



## Prevalence and Correlates for Tinnitus among Elderly Subjects: A Community Study

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### Authors' contributions

*This work was carried out in collaboration between all authors. Author OAS designed the study, analysed the data and wrote the manuscript. Author OEA designed the methodology and collected data for analyses. Author EAO managed the literature searches and reviewed manuscript critically for important intellectual content. All authors read and approved the final manuscript.*

### Article Information

DOI: 10.9734/BJMMR/2016/25337

#### Editor(s):

(1) Gauri Mankekar, ENT Department, PD Hinduja Hospital, Mumbai, India.

#### Reviewers:

(1) Prasan Kumar Hota, NTR University of Health Sciences, India.

(2) Ibrahim El-Zraigat, The University of Jordan, Jordan.

Complete Peer review History: <http://sciencedomain.org/review-history/14159>

Original Research Article

Received 27<sup>th</sup> February 2016  
Accepted 18<sup>th</sup> March 2016  
Published 14<sup>th</sup> April 2016

### ABSTRACT

**Aims:** To determine the prevalence, and explore clinical correlates for tinnitus among elderly subjects.

**Study Design:** Cross sectional community-based analytical study.

**Place and Duration of Study:** Study was conducted in Sagamu community for a period of six weeks between 1st April and 18th May, 2015.

**Methodology:** Consenting elderly subject (aged  $\geq 60$  years), who lived in the communities for a minimum of five years continuously were selected by multistage stratified sampling technique. Estimated sample size was 216 subjects. Interviewer administered questionnaire was used to obtain information on socio-demographic, otological and other systemic diseases parameters. The main outcome measure was Tinnitus present or absent. The data obtained was subjected to descriptive, uni and multivariate logistic regression analyses, LRA.

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**Results:** 212 elderly subjects completed the study. Prevalence of tinnitus according to socio-demographic characters revealed significant differences between age groups ( $p=0.016$ ), sex ( $p=0.010$ ), level of education ( $p=0.005$ ) and family settings ( $p=0.001$ ). Univariate analyses revealed significant differences in previous ear discharge ( $p=0.019$ ), previous ear syringing ( $p<0.001$ ), previous loss of consciousness ( $p=0.004$ ), observed hearing loss ( $p<0.001$ ), confirmed hearing loss ( $p<0.001$ ), exposure to noise ( $p<0.001$ ), tendency to depression ( $p<0.001$ ), and osteoarthritis of knee joint ( $p=0.045$ ). Multivariate adjusted LRA confirmed previous ear syringing for wax impaction OR=6.863, 95% CI, 1.043-45.149 ( $p=0.045$ ), observed hearing loss OR= 2.755, 95% CI, 1.116-6.800 ( $p=0.028$ ), exposure to noise OR=50.213, 95% CI=5.358-70.542 ( $p=0.001$ ) and tendency to depression OR=2.600, 95% CI, 1.000-6.759, ( $p=0.049$ ) as clinical correlates for tinnitus among elderly subjects.

**Conclusions:** There is high prevalence of tinnitus, with clinical correlates being otological and audiological parameters. Noise regulation and need for proper care for elderly at the community level were emphasized.

*Keywords: Community; correlates; elderly; prevalence; tinnitus.*

## 1. INTRODUCTION

Tinnitus is an irritating and often disturbing symptom that can be associated with morbidities. It is one of the most common symptoms associated with hearing loss especially of the sensorineural type. Tinnitus occurrence ranges from barely noticeable through intermittent, persistent, and unrelenting to debilitating in nature [1]. The projected increase in the population of the elderly in the world premixed upon increased average life expectancy from improved healthcare and increased standard of living, can aptly describe the elderly as an emerging population. Yet the increased average life expectancy may not necessarily culminate into good quality of life. In fact, the elderly suffer from significant morbidities resulting from different and sometimes multiple diseases occurring in the body. Association of co-morbidity of diabetes mellitus and hypertension was reported as an independent risk factor for tinnitus [2]. The elderly is a vulnerable group of individuals who are particularly prone to suffer psychological and emotional disturbances.

Age-related hearing loss (presbycusis), remains the most common sensory impairment experienced by elderly subjects. Presbycusis is strongly associated with tinnitus which may be a more irritating phenomenon. Actually 11.9% of the general adult population in Japan reported they were experiencing tinnitus [3]. The frequency and intensity of tinnitus seems to increase with increasing age. In the USA, the frequency of tinnitus is highest among the age range 60-69 years [4], while tinnitus prevalence peaked at 13.5% in older adults aged  $\geq 65$  years in New Zealand [5]. It suffices to hypothesize then that debilitating effects of tinnitus will be

more in the elderly. In reality, many elderly subjects are distressed about tinnitus, and some physicians describe them as tinnitus sufferers.

There are two peculiar challenges posed to the physician in managing tinnitus. The initial challenge is that most experience of tinnitus is subjective in nature, and it may be difficult to substantiate its magnitude and extent. More challenging however is the fact that the disorder is heterogeneous in nature and no single pathogenesis or mechanism can explain the presence of tinnitus in all subjects that are affected. Consequently, there is no standardized management nor single effective treatment for the condition [6], giving room to a variety of treatment options. Different medications including antioxidants like Ginkgo biloba,  $\alpha$ -lipoic acid with vitamin C, and papaverine hydrochloride with vitamin E have been used in the treatment [7]. Unfortunately, the efficacy of most interventions for tinnitus remains to be demonstrated conclusively [8]. It is important that tinnitus is well explored in elderly subjects before effective treatment can be given.

A previous study on this subject from our centre characterized tinnitus among adult patients [9]. Findings from that study were for all adult patients that presented with the major symptom of tinnitus. Secondly, the study was hospital based and limited by the fact that the findings could not be generalized to the community.

We anticipated the burden of tinnitus at the community level, and possibility of preventing or ameliorating its effects in elderly subjects. This study therefore aims to determine the prevalence, and explore the clinical correlates for tinnitus among community-dwelling elderly

subjects. This should assist in reducing the burden of tinnitus, and also in community health planning for the elderly population.

## **2. SUBJECTS AND METHODS**

### **2.1 Type of Study**

This is a cross sectional community- based analytical study performed among elderly subjects (aged 60 years and above) who were living in Sagamu township, the headquarter town of Sagamu local government area, Ogun state, south-western Nigeria.

#### **2.1.1 Sampling**

The minimum sample size calculated for the study was 196 subjects, and an additional 10% rate of non or invalid response added to produce an estimated sample size of 216 subjects. Subjects were selected by using the multistage stratified sampling technique. Three out of the fifteen wards in the local government area were selected by simple random sampling. Estimated population of the elderly in each of the wards were obtained from the register at local government area headquarters based on the 2006 Nigeria national population survey and the total sample size was divided proportionately among the wards. The sample frame of the streets in the areas in each of the wards were obtained and each street selected by random sampling technique in each area. The first house on each street was selected until the sample size in that area was completed. Every eligible elderly subject in each of the selected houses was approached, and the nature, requirements, and benefits of the study discussed with them in order to gain the subject's consent. Every consenting subject was included in the study.

#### **2.1.2 Inclusion/exclusion criteria**

Elderly subject must have lived in the town for a minimum of five years continuously to be included. Excluded were the subjects who did not consent, who had present ear discharges, those that had previous ear surgeries, those on hearing aids, those with tympanic membrane perforation, while those with impacted wax were treated before inclusion into the study.

#### **2.1.3 Data collection**

Every consenting elderly was taken apart and made to be comfortable before information was

sought. The screening question..." *In the past one year, have you experienced ringing, buzzing or other sounds in your ears*". was asked. A response of Yes or No was expected, while those who were equivocal were abandoned. Thereafter, an otoscopy was done to examine the ears noting particularly the patency or otherwise of the external auditory canals, and the state of the tympanic membranes, in order to determine the appropriateness or otherwise of the subject.

### **2.2 Methods**

Questionnaires were administered by interviewers (medical students who had been trained for this purpose). The questionnaires consisted of two parts. The first part consisted of questions relating to the socio-demographic characteristics of the subjects, including the age, sex, family setting, social history and habits. In the second part were questions relating to medical including otological, and other systemic diseases. A Yes/No response was obtained for each of the questions.

### **2.3 Statistical Analysis**

The information obtained was fed into the spreadsheet. Descriptive analysis was done based on the categorization of the subjects (Tinnitus Present/Absent) and prevalence of tinnitus calculated according to the socio-demographic characteristics. Univariate analyses for the socio-demographic and medical history characteristics were done with student's t-test, for continuous variables, and chi-square test for discrete variables respectively. Significant medical factors were further subjected to multivariate logistic regression analyses, with each of the medical factors serving as the predictor and presence of tinnitus as outcome variable. For every statistical analysis, level of significance was set at  $p < 0.05$ . The analyses were done using SPSS statistical package, version 19.0 (Chicago, IL).

## **3. RESULTS**

Two hundred and twelve elderly subjects participated in this study, this comprised of 99 males and 113 female subjects (M:F=1:1.1). Majority (58.0%) of the subjects were between 60 and 69 years of age, while 5 subjects were above 90 years. The age distribution according to the sex of the subjects is shown in Fig. 1. The prevalence of tinnitus according to the socio-

demographic characters of the subjects depicts significant differences in prevalences based on the age groups ( $p= 0.016$ ), sex ( $p=0.010$ ), level of education ( $p=0.005$ ) and family settings ( $p=0.001$ ) of the subjects, as shown in Table 1. Table 2 is the univariate analyses comparing the medical and social histories of the subjects according to their tinnitus status. There were statistically-significant differences observed in previous ear discharge ( $p=0.019$ ), previous ear syringing ( $p<0.001$ ), previous loss of consciousness from a road traffic injury ( $p=0.004$ ), observed hearing loss ( $p<0.001$ ), confirmed hearing loss ( $p<0.001$ ), exposure to noise ( $p<0.001$ ), tendency to depression ( $p<0.001$ ), and history of osteoarthritis of the knee joint ( $p=0.045$ ). Further subsection of these significant factors to multivariate logistic regression analyses, adjusting for age, sex, level of education, and family setting is shown in Table 3. The following parameters namely previous ear syringing for wax impaction ( $p=0.045$ ), observed hearing loss ( $p=0.028$ ), exposure to noise ( $p=0.001$ ) and tendency to depression ( $p=0.049$ ) were confirmed as clinical correlates for tinnitus among elderly subjects.

#### 4. DISCUSSION

This study has revealed that one in every three community dwelling elderly subjects experienced notable tinnitus. Tinnitus prevalence significantly reduced with increasing age, more common in females, among subjects with lower educational status, and those with any other family setting aside from monogamy. The clinical correlates for tinnitus were previous ear syringing for wax impaction, observed hearing loss, exposure to noise and tendency to depression.

The prevalence of tinnitus of 32.1% found in this study appears quite high compared to some previous studies which reported prevalence range between 10.6 [10] and 14.5% [11] among general adult (including some elderly) population. A prevalence of 24.2% was reported among elderly hospitalized patients aged 60 years and above [12]. Gibrin et al. [2] however reported prevalence of tinnitus of 42.7% among community dwelling elderly subjects in Brazil. The high prevalence reported in this present study underscores the fact that tinnitus is a common experience among our elderly subjects.

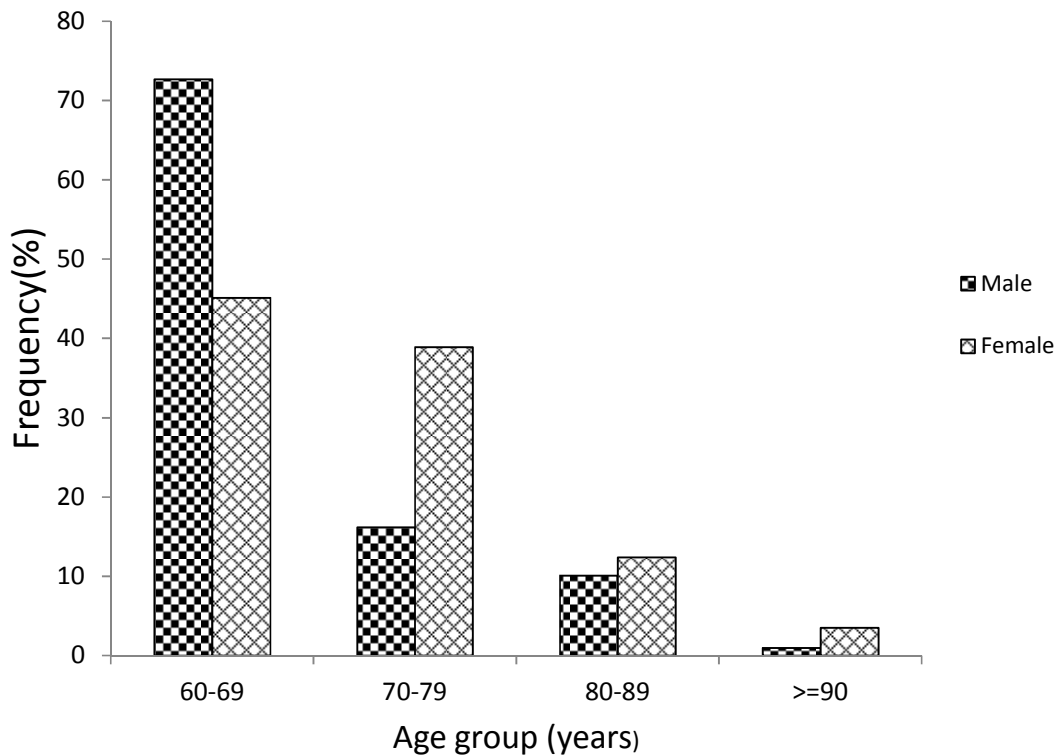


Fig. 1. Age group according to sex of subjects

**Table 1. Prevalence of tinnitus**

<b>Parameter</b>	<b>Prevalence n (%)</b>	<b>p-value</b>
<b>Age group (years)</b>		
60-69	33 (48.5)	0.016
70-79	19 (27.9)	
80-89	12 (17.6)	
≥90	4 ( 5.9)	
<b>Sex</b>		
Male	23 (33.8)	0.010
Female	45 (66.2)	
<b>Occupation</b>		
Active	44 (64.7)	0.628
Inactive	24 (35.3)	
<b>Level of education</b>		
Less than secondary school	56 (82.4)	0.005
Secondary school and above	12 (17.6)	
<b>Marital status</b>		
Married	39 (57.4)	0.156
Others e.g. divorced, widow(er)	29 (42.6)	
<b>Family setting</b>		
Monogamy	17 (25.0)	0.001
Others e.g. polygamy, communal	51 (75.0)	

**Table 2. Clinical factors associated with tinnitus**

<b>Variable</b>	<b>Tinnitus absent n (%)</b>	<b>Tinnitus present n (%)</b>	<b>p-value</b>
Previous otorrhoea	5 (3.5)	8 (11.8)	0.019
Previous ear syringing	4 (2.8)	14 (20.6)	<0.001
Previous LOC from RTA	9 (6.3)	13 (19.1)	0.004
Observed hearing loss	25 (17.4)	41 (60.3)	<0.001
Confirmed hearing loss	6 (4.2)	21 (30.9)	<0.001
Exposure to noise	1 (0.7)	22 (32.4)	<0.001
Alcohol consumption	42 (29.2)	21 (30.9)	0.763
Smoking	29 (20.1)	13 (19.1)	0.259
Tendency to depression	21 (14.6)	27 (39.7)	<0.001
Regular exercise regimen	64 (44.4)	33 (48.5)	0.577
Obesity	21 (14.6)	17 (25.0)	0.065
Hypertension	57 (39.6)	23 (33.8)	0.419
Diabetes	8 (5.6)	5 (7.4)	0.611
Osteoarthritis	72 (50.0)	44 (64.7)	0.045
Cerebrovascular disease	18 (12.5)	11 (16.2)	0.467

Note: LOC loss of consciousness, RTA road traffic accident

Many of the elderly subjects may not present to the hospital for medical attention because of the tendency to wait and observe, hoping for a resolution. Furthermore, absence of ominous symptoms like earache and ear discharge may also make the subjects further delay seeking medical attention. The variations in reported prevalence may have also resulted from different definitions of tinnitus in different studies making it difficult to compare prevalence among populations [3].

Reports concerning tinnitus and ageing had not been consistent. While some studies had reported significant association between tinnitus experience and age [13], others had reported a reverse trend [12]. Findings in this study depicted significantly reduced prevalence with an increase in the age of subjects, similar to the finding among hospitalized elderly patients [12]. Our finding might have been a result of disproportionate distribution of our subject population in favour of the “younger elderly” with

**Table 3. Multivariate adjusted correlates for tinnitus**

Variable	Odds ratio (95% confidence interval)	p-value
Age	0.012 (0.965-1.061)	0.625
Sex (Female)	1.429 (0.558-3.660)	0.457
Education level (< 2 <sup>o</sup> school)	0.414 (0.141-1.218)	0.109
Family setting (Others)	1.969 (0.826-4.692)	0.126
Previous otorrhoea	1.059 (0.138-8.102)	0.956
Previous ear syringing	6.863 (1.043-45.149)	0.045
Previous LOC from RTA	1.505 (0.349-6.488)	0.583
Observed hearing loss	2.755 (1.116-6.800)	0.028
Confirmed hearing loss	2.101 (0.482-9.155)	0.323
Exposure to noise	50.213 (5.358-70.542)	0.001
Tendency to depression	2.600 (1.000-6.759)	0.049
Osteoarthritis	0.891 (0.364-2.180)	0.800

58.0% being <70 years in age. Michikawa et al. [14] however did not find a significant difference in the age group or sex of community-based elderly Japanese subjects. The female gender had significantly higher prevalence of tinnitus in this study. Li et al. [15] reported a marginal preponderant prevalence of tinnitus in women among elderly subjects aged 65 and older in the United States. It may connote more women are willing to speak up than men. It was also reported that irrespective of age and tinnitus duration, women were more annoyed by tinnitus and perceived more stress than men did [16].

Despite the significant differences observed in age, sex, and other parameters (level of education, and family settings) observed in the prevalence, none of these factors was found to be a clinical correlate for tinnitus among our elderly subjects, similar to findings of previous studies [12]. Also other factors like hypertension, diabetes mellitus, osteoarthritis [14,17], cardiovascular diseases, and features of metabolic syndrome that some researches had reported associated with tinnitus [18,19], were not found to be clinical correlates of tinnitus in this study. While many hypertensive patients and those with some of these chronic diseases may be on medications and willing to disclose such information, some of our elderly patients may not be aware that they had such chronic diseases, and logically deny such ailments. It is perhaps also imperative to note some cultural barriers concerning disclosure of information on issues bothering on health, ailments, diseases and believe system. There is the cultural belief that a person's affirmation of suffering from an ailment or disease amounts to declaration of being a victim of the disease and as such, the ailment progresses. Thus subjects may not confirm when asked about a disease which they knew they are

suffering and possibly receiving treatment for. Gibrin et al. [2] however found there was no difference between tinnitus and hypertension and between tinnitus and diabetes mellitus alone.

The main clinical correlates for tinnitus among our elderly subjects were otologic and audiological symptoms notably previous ear syringing for wax impaction, observation of a hearing impairment by the subjects, and exposure to noise. It is an established fact that wax impaction tends to be disproportionately common among elderly subjects [20], by reason of the reduction in the activity of the ear-cleansing lateral migration mechanism and reduction in the diameter of the external auditory canal with advancing age [21]. It is therefore not surprising that a sizeable proportion of our elderly subjects had ear syringing at one time or another. However, it is also a common practice among general medical care givers to assume wax or debris impaction in the ear and recommend ear syringing without a confirmation of an ailment. Interestingly, many people in the community even request for ear-syringing as a prophylaxis. While it is possible for impacted wax to present with tinnitus which may be amenable to ear syringing, ear syringing is not an innocuous procedure; the procedure can lead to cochleo-vestibular trauma to the ears that can actually precipitate or aggravate a pre-existing tinnitus [22,23].

Tinnitus is a common symptom that is associated with hearing impairment of any type. Observed hearing loss was a clinical correlate for tinnitus in this study. Other studies had also confirmed hearing impairment as correlates for tinnitus [4,11,14]. The most common type of hearing impairment in the elderly is age-related. The effects of ageing in the ear is complex, but the

final common pathway seems to be degeneration of both the sensory neuroepithelia cells and the neurons, leading to unusual and abnormal firing of cells and generating sounds which is perceived as tinnitus [9]. Thus any pathology that tends to disrupt the normal functioning of the hair cells of the cochlear will necessarily present with tinnitus, among other symptoms.

A notable precipitant of distorted cochlear functioning is noise. Exposure to noise was the most strongly correlated factor associated with tinnitus among our community-dwelling elderly subjects. The harmful effects of noise to hearing, and by extension the generation of tinnitus have been well-documented [24,25]. The correlation of noise exposure and tinnitus was therefore anticipated. Some of these elderly subjects had histories of significant exposure to hazardous noise in their active working years as factory workers, blacksmith, or railway workers. Unfortunately they were either not aware of the harmful effects of the loud noise on the ears and did not protect themselves against it. Furthermore, these subjects had no hearing assessments during their active working years, and thus could not attribute their present condition to their previous job descriptions. Since 1980, occupational noise-induced hearing loss (NIHL) had been incorporated into the international labour organization (ILO) occupational list for compensation to be claimed on morbidities experienced as a result of occupation [26]. It is however difficult to substantiate NIHL if the pre-employment hearing levels were not measured. It might have been possible to ameliorate or possibly prevent the development of tinnitus if protective measures had been taken. Simple protective measures like consistent wearing of ear-plugs will reduce the intensity of the sounds (noise) in the ears and also the extent of injury to the hair cells (noise hazards) [27]. The intensity of sounds in the workplace should also be monitored and regulated and hearing thresholds of at-risk workers should be measured serially and regularly.

Tendency to depression was also found to correlate with tinnitus. Generalized anxiety disorder [4], depressive symptoms [10] and mood [14] had been documented to correlate with tinnitus. The correlation between tinnitus and depression however appears to be reciprocal, as subjects that have suffered tinnitus also tend to be depressed [28,29]. This is the basis for the use of antidepressants to treat tinnitus, although there is insufficient evidence

regarding its efficacy [30]. It is noteworthy that tinnitus as an entity can only be treated satisfactorily if the cause is known. Unfortunately, it may not be possible to find the cause in many instances, hence the necessity of evaluation of the predisposing factors and clinical correlates.

Except for psychosocial tendency to depression, the clinical correlates for tinnitus in this study were more of otological and audiological events. While correlates like exposure to noise, and hearing impairment may be preventable or amenable to some control, the other correlates bother on care for the elderly. There is need for education of our elderly subjects concerning the process of ageing and health, personal care and realistic expectations about disease outcome. The community health care personnel will need to be taught rudiments of diagnosis and caring for common ailments in the ear like wax impaction and other causes of hearing impairment, and there should be provision for basic ear care equipment at the community level. Furthermore, there should be collaboration and good referral system between medical personnel located within the communities and specialists who are mainly at the cities.

Some limitations should be noted in this study. The intensity and magnitude of tinnitus were not measured, neither was its laterality assessed. The use of interviewer administered questionnaire predisposes respondents to recall, and other forms of bias responses especially since these were spot assessments, and there were no follow-up re-questioning. Nevertheless, this study has been able to quantify the burden of tinnitus and its clinical correlates in elderly subjects residing in the community.

## 5. CONCLUSION

In conclusion, prevalence of tinnitus among community elderly subjects was 32.1%, tinnitus was associated with age group, gender, level of education, and type of family setting. The clinical correlates for tinnitus were otological and audiological few of which are potentially modifiable. Noise regulation at the work place and need for proper care for the elderly at the community level were emphasized.

## ETHICAL APPROVAL

Ethical approval for this study was obtained from the institutional (Olabisi Onabanjo University Teaching Hospital, Health Research and Ethics Committee (OOUTH-HREC), and verbal

consents were also obtained from all the participating elderly subjects.

## ACKNOWLEDGEMENTS

The authors wish to acknowledge and appreciate the efforts of the Medical students who assisted us in data collection for the study, during their community health posting.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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DOI: 10.1002/14651858.CD003853.pub3

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