

Original Article

Do body mass index and demographic data affect subjective tinnitus?

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Abstract: Background: Tinnitus is a common otological symptom that affects quality of life seriously. Several factors involved in the etiology of tinnitus have been investigated. However, some independent main risk factors affecting subjective tinnitus are still unclear in the current literature. The purpose of this study was to evaluate body mass index (BMI) and other demographic data and to determine their effects on patients with tinnitus. Materials and methods: This retrospective study was performed at our clinic and involved 100 patients with subjective tinnitus and 113 control patients without tinnitus. Patients' age, gender, BMI, side of tinnitus involvement and place of residence (city, town or village) were investigated. Then these data were analyzed statistically. Results: BMI values of patients with tinnitus were significantly higher than those of the control group. However, no statistical significant difference was observed in other demographic data. Conclusion: Tinnitus is a common subjective symptom. Various studies have investigated the risk factors. However, the number of studies assessing BMI and the place that the patients' live is limited. Our results suggest that tinnitus may be associated with modifiable risk factors, such as BMI. Further research is needed to evaluate the relationship between these factors and tinnitus.

Keywords: Tinnitus, body mass index, demographic data

Introduction

Tinnitus is one of the most common otological symptoms. It has a severe impact on the quality of life and is seen in 1-3% of the general population [1]. The disorder can be one of the first and most important symptom of various diseases. The prevalence of tinnitus has been reported at 7-32% in the literature [2]. The prevalence of troublesome tinnitus increases the ages of 40 and 80 [3]. The prevalence of tinnitus also increases with age, from 1% under 45 years to 9% over 65 [4].

Etiologically, tinnitus may be classified as objective or subjective. In vascular originated cases, objective tinnitus can be synchronous with the heartbeat. If it is asynchronous, potential causes include myoclonus of the middle-ear or palatal muscles, patent eustachian tube, temporomandibular joint syndrome and local inflammations. Several factors have been identified in the etiology of tinnitus. However, it is still unclear what other independent main risk factors affect subjective tinnitus. Particularly

some studies have investigated the effects on tinnitus of age, gender, occupation and psychological state. However, few studies have investigated body mass index (BMI) and place of residence.

The purpose of this study was to investigate the relationship between BMI and other possible risk factors that affect tinnitus, such as age, gender and place of residence.

Materials and methods

This study was planned with two groups retrospectively. The tinnitus group consisted of 100 patients with subjective tinnitus (duration exceeding 6 months) and the control group of 113 patients without tinnitus. Patients with systemic disease (hypertension (HT), diabetes mellitus (DM) etc.), an otological problem that may cause tinnitus (such as Meniere's syndrome, otosclerosis, presbycusis and sensorineural hearing loss) or psychiatric disease were excluded from the patient group. The control group was selected at random from patients

Body mass index and demographic data

Table 1. Gender distribution in both groups

| | Tinnitus group | Control group |
|--------|----------------|---------------|
| Female | 58 (58%) | 60 (53.1%) |
| Male | 42 (42%) | 53 (46.9%) |
| Total | 100 (100%) | 113 (100%) |

No statistically significant difference was observed between the groups (Chi-square, $P=0.473$).

Table 2. Place of residence

| | Tinnitus group | Control group | All patients |
|---------|----------------|---------------|--------------|
| City | 61 (61%) | 68 (60.2%) | 129 (60.6%) |
| Town | 26 (26%) | 18 (15.9%) | 44 (20.7%) |
| Village | 13 (13%) | 27 (23.9%) | 40 (18.8%) |
| Total | 100 (100%) | 113 (100%) | 213 (100%) |

No statistically significant difference was determined between the groups (Chi-square, $P=0.051$).

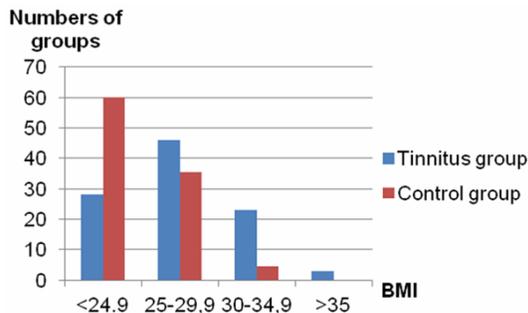


Figure 1. BMI levels in both groups. Mean BMI in the tinnitus group was statistically significantly higher than that in the control group (Fisher's exact test $P<0.001$).

with no hearing loss or tinnitus. Pregnant women and subjects younger than 18 were excluded from both groups.

Patients' weights and heights were used for BMI calculation. The universal BMI formula [weight/(height)²] was used, and scores were classified as normal (<24.9), overweight (25-29.9), obese (30-34.9) or morbidly obese (>35).

Places of residence were defined as city, town or village.

History of systemic disease, otological disease, ear surgery and chronic drug usage were investigated. All patients underwent ear, nose and throat examination. The patients were evaluated using an audiometric test battery including puretone thresholds between 125 and 8000

Hz. A Maico, MA 53 device was used for audiometry and a Maico, MIUU device for tympanometry. Patients with hearing loss or a problem at tympanography were excluded from the study groups.

No problems were observed in terms of complete blood count or biochemical parameters, such as anemia or impaired thyroid functions.

All procedures were compatible with the ethical standards of the relevant national and institutional guidelines on human experimentation and with the 1975 version of the Declaration of Helsinki, as revised in Seoul in 2008.

Statistical analysis

Since the aim of the study is to evaluate demographic data of patients with tinnitus, only categorical data was analyzed (such as gender, BMI groups and locations) by using Chi-Square test and Fisher Exact test (when expected values are lower than 5). Statistical significance was accepted when two sided P value was lower than 0.005. Statistical analysis was performed using the MedCalc Statistical Software version 12.7.7 (MedCalc Software bvba, Ostend, Belgium; <http://www.medcalc.org>; 2013).

Results

Seventy-seven patients (77%) had bilateral tinnitus and 23 (23%) had unilateral tinnitus. Fifty-eight percent of the tinnitus group were female and 42% were male. In the control group, 53.1% of subjects were female and 46.9% were male (**Table 1**). There was no significant relationship between the gender groups. Median ages were 52.4 years (range: 19-83) in the tinnitus group and 48.8 (range: 18-84) in the control group. There was no statistically significant difference between the groups.

Levels of residence in city, town or village were 61%, 26% and 13%, respectively, in the tinnitus group and 68%, 18% and 27% in the control group (**Table 2**). There was no statistically significant relationship between the groups.

BMI levels were classified as normal (<24.9), overweight (25-29.9), obese (30-34.9) or morbidly obese (>35) in 28%, 46%, 23% and 3%, respectively, of the tinnitus group and 60.2%, 35.4%,

4.4% and 0%, respectively, in the control group (Figure 1). Mean BMI in the tinnitus group was significantly higher than that in the control group.

Discussion

Tinnitus is a common medical symptom that can be debilitating. Although many patients are not troubled, others find the disorder life-changing.

Studies have investigated the side of tinnitus, but this is regarded as being of no value for diagnosis [5]. Stouffer and Tyler reported that tinnitus was bilateral in 52% of cases, unilateral in 37%, intracranial in 10% and extracranial in 1% [6]. Gibrin et al. reported levels of 58.7% bilateral tinnitus and 41.3% unilateral [7]. In our study, tinnitus was bilateral in 77% of patients and unilateral in 23%.

Several risk factors of tinnitus have been described in the literature. Relations between tinnitus and factors such as hearing loss, increasing age, head injury and noise exposure are also well described. However other demographic and health factors (drug usage, mental health, arthritis, gender, dyslipidemia, DM, HT, etc.) are described in the current literature minimally [8, 9]. Only a few studies have investigated the relation between tinnitus and BMI.

The prevalence of troublesome tinnitus increases between the ages of 40 and 80 [3]. The prevalence increases with age, but it is still unclear whether it is age-related changes in the ear and nervous system that cause tinnitus to increase with age, or whether it is the age-related hearing loss that causes the increase in the prevalence of tinnitus [8, 10]. Shargorodsky et al. showed that the prevalence of tinnitus increased with age until 60-69, after which it decreased again [8]. In agreement with the literature, the mean age of the tinnitus patients in our study was 52.4.

The evidence for a gender difference in the prevalence of tinnitus is equivocal. The prevalence of tinnitus among women in one study was lower for ages 65-84 than for ages 55-64 (12.6% vs. 14.6%), while no such difference was observed for men [10]. Different results have been reported concerning the relation between tinnitus and gender, but no statisti-

cally significant differences have been determined in the literature. We also observed no significant difference between the sexes.

The main risk factor for tinnitus is hearing loss, but this association is not simple. Some individuals with troublesome tinnitus have normal hearing at audiometric tests and conversely many subjects with hearing loss do not report tinnitus [9, 11]. Exposure to loud noise is generally considered an important risk factor for tinnitus. Occupational noise exposure has been reported to be strongly associated with both tinnitus and hearing loss [12]. A history of head injury was associated with prevalence and incidence of tinnitus in the Epidemiology of Hearing Loss Study [9].

Other minimal risk factors have been described in a few studies. Various drugs can trigger tinnitus, including salicylates, quinine, aminoglycoside antibiotics and some antineoplastic agents, particularly the platinum-based drugs [13]. Shargorodsky et al. reported significant associations between tinnitus and smoking and HT but the data on the association between smoking and tinnitus remain scant [8]. Nodahl et al. reported that arthritis was also associated with tinnitus [9].

Some studies suggest that inner ear alterations causing tinnitus, vertigo and hearing loss may be related to a microcirculatory insufficiency resulting from vascular occlusion by embolism, hemorrhage or vasospasm [7]. These would be the result of hyperviscosity or microangiopathy syndrome caused by DM or HT. Kazmierczak et al. suggested that disturbances of glucose metabolism such as DM and hyperinsulinemia may be responsible for inner ear diseases [14]. There was no history of hearing loss, head injury, drug usage or systemic disease (which may cause tinnitus) in our case profile.

Several studies have demonstrated an important correlation between tinnitus and mental health, as both anxiety and major depressive disorder are associated with increased risk of tinnitus [8, 15]. Goma et al. reported that depression, anxiety and stress should be taken into consideration in the treatment of patients suffering from tinnitus [16]. These symptoms occur as a result of tinnitus and increasing environmental stress may exacerbate the condition [17]. Socio-economic and occupational status

may therefore affect the epidemiology of tinnitus. Hoffman et al. demonstrated that lower educational attainment, annual income and poorer health status were associated with a higher prevalence of troublesome tinnitus [12]. That study also reported that the prevalence of tinnitus was lower among people living in metropolitan areas than elsewhere. One recent study demonstrated an increased incidence of high-frequency hearing loss and tinnitus among females of low economic status [18]. Another study reported a higher prevalence of tinnitus in industrialized countries [14]. In our study there was no significant difference among patients living in city, town or village. This may perhaps be attributed to the limited number of cases in our study. Another reason may be that socio-economic conditions are similar among city, town and village in our study area.

The observed associations between, first, history of cardiovascular disease and the prevalence of significant tinnitus and, second, total cholesterol and the 5-year incidence of significant tinnitus provide additional evidence that cardiovascular disorders may be a contributing factor to some forms of tinnitus [12].

Olzowy et al. reported that a hyperlipidemic diet damages hairy cells, this causes deterioration in the inner ear and that high cholesterol levels may thus lead to tinnitus [19]. High-plasma cholesterol and triglyceride levels are the major risk factors for occupational hearing loss [20]. Sutbas et al. reported a high incidence of hyperlipidemia among cases of noise-induced hearing loss [21]. They observed a significant improvement in tinnitus intensity and higher frequencies in average hearing thresholds after antilipid therapy. Experimental occlusion of the cochlear blood vessels in an animal model has been shown to reduce cochlear blood flow, resulting in drastically reduced cochlear oxygenation and auditory dysfunction, while reduction of oxygenation in the inner ear causes an auditory misperception in these cochleas, such as tinnitus [22]. One experimental study reported that lipid accumulation in the striavascularis and outer hair cells might exacerbate the deleterious effects of ototoxic drugs or noise [23]. Exposure to noise and metabolic disorders has synergistic effects on improvement in tinnitus and hearing loss [23]. Obesity may cause miscellaneous dyslipidemia. Plasma triglyceride

values increase in obese subjects while HDL cholesterol values decrease [24]. Plasma cholesterol and LDL cholesterol levels are slightly elevated or normal [25]. Hoffman et al. reported high BMI in chronic tinnitus patients [13]. In another study, weight reduction surgery was reported to be effective in the treatment of morbidly obese subjects with pulsatile tinnitus [26]. In our study, BMI in the tinnitus group was significantly higher than that in the control group ($P < 0.001$).

On the basis of our study, obesity is a modifiable risk factor in tinnitus patients. The limited number of patient is the major limitation of the study. When patients attain an ideal weight, tinnitus symptom complaints can be evaluated again and the results may corroborate our conclusions.

Conclusion

Our study results show that tinnitus may be associated with high BMI. Further researches should examine the prospective relations between BMI, place of residence and tinnitus. A change of life style (such as weight reduction) can reduce tinnitus symptoms.

Disclosure of conflict of interest

None.

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