	2008- 2009	<u>Sample</u> : Multistage stratified cluster sampling; nationally representative household sample (≥ 6 yrs) <u>AT</u> : Participants with a perception of sound in the absence of external acoustic stimulation <u>ST</u> : Tinnitus Handicap Inventory ≥ 58 (i.e., severe or catastrophic handicap)	8484	≥ 6 yrs	5.2%		0.8%
					≥ 6 yrs; M	5.4%		-
					≥ 6 yrs; F	5.0%		-
					≥ 60 yrs	17.7%		-
Lasisi et al., 2010 [23]	Nigeria	2008	<u>Sample</u> : Multistage stratified probability sampling; nationally representative household sample (≥ 65 yrs) <u>AT</u> : Do you have a perception of ringing, swishing, humming, or other type of noise in the	1302	≥ 65 yrs	14.1%		
					≥ 65 yrs; M	14.7%		
					≥ 65 yrs; F	13.4%		

Publication (author, yr)	Country	Study period	Study design	Sample size	Age group; Sex	Percent prevalence		
			Assessment of tinnitus			AT	CT	ST
			ear or head without an external source of sound? (yes)					

M: males; F: females; HANES: Health And Nutrition Examination Study; NHIS: National Health Interview Survey; NHANES: National Health And Nutrition Examination Study; BMHS: Blue Mountains Hearing Study; NSH: National Study of Hearing; KNHANES: Korean National Health And Nutrition Examination;

^a Estimated from available data.

Table 2. Prevalence (%)^a of tinnitus, and corresponding 95% confidence intervals (CI), any, by sex and age group, according to the duration of symptom and its severity, in 2952 Italians aged ≥ 18 years. Italy, 2014.

	Overall		Sex				Age group					
			Men		Women		18-44		45-64		≥ 65	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Any tinnitus	6.2	5.3-7.0	6.0	4.7-7.2	6.4	5.2-7.6	2.7	1.8-3.6	5.9	4.5-7.4	12.3	9.9-14.6
Tinnitus duration												
Acute tinnitus (<3 months)	1.3	0.9-1.7	1.1	0.5-1.6	1.6	1.0-2.2	1.4	0.7-2.1	1.3	0.6-2.1	1.2	0.4-2.0
Chronic tinnitus (≥ 3 months)	4.8	4.1-5.6	4.9	3.8-6.0	4.8	3.7-5.9	1.3	0.7-1.9	4.6	3.3-5.9	11.1	8.8-13.3
Tinnitus severity												
Mild tinnitus	2.9	2.3-3.5	3.1	2.2-4.1	2.6	1.8-3.4	2.1	1.3-2.9	2.8	1.8-3.9	4.3	2.8-5.7
No problem	0.5	0.2-0.7	0.2	0.0-0.5	0.7	0.3-1.1	0.6	0.1-1.0	0.3	0.0-0.6	0.7	0.1-1.3
Small problem	2.4	1.8-3.0	2.9	2.0-3.8	1.9	1.2-2.6	1.5	0.8-2.2	2.6	1.6-3.6	3.6	2.3-5.0
Moderate tinnitus	2.1	1.6-2.6	2.0	1.3-2.8	2.1	1.4-2.8	0.5	0.1-0.9	2.0	1.1-2.8	4.8	3.2-6.3
Moderate problem												
Severe tinnitus	1.2	0.8-1.6	0.8	0.3-1.3	1.6	1.0-2.3	0.1	0.0-0.3	1.2	0.5-1.8	3.2	1.9-4.5
Big problem	1.0	0.6-1.3	0.4	0.1-0.7	1.5	0.9-2.1	0.0	-	0.9	0.3-1.5	2.7	1.5-3.8
Very big problem	0.3	0.1-0.5	0.4	0.1-0.8	0.1	0.0-0.3	0.1	0.0-0.3	0.3	0.0-0.6	0.6	0.0-1.1

^a Sometimes the sum does not add up to the total due to decimal approximations.

Table 3. Percent prevalence (%) of any, chronic and severe tinnitus among 1724 Italians aged ≥ 45 years, according to selected socio-demographic characteristics, with corresponding odds ratios^a (OR) and 95% confidence intervals (CI). Italy, 2014.

	N	Any tinnitus		Chronic tinnitus		Severe tinnitus	
		%	OR (95% CI)	%	OR (95% CI)	%	OR (95% CI)
Total	1724	8.7	-	7.4	-	2.0	-
Sex							
Men	792	8.3	1 ^b	7.0	1 ^b	1.3	1 ^b
Women	932	9.0	1.43 (0.92-2.20)	7.8	1.45 (0.91-2.32)	2.7	3.26 (1.28-8.31)
Age group (years)							
45-54	536	3.8	1 ^b	2.5	1 ^b	0.5	1 ^b
55-64	445	8.6	2.18 (1.20-3.95)	7.1	2.63 (1.32-5.23)	2.0	3.57 (0.87-14.66)
65-74	492	10.8	2.80 (1.55-5.08)	9.9	3.79 (1.93-7.45)	2.4	4.21 (1.03-17.17)
≥ 75	251	15.2	4.49 (2.34-8.62)	13.4	5.87 (2.81-12.26)	4.9	9.59 (2.24-40.96)
P for trend			<0.001		<0.001		0.002
Level of education							
Low	934	10.1	1 ^b	8.6	1 ^b	2.6	1 ^b
Intermediate	596	7.9	1.30 (0.85-1.99)	7.2	1.55 (0.98-2.43)	1.7	1.34 (0.59-3.04)
High	193	3.9	0.61 (0.28-1.35)	2.2	0.43 (0.16-1.19)	0.5	0.29 (0.03-2.52)
P for trend			0.727		0.788		0.587
Family income (€/month)							
I tertile (<1160€)	484	12.8	1 ^b	11.2	1 ^b	3.8	1 ^b
II tertile (1160€-1939€)	607	9.2	0.91 (0.59-1.40)	7.8	0.88 (0.56-1.39)	2.6	1.05 (0.50-2.21)
III tertile (≥ 1940 €)	633	5.0	0.50 (0.29-0.85)	4.1	0.49 (0.27-0.88)	0.1	0.06 (0.01-0.57)
P for trend			0.015		0.020		0.011
Marital status							
Married	1213	7.6	1 ^b	6.5	1 ^b	1.3	1 ^b
Single	136	3.4	0.67 (0.25-1.78)	3.1	0.78 (0.28-2.15)	0.4	0.46 (0.03-6.90)
Widowed	262	15.2	1.88 (1.15-3.06)	13.3	1.86 (1.10-3.12)	5.0	2.30 (0.94-5.68)
Divorced/Separated	112	11.8	2.32 (1.21-4.43)	8.4	1.85 (0.88-3.89)	5.4	5.43 (1.95-15.10)
Geographic area							

Northern Italy	814	8.1	1 ^b	7.3	1 ^b	2.2	1 ^b
Central Italy	350	6.7	0.90 (0.54-1.50)	4.9	0.69 (0.39-1.23)	0.5	0.22 (0.05-1.08)
Southern Italy / islands	560	10.8	1.45 (0.96-2.18)	9.1	1.33 (0.86-2.05)	2.8	1.51 (0.73-3.16)
Municipality size							
≤10,000 inhabitants	535	10.9	1 ^b	10.1	1 ^b	4.2	1 ^b
10,001-50,000 inhabitants	657	7.8	0.75 (0.49-1.14)	6.7	0.68 (0.43-1.06)	0.9	0.24 (0.09-0.63)
>50,000 inhabitants	532	7.5	0.80 (0.50-1.26)	5.5	0.63 (0.38-1.05)	1.3	0.44 (0.18-1.11)
P for trend			0.282		0.054		0.022

^a ORs were estimated using unconditional multiple logistic regression models after adjustment for sex, age category, level of education, geographic area, smoking status, alcohol drinking, and body mass index category.

^b Reference category.

Table 4. Percent prevalence (%) of any, chronic and severe tinnitus among 1724 Italians aged ≥ 45 years, according to smoking status, alcohol consumption and body mass index (BMI) categories, and corresponding odds ratios^a (OR) and 95% confidence intervals (CI). Italy, 2014.

	N	Any tinnitus		Chronic tinnitus		Severe tinnitus	
		%	OR (95% CI)	%	OR (95% CI)	%	OR (95% CI)
Smoking status							
Never smokers	1097	8.4	1 ^b	7.2	1 ^b	2.1	1 ^b
Current smokers	312	5.2	0.64 (0.34-1.20)	3.8	0.59 (0.29-1.19)	1.1	0.94 (0.29-3.09)
Ex-smokers	314	13.0	1.50 (0.96-2.34)	11.7	1.53 (0.96-2.46)	2.6	1.51 (0.61-3.76)
Alcohol drinking§							
Non-drinkers	727	9.7	1 ^b	8.5	1 ^b	2.8	1 ^b
<7 drinks/week	483	5.0	0.59 (0.36-0.98)	4.4	0.60 (0.35-1.03)	0.4	0.19 (0.04-0.89)
≥ 7 drinks/week	500	10.7	1.38 (0.87-2.21)	8.8	1.29 (0.78-2.14)	2.6	1.69 (0.72-3.97)
P for trend			0.307		0.479		0.447
BMI categories^c							
Under/normal weight (BMI<25 kg/m ²)	741	6.1	1 ^b	5.0	1 ^b	1.4	1 ^b
Overweight (25 \leq BMI<30 kg/m ²)	642	10.5	1.49 (0.99-2.25)	9.1	1.56 (1.00-2.44)	3.2	1.99 (0.91-4.39)
Obesity (BMI \geq 30 kg/m ²)	175	14.7	2.14 (1.25-3.67)	13.3	2.31 (1.30-4.10)	2.7	1.50 (0.48-4.75)
P for trend			0.004		0.003		0.241

^a ORs were estimated using unconditional multiple logistic regression models after adjustment for sex, age category, level of education, geographic area, smoking status, alcohol drinking, and BMI category.

^b Reference category.

^c The sum does not add up to the total because of some missing values.