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# Association of perceived tinnitus with duration of hormone replacement therapy in Korean postmenopausal women: a cross-sectional study

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## ABSTRACT

**Objective** The purpose of this study was to determine the relationship between hormone replacement therapy (HRT) and tinnitus in South Korea using data from the Korea National Health and Nutrition Examination Surveys (KNHANES) (2010–2012).

**Study design** Cross-sectional analysis of a nationwide health survey.

**Methods** KNHANES is a nationally representative cross-sectional survey of South Korea population. Only postmenopausal women aged 19–65 years were included in the study (n=2736). Auditory function was evaluated using pure-tone audiometric testing according to established KNHANES protocols. Subjects were questioned about their experience with tinnitus. Exogenous hormone-related factors included the starting age and duration of HRT.

**Results** The overall prevalence of tinnitus was 22.2% among postmenopausal women. (1) Tinnitus severity was significantly higher in women using HRT (p=0.0024) and (2) significantly lower in women who breast fed their children (p=0.0386). (3) According to logistic regression models, the longer duration of HRT was significantly associated with increasing tinnitus (OR=1.323, 95% CI 1.007 to 1.737, p=0.0441).

**Conclusion** A longer duration of HRT was associated with developing tinnitus in Korean postmenopausal women. Further experimental and epidemiological researches are needed to elucidate the causal relationship between HRT and tinnitus.

## Strengths and limitations of this study

- We used a nationally representative, cross-sectional, civilian non-institutionalised sample of Korean adults.
- We evaluated the relationships between tinnitus and hormone replacement therapy (HRT) by including a variety of economic, social, behavioural and health variables.
- We used five models that were regarded as possible confounding variables in a series of logistic regression analyses to lessen the confounding effect of possible tinnitus determinants.
- Tinnitus status was notified only by respondents and were not observed directly or recorded. And we could not examine the HRT preparations being used by the participant.

## INTRODUCTION

Tinnitus is a debilitating condition described as the conscious perception of sound without an actual external sound.[1] The prevalence of tinnitus has been reported to range from 5% to 25% in the adult population.[2 3] Risk factors for tinnitus include hearing loss, occupational and recreational noise exposure, obesity, smoking, alcohol consumption, head injury, arthritis, use of ototoxic medications (to treat hypertension), genetic predisposition, otosclerosis, Ménière's disease, vestibular schwannoma, anxiety, depression and temporomandibular joint dysfunction.[3–9] Reproductive hormones may also affect the development of tinnitus.[1]

Postmenopausal women have a dramatically altered physiology due to sex hormone changes, resulting in hot flashes, flushing, oedema and mood changes.[10] Some postmenopausal women select the use of hormone replacement therapy (HRT) to alleviate their symptoms. Previous reports have indicated that HRT may cause sensorineural hearing loss, tinnitus and hyperacusis.[11 12] Based on these findings, we hypothesised that HRT might be associated with tinnitus in postmenopausal women in Korea.

As we know for certain, no previous studies have used nationwide data to investigate the association between self-reported tinnitus and HRT in postmenopausal females. In this study, we scrutinise the correlation between tinnitus and HRT in postmenopausal females using the Korea National Health and Nutrition Examination Surveys (KNHANES).

## METHODS

### Study population

This study was conducted using KNHANES information obtained between 2010 and 2012 (Korea Centers for Disease Control and Prevention (KCDCP), Cheongwon, Korea). KNHANES, a nationally representative survey planned to precisely evaluate nutrition and health, has been used by the KCDCP's Division of Chronic Disease Surveillance since 1998. A health survey team, consisting of an otolaryngologist and nurse examiners, travel around the country in a mobile examination centre performing physical examinations and interviews. The KNHANES consists of a health examination survey, a health interview and a nutritional survey. The survey collects information through domestic interviews and direct formalised physical investigations implemented in the especially well-found mobile examination centre. The KNHANES programme has previously been depicted in full.[13 14]

During 2010–2012, there were 25 534 KNHANES participants aged 19 years or older. Of these, 22 798 participants were excluded from the analysis because of at least one of the following reasons: male (n=11 616), older than 65 years (n=2711), not postmenopausal (n=8447) or missing the 'Presence of Tinnitus' questionnaire (n=24). In Korea, only a small proportion of menopausal women aged 65 years or older currently take HRT. So we excluded the older women. A total of 2736 women were eligible for the study. Written informed consent was received from all subjects ahead of survey. Endorsement of this study protocol was acquired from the Institutional Review Board of the Catholic University of Seoul Korea (IRB no. HC14EISE0097; Bucheon, Korea).

### Audiometric measurement and tinnitus survey and noise exposure

The test of pure-tone audiometry was performed using an automatic audiometer (SA 203, Entomed, Malmö, Sweden) in a double-walled, sound-isolated chamber located in a KNHANES mobile examination centre. All audiometric examinations were performed under the direct control of an otolaryngologist qualified to operate an audiometer. Only an air conduction hearing threshold was estimated. The supra-auricular headphones were used in all participants in soundproof chamber to provide good sound isolation form room noise. The trained otolaryngology-specialist offered standardised directions about the automated audiometric examination. The test of automated audiometry was fully implemented through a modified Hughson-Westlake procedure; it used a single pure tone for 1–2 s duration. Threshold was defined as the lowest hearing level at which can be heard for at least half of a series of ascending trials with a minimum of two responses out of three at a single level. The automated audiometry test including air-conducted pure-tone stimuli demonstrated a good repeatability (test–retest reliability) and validity, which were equivalent to those of the manual pure-tone audiometry test.[15 16] All subjects reacted by pressing a button when they perceived a tone. Pure-tone air conduction was estimated for test frequencies of 0.5, 1.0, 2.0, 3.0, 4.0 and 6.0 kHz. Hearing impairment was defined as the pure-tone averages of 0.5, 1.0, 2.0 and 4.0 kHz stimuli at a threshold of a 40 dB hearing level in the ear with better hearing.[17]

Subjects were inquired of their experiences with tinnitus.[18] In reply for the questionnaire item, 'Within the past year, did you ever hear a sound (buzzing, hissing, ringing, humming, roaring, machinery noise) originating in your ear?', examiners were trained to inscribe 'yes' if the subject stated perceiving an unusual or odd sound at any time in the past year. Participants who answered 'yes' to the question were then inquired about the resultant annoyances in their lives: 'How severe is this noise in your daily life?' Participants circled the response that best described their experiences: not annoying, annoying (irritating), severely annoying or causes sleep problems. Participants were deemed to suffer from annoying tinnitus if they rated tinnitus severity as annoying or severely annoying. Subjects were asked about their experience with noise exposure. Subjects were instructed to circle 'yes' 'Have you ever worked in the place for over 3 months that you should have a loud voice for communicating with the other people because of noising sound?'

### Assessment of HRT and other risk factors

Endogenous hormone-related risk factors included age at menarche, age at menopause, total reproductive years, age at first birth, duration of breast feeding and number of pregnancies. Information of obstetric and gynaecological issues was assembled by questioning the subjects for recalling the age of menopause and menarche and the age at last and first parturition, breast -feeding, parity and gravity. Exogenous hormone-related risk factors included duration of oral contraceptive use and starting age and duration of HRT.

The health interview survey consists of individual factors and household factors. The individual components included information on cigarette smoking, alcohol drinking, physical activity mental and oral health, weight control, which was collected via self-administration. The household components were composed of medical conditions, socioeconomic status, injury and activity limitation, which were collected using face-to-face interview in mobile examination centre. Cigarette smoking status was classified into three categories: current smokers, ex-smoker and non-smoker. The amount of pure alcohol consumed was calculated in grams per day during the 1 month before the interview. Depending on average of daily alcohol consumption, participants were categorised into three groups. Subjects who consumed an average of less than 1 g/day of alcohol were non-drinkers, while those who consumed 1–15 g/day were considered mild to moderate drinker. The heavy drinkers consumed an average of more than 15 g/day of alcohol. Regular exercise means energetic aerobic activity done for at least 20 min at least 3 days a week. Height